

ರೈಲು ಮೂಲಸೌಲಭ್ಯ ಅಭಿವೃದ್ಧಿ ಕಂಪನಿ (ಕರ್ನಾಟಕ) ನಿಯಮಿತ

रेल इन्फ्रास्ट्रक्चर डेवलपमेंट कंपनी (कर्नाटक) लिमिटेड

**Rail Infrastructure Development Company (Karnataka) Limited
(K-RIDE)**

(A Joint Venture of Govt. of Karnataka and Ministry of Railways)

EPC TENDER

TENDER DOCUMENT FOR THE WORK OF

“NAME OF WORK: “DESIGN AND CONSTRUCTION OF ELEVATED VIADUCT OF LENGTH 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 Km) INCLUDING RAMPS AND FORMATION IN EMBANKMENTS /CUTTINGS INCLUDING BLANKETING, MAJOR BRIDGES, MINOR BRIDGES, RUB, ROB, ROR, RETAINING WALL, SACRIFICIAL RETAINING WALL AND DRAINS, UTILITY DIVERSIONS OF AT-GRADE SECTION OF LENGTH 17.551 Km (CH: -0.964 Km to CH:-0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) AND OTHER RELATED INFRASTRUCTURAL WORKS FROM BENNIGANAHALLI TO CHIKKABANAVARA, EXCLUDING STATION BUILDINGS, OF CORRIDOR - 2 OF BENGALURU SUBURBAN RAILWAY PROJECT (BSRP)”.

TENDER NO. K-RIDE/BSRP/10/2021, DATED:23/11/2021

RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED

Samparka Soudha, 1st Floor,

Dr. Rajkumar Road,

Opposite Orion Mall,

Rajajinagar 1st Block, Bengaluru-560010

Tel +91-7410004083,

Email: gmcivil4@kride.in



TENDER DOCUMENT

(Through e-Tendering Mode)

Tender for the work of :

“Design and Construction of Elevated Viaduct of length 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.

TENDER NO:	K-RIDE/BSRP/10/2021, Date: 23.11.2021
TENDER DOCUMENT CAN BE DOWNLOADED FROM	Date: 24/11/2021
LAST DATE AND TIME FOR RECEIPT OF BIDS	Date: 10/01/2022, IST 15:00 Hrs (Only electronic tender permitted.)
DATE AND TIME OF OPENING OF COVER ONE OF TENDER (TECHNICAL BID)	Date: 10/01/2022, IST 15:30 Hrs
PLACE OF OPENING OF COVER ONE OF TENDER (TECHNICAL BID)	The opening of the Technical Bid shall take place at e- procurement portal of K-RIDE i.e., https://eproc.karnataka.gov.in
PLACE OF OPENING OF COVER TWO OF TENDERS (FINANCIAL BID)	The opening of the Financial Bid shall take place at e- procurement portal of K-RIDE i.e., https://eproc.karnataka.gov.in
DATE AND TIME OF OPENING OF COVER TWO OF TENDERS	Will be intimated to the Qualified Tenderers through Karnataka Public Procurement Portal.
ADDRESS FOR COMMUNICATION	GM/Civil (Projects/Corridor-2) K-RIDE (Rail Infrastructure Development Company (Karnataka) Limited) #8, 1 st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall Rajajinagar 1 st Block, BENGALURU Tel – 91-7410004083 E Mail – gmcivil4@kride.in

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SECTION: 1

NOTICE FOR INVITATION FOR TENDERS (IFT)
EPC TENDER

Rail Infrastructure Development Company (Karnataka) Limited

INVITATION FOR BIDS ON EPC MODE.

(Through e-tendering mode)

Tender Notice No. **K-RIDE/BSRP/10/2021**

Date: 23.11.2021

THE RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED (K-RIDE), having its Corporate office, at #8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall, Rajajinagar 1st Block, Bengaluru-560010, India, which is a Joint Venture of Government of Karnataka and Ministry of Railways invites Bids from eligible Bidders, for the construction of works detailed in the table below under **Single stage: Two Cover System (Technical Bid and Financial Bid) on EPC (Engineering, Procurement and Construction) Mode.**

SL. NO.	NAME OF WORK	TENDER SECURITY/EMD	PERIOD OF COMPLETION
1	2	3	4
1	"Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".	Need not be paid. Tender Security Declaration as per form BDF-1 has to be submitted	27 months

NOTE:

1. The Selected Bidder (the "Contractor") shall be responsible for Engineering, Procurement and Construction of the Project under and in accordance with the provisions of an Engineering, Procurement and Construction agreement (the "EPC Agreement") to be entered into between the Selected Bidder and the Authority (K-RIDE). The scope of work will broadly including "Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works

from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".including survey, Geo- technical investigations, including testing.

2. The detailed terms and conditions of the Project, including the scope of the works, services and obligations are in Employer's requirement and scope of work and conditions of contract (GCC, SCC, PCC and contract data)
3. The Tenderers are advised to examine the Project in greater detail, and to carry out, at their cost, such studies as may be required for submitting their respective Bids for award of the contract
4. The Tenderers shall submit the tender through e - procurement portal. Tenderers should scan the registration copy; work done certificate and any other document and submit through online. More information can be had from website www.eproc.karnataka.gov.in
5. On the stipulated date of opening of Tenders, initially, only the Technical Bids are opened through Karnataka Public Procurement Portal. The Technical Bids shall be evaluated by the Employer in accordance with the stipulated Qualification and Evaluation criteria. No amendments or changes to the Technical Bids would be permitted after the opening of Technical Bids.
6. Tenderers who are qualified in the Technical Evaluation, their Price Bid shall be opened at a date and time advised by the Employer (K-RIDE) through e-tendering portal. The Price Bids are evaluated and the Contract is awarded to the Tenderer whose Tender has been determined to be the lowest evaluated substantially responsive tender.
7. Tenderers are advised to note the eligibility and minimum qualifying criteria specified in the Section 2: Instruction to Tenderers of the tender document.
8. Tenders must be accompanied by a Tender Security as per Form (BDF/1) in Section 3: Qualification Information/Bidding Forms in any one of the forms as specified in the tender documents and shall have to be valid for 45 days beyond the validity of the tender. Any Tenders received without tender security declaration form in the stipulated format, shall be summarily rejected.
9. Incomplete Tender submission will be considered non-responsive and such Tenders shall not be considered for further evaluation.
10. Tender Documents can be downloaded free of cost from Karnataka Public Procurement Portal i.e., <https://eproc.karnataka.gov.in> from 24/11/2021 and the Tenders must be submitted online via Karnataka Public Procurement Portal only.

Please note that drawings, if any, referred in the tender document, but not uploaded with the tender document, can be viewed in this office on any working day. The Tenderer can also have a copy of the same on payment of non-refundable cost of Rs. 5,000/- (Rupees Five Thousand only) by a e-Payment mode (credit card/debit card/net banking/UPI) in favor of **Rail Infrastructure Development Company (Karnataka) Limited**, Bangalore.

It will be the responsibility of the Tenderer who is submitting the Tender on downloaded Tender documents to check and see any Addendum/Corrigendum issued in this regard from the website from time to time and ensure submission of bid along with all Addendum/Corrigendum.

In case of any clarification the Tenderer can visit the Rail Infrastructure Development Company (Karnataka) limited Corporate Office Bengaluru at #8, 1st Floor, Samparka Soudha, Dr.

Rajkumar Road, Opposite Orion Mall, Rajajinagar 1st Block, Bengaluru-560010. Tel. No.+91-7410004083.

11. Validity of Tender: Tenders shall remain valid for a period of 180 days after the Tender submission deadline date prescribed by the employer. A Tender valid for a shorter period shall be rejected by the employer as non-responsive.
12. In exceptional circumstances, the Employer may request Tenderers to extend the period of validity of their Tenders. The request and the responses shall be made in writing. If a Tender security is requested in accordance with ITT 13, it shall also be extended up to the date mentioned in the letter of request for extension. A Tenderer may refuse the request without forfeiting its Tender security. A Tenderer granting the request shall not be required or permitted to modify its Tender.
13. If, the office happens to be closed on the date of opening of Tender, the Tenders will be opened on next working day at the same time and venue.
14. A Pre- Bid meeting will be held on 17/12/2021 at 11:30 Hrs. IST at the office of K-RIDE, Bangalore to clarify the issues if any and to answer questions on any matter that may be raised at that stage as stated in Clause - 8 of ITT of the Tender document.
15. Other details can be seen in Tender documents.

16. REGISTRATION:

- a. Tenderers are required to enroll on the e-tendering Portal (<https://eproc.karnataka.gov.in>) with clicking on the link "Tenderers Registration" on the e-tender Portal by paying requisite registration fee as applicable.
- b. As part of the enrolment process, the Tenderers will be required to choose a unique user name and assign a password for their accounts.
- c. Tenderers are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication with the Tenderer.
- d. Upon enrolment, the Tenderers will be required to register their valid Digital Signature Certificate (Only Class III Certificates with signing + encryption key usage) issued by any Certifying Authority recognized by CCA India with their profile.
- e. Only one valid DSC should be registered by a Tenderer. Please note that the Tenderers are responsible to ensure that they do not lend their DSC"s to others which may lead to misuse.
- f. Tenderers then logs in to the site through the secured log-in by entering their user ID/password and the password of the DSC / e-Token.
- g. The scanned copies of all original documents should be uploaded on portal.
- h. For any query regarding e-procurement on the Karnataka Public Procurement Portal, contact helpdesk number **+91-8046010000, +91-8068948777, support@eprochelpdesk.com**

17. **SEARCHING FOR PROPOSAL DOCUMENTS**

Once the Tenderers have selected the proposals they are interested in, the Tenderers can pay nonrefundable processing fee as per the Karnataka Public Procurement Portal.

18. **PRECAUTIONS FOR SUBMITTING / PREPARATION OF PROPOSALS THROUGH E TENDERING PORTAL**

- a. Tenderer, in advance, should get ready the proposal documents to be submitted as indicated in the proposal document / schedule and generally, they can be in PDF /JPEG formats.
 - b. Tenderer should log into the website well in advance for the submission of the proposal so that it gets uploaded well in time i.e., on or before the proposal submission time. Bidder will be responsible for any delay due to other issues.
 - c. The Tenderer has to digitally sign and upload the required proposal documents one by one as indicated in the tendering document.
 - d. The server time (which is displayed on the consultant's dashboard) will be considered as the standard time for referencing the deadlines for submission of the proposals by the consultants, opening of proposals etc. The consultants should follow this time during proposal submission.
19. The Tenderer should furnish the Name of the individual / firm/ Company / Joint venture with address and telephone number with place of registration, year of incorporation etc.,
20. Tender by a joint venture of contractors is permitted subject to conditions indicated in tender document.
21. The application made by the firm / company / Joint Venture shall be signed by a person holding the power of attorney, in which case the Tenderer shall furnish a copy of power of attorney.
22. Bid through any other mode shall not be entertained. However, power of attorney and JV agreement etc., shall be submitted by the bidder on or before submission date and time.

23. **Employees Provident Fund Registration Certificate**

The Contractor shall furnish EPF Registration Certificate before entering into agreement in the event of award of work to them after tender, subject to compliance with the following conditions:

- a) If the contractor is registered already with the EPF authorities, they should produce a copy of the EPF Registration Certificate.
- b) If not registered with the EPF authorities, the Tenderer should produce an undertaking at the time of participating in the tender that he shall within 7 days of the close of every month submit a Statement to Engineer showing the recoveries of contribution in respect of Employees by or through him and shall also furnish such information as the Engineer is required to furnish under the provisions of the Scheme to the Commissioner EPF.

- c) However, having given an undertaking to this effect if the Contractor does not furnish the information, the Employer will deduct the necessary amount from the amount due to the Contractor. Notwithstanding the above, the Contractor will be liable for any consequential penalty /damages levied by the EPF authorities.
24. The necessary certificates / documents in support fulfilling qualifying criteria stipulated separately shall be scanned and attached to e-procurement document. The original documents if required by the Employer shall be produced whenever asked by Employer on Technical Bid/ Financial Bid.
25. The intending Tenderers are advised to visit the site of work before attending the Pre- Bid meeting and also before submitting the Tenders.
- 26. Site visit and verification of information.**
- 27.1 Tenderer are encouraged to submit their respective Bids after visiting the Project site and ascertaining for themselves the site conditions, traffic, location, surroundings, climate, availability of power, water & other utilities for construction, access to site, handling and storage of materials, weather data, applicable laws and regulations, and any other matter considered relevant by them. Tenderers are advised to visit the site and familiarize themselves with the Project within the stipulated time of submission of the Bid. No extension of time is likely to be considered for submission of Bids.
- 27.2 It shall be deemed that by submitting a Bid, the Tenderer has:
- (a) made a complete and careful examination of the Bidding Documents, Schedules annexed to the Tender document.
 - (b) received all relevant information requested from the Authority;
 - (c) accepted the risk of inadequacy, error or mistake in the information provided in the Bidding Documents or furnished by or on behalf of the Authority relating to any of the matters referred to in Clause 27.1 above. No claim shall be admissible at any stage on this account.
 - (d) satisfied itself about all matters, things and information including matters referred to in Clause 27.1 here in above necessary and required for submitting an informed Bid, execution of the Project in accordance with the Bidding Documents and performance of all of its obligations there under.
 - (e) acknowledged and agreed that inadequacy, lack of completeness or incorrectness of information provided in the Bidding Documents or ignorance of any of the matters referred to in Clause 27.1 here in above shall not be a basis for any claim for compensation, damages, extension of time for performance of its obligations, loss of profits etc. from the Authority, or a ground for termination of the Agreement by the Contractor.
 - (f) acknowledged that it does not have a Conflict of Interest; and
 - (g) agreed to be bound by the undertakings provided by it under and in terms hereof.

- 27.3 The Authority shall not be liable for any omission, mistake or error in respect of any of the above or on account of any matter or thing arising out of or concerning or relating to the Tender document, including any error or mistake therein or in any information or data given by the Authority.
- 27.4 The qualification criteria as indicated in bid document should be met by the intending Tenderers.
28. Tenderers shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by the Govt. of Karnataka, Govt of India and any PSUs thereof.
29. Pre-bid meeting will be held on **17/12/2021 at 11.30AM** in the office of K-RIDE Bangalore.
30. The conditional Tenders will not be accepted.
31. The Employer is not responsible for any delay in accessing Karnataka Public Procurement Portal.
32. The rates quoted by the Tenderer must be inclusive of all Taxes, Duties etc.,
33. The Employer reserves the right to either postpone or to cancel the entire process of tender.
34. If Employer wishes to engage third party consultants for quality control assessment, apart from the Employer quality control and field tests, the Tenderer should co-operate with both Quality control authorities and the third party.
35. Building and other construction workers welfare: The Tenderer shall subscribe 1% of gross amount of each bill payable to him in respect of contract to the building and other construction workers welfare cess as per GO No: LD 300 LET 2006, Bangalore, dated: 18-01-2007. The amount of subscription will be recovered out of payable amount to him in each bill. This component is deemed to have been included in the quoted rate.
36. **Last Date of Receipt and opening of Bids:** The completed Tenders must be submitted through Karnataka Public Procurement Portal <https://eproc.karnataka.gov.in> not later than **15.00 Hrs. on 10/01/2022** and shall be opened on **10/01/2022 at 15.30 hrs.** K-RIDE will not be responsible for any delays in the receipt of Tender by K-RIDE. Late Tenders (received after stipulated date and time of submission of Tenders) shall not be accepted under any circumstances. K-RIDE reserves the right to accept/reject any or all proposals without assigning any reason thereof.
37. Any suit or application, arising out of any dispute or differences on account of this tender shall be filed in a competent court at Bengaluru, Kamataka only and no other court or any other district of the country shall have any jurisdiction in the matter.

38. **Address for Communication:** Interested eligible Tenderers may obtain further information from the following address:

**GM/Civil (Projects/Corridor-2),
Rail Infrastructure Development Company (Karnataka) Limited,
#8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall
Rajajinagar 1st Block, Bengaluru-560010
Tel +91-7410004083
E-mail: gmcivil4@kride.in**

**For any Query regarding e tendering portal/ Tender submission please contact helpdesk
Number +91-8046010000, +91-8068948777
Email: support@eprochelpdesk.com**

K-RIDE

SECTION – 2

INSTRUCTIONS TO TENDERERS (ITT)

SECTION 2: INSTRUCTIONS TO TENDERERS (ITT)
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A. GENERAL

1. SCOPE OF THE TENDER:

1.1 THE RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED (K-RIDE), Having its Corporate office, at #8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall, Rajajinagar 1st Block, Bengaluru-560010, India, which is a Joint Venture of Government of Karnataka and Ministry of Railways invites Tenders from Eligible Tenderers, for the construction of works details as given in the invitation for the Tenders (IFT). The tenderers may submit the tenders for the works detailed in the IFT.

2. ELIGIBLE TENDERERS:

2.1 The Tenderers shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by Govt. of Karnataka, Govt of India and PSUs.

2.2 JOINT VENTURES:

Tendering by a joint venture of Contractors is permissible subject to following conditions:

- a. If the Applicant comprises a number of firms combining their resources in a joint venture, the legal entity constituting the joint venture and the individual partners in the joint venture shall be registered after award of work and shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by GOK.
- b. The joint venture must satisfy collectively the Qualification criteria. For this purpose, the following data of each member of the joint venture may be added together to meet the collective qualifying criteria:
 - i. Average annual turnover (sub clause 3.2a).
 - ii. Particular experience including key production rates. (Sub clause 3.2b & c).
 - iii. Financial means (sub clause 3.3b liquid assets, 3.6 assessed available Tender capacity & the audited balance sheets or other financial statements acceptable to the employer, for the last five years shall be submitted and must demonstrate current soundness of the applicant's financial position and indicates its prospective long-term profitability.
 - iv. Personnel capabilities (sub clause 3.3c: List of minimum key staff/position required during the contract implementation).
 - v. Equipment capabilities (sub clause 3.3a: own/lease equipment's).
- c. Each partner must satisfy the following criteria individually:
 - i. General construction experience for the period of years stated in Tender document (Instructions to Tenderers: The intending Tenderer/firm/company/ joint venture shall provide evidence that it has been actively engaged in "Work of execution of Elevated Viaduct / bridge excluding earthen approaches having sub-structure with pile/well/ open foundations and RCC piers and superstructure with prestressed concrete/Steel Composite for Metro Railway/ Railway/ High Speed Railway /Regional Railway/ Light

SECTION:2: - INSTRUCTIONS TO TENDERERS (ITT)

Railway/ Highway” work for at least for a period of 5 years prior to the submission of application. (From FY: 16-17 to FY: 20-21)

- ii. Adequate sources to meet financial commitments on the other contracts (Sub clause 3.5: Accessed available Tender capacity).
 - iii. **Financial Soundness (Instructions to Tenderers:** The intending Tenderer/ firm/ company shall provide the audited balance sheets or other financial statements acceptable to the employer for the last five years and must demonstrate the current soundness of the applicant's financial position and indicate its prospective long-term profitability. If deemed necessary, the employer shall have the authority to make enquiries with the applicants' bankers).
 - iv. **Litigation History (Instructions to Tenderers:** The intending Tenderer/firm/company/ joint venture shall provide accurate information on the related application form about any litigation or Arbitration resulting from contracts completed or on going under its execution over the last five years. The consisting history of awards against the tenderer or any partner of a joint venture may result in failure of the application).
 - v. In accordance with the above, the Application shall include all related information required for individual partners in the joint venture
- d. **Joint venture is restricted to 3 (Three) number of partners.** One of the partners, who is responsible for performing a key function in contract management or is executing a major component of the proposed contract, shall be nominated as being in charge during the tendering periods and, in the event of a successful tender, during contract execution. The partner in charge shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the joint venture; this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners.
- e. All partners of the joint venture shall be legally liable, jointly and severally, during the tendering process and for the execution of the contract in accordance with the contract terms, and a statement to this effect shall be included in the authorization mentioned under Sub-Clause 2.2(d) above. **To enable the above, each of the partners of the joint venture shall meet not less than 25% of the qualifying criteria specified for Average annual turnover and Line of credit / liquid assets. All members of the joint venture must have experience in execution of similar work.**
- f. A copy of the Joint Venture Agreement (JVA) entered into by the partners shall be submitted with the Application. Pursuant to Sub-Clauses 2.2(c) to 2.2(f) above, the JVA shall include among other things: the JV's objectives; the proposed management structure; the contribution of each partner to the joint venture operations; the commitment of the partners to joint and several liability for due performance; recourse/sanctions within the JV in the event of default or withdrawal of any partner; and arrangements for providing the required indemnities.
- The lead partner shall enter into a Joint Venture agreement of Rs. 200.00 stamp paper in the prescribed format which shall be concluded prior to Tender and enclosed to the Tender document J.V. Partner shall not enter in to multiple J. V's with different Tenderers of the same work.

SECTION:2: - INSTRUCTIONS TO TENDERERS (ITT)

- g. The qualification of a joint venture does not necessarily qualify any of its partners to tender individually or as a partner in any other joint venture or association. In case of dissolution of a joint venture prior to the submission of tenders, any of the constituent firms may qualify if they meet all of the qualification requirements, subject to the return approval of the employer. Individual members of a dissolved joint venture may participate as sub-contractor to qualified applicants, subject to the provisions mentioned below:
- “No firm can be a sub-contractor while submitting a tender individually or as a partner of a joint venture in the same tendering process. A firm, if acting in the capacity of sub-contractor in any tender, may participate in more than one tender, but only in that capacity. A tenderer who submits, or participates in, more than one tender will cause all the proposals in which the tender has participated to be disqualified.”
 - A firm shall submit only one Tender in the same Tendering process, either individually as a Tenderer or as partner of Joint Venture.
 - The necessary certificates/documents in support of pre-qualification criteria fulfilled as stipulated shall be scanned and attached to e-tender document. Scanned signature of the Tenderer/authorized representatives of the Tenderer shall be attached while uploading the Tender document.

Any Tenderer who is otherwise technically qualified withdraws from the Tender process at any stage before a final decision is taken on the tender, the EMD of such Tenderer shall be forfeited, the name of such Tenderer shall be removed from the category list of contractors at least for a minimum period of one year in K-RIDE beside making such Tenderer liable for blacklisting.
 - Tenders submitted by all Tenderers in the process of Tender evaluation will be opened even if the Tenderer withdraws from the Tender process by not submitting the original documents for verification or for any other reasons and the prices quoted by them will be looked into, to ascertain if there is collision amongst the Tenderers to determine the competitiveness of the L1 price quoted by other Tenderers, as per the decision by the K-RIDE.
 - Prior to awarding of the work, the Lowest (L-1) Tenderer should produce the original documents in support of the uploaded documents to enter in to the agreement. If the lowest Tenderer (L-1) does not produce the original documents for entering into the agreement then his Tender can be treated as non-responsive Tender as per clause 26(4) of the KTPP Rules. The name of the Tenderers who do not produce the original documents shall be removed/debarred from the select list of K-RIDE enrollment and barred from participation in any of the tenders to be invited by K-RIDE a part from forfeiting the EMD paid through e-cash.
 - The bidder, JV Partner shall not be under Corporate Debt Restructuring (CDE)/ Strategic Debt Restructuring (SDR) or Bureau of Industrial & financial reconstruction (BIFR) in last 5 years to bid submission date. In this regard, the bidder shall submit along with bid, a certificate with a declaration that, the bidder is not under CFR/SDR or BIFR.
 - Further information about e-tendering can be had from Karnataka Public Procurement Portal <http://eproc.karnataka.gov.in>

3. QUALIFICATION OF THE TENDERER.

- 3.1 All the tenderers shall provide the requested information accurately and sufficient details in section 3: Qualification information. The Joint Venture to be formed prior to the Bidding.

Pre-qualification will be based on Applicants meeting all the following minimum pass-fail criteria regarding their general and particular construction experience, financial position, personnel and equipment capabilities, and other relevant information as demonstrated by the Applicant's responses in the Information Forms attached to the Letter of Application. Additional requirements for joint ventures are given in para 2.2

- 3.2 The following qualification criteria should be met by the intending Tenderers.

- a) Required average annual turnover (In all classes of civil engineering construction work only):
The intending Tenderer/firm/ Company/Joint Venture should have achieved a **MINIMUM AVERAGE ANNUAL CONSTRUCTION TURNOVER of Rs.664.00 Crores in last five Financial Years from 2016-17 to 2020-21.**

NOTE: The Tenderers shall submit certificates to this effect which may be attested certificates from the concern departments/ Client or Audited balance sheet duly certified by the statutory Auditor / certificate from Chartered Accountant duly supported by audited balance sheet. The Turnover certificate duly certified by statutory Auditor should be uploaded. Financial turnover of previous years will be given a weightage of 10% per year or part thereof up to the month previous to the Bid submission month as indicated in qualification information (Tender Forms) Form FIN-2 based on the rupee value to bring them to current FY: 2021-22 price value.

- b) I) The Tenderer/Firm/Company/JV should have satisfactorily completed at least one similar work such as "Work of execution of Elevated Viaduct / bridge excluding earthen approaches having sub-structure with pile/well/ open foundations and RCC piers and superstructure with prestressed concrete/Steel Composite for Metro Railway/ Railway/ High Speed Railway /Regional Railway/ Light Railway/ Highway" of value not less than Rs. 514.00 Crores at current FY: 2020-21 price level in the preceding five financial years. (FY 2016-17 to FY 2020-21) AND

II) The Tenderer/Firm/Company/JV should have satisfactorily completed at least one similar work such as "Work of execution of Earthwork in embankment & cutting/ Major bridges/ Minor bridges/ RUB /ROB /Retaining wall / drains for Metro Railway/ Railway/ High Speed Railway /Regional Railway/ Light Railway/ Highway" of value not less than Rs. 283.00 Crores at current FY: 2020-21 price level in the preceding five financial years. (FY 2016-17 to FY 2020-21).

NOTE:

1. The criteria above applies to the Individual Tenderer/Firm/company/Joint venture also. Certificate regarding the same duly signed by an officer not below the rank of the Executive Engineer to be submitted along with the technical Tender.
2. Similar work is defined as below:
For para 3.2 b I) Work of execution of Elevated Viaduct / bridge excluding earthen approaches having sub-structure with pile/well/ open foundations and RCC piers and

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superstructure with prestressed concrete/Steel Composite for Metro Railway/ Railway/ High Speed Railway /Regional Railway/ Light Railway/ Highway.

For para 3.2 b II) Work of execution of Earthwork in embankment & cutting/ Major bridges/ Minor bridges/ RUB /ROB /Retaining wall / drains for Metro Railway/ Railway/ High Speed Railway /Regional Railway/ Light Railway/ Highway.

3. The contract is considered as satisfactorily completed if 80% or more of the work is physically completed which is to be substantiated by a certificate from the Employer who has awarded the contract to the Bidder and the contract amount so received should be equal to or more than the minimum value as per eligibility criteria 3.2 (b).
4. For completed works, the value of work done shall be updated to current FY 2021-22 price level assuming 10% inflation for Indian rupees every year or part thereof up to the month previous to the Bid submission month. Credentials if submitted in foreign currency shall be converted into Indian currency i.e., Indian Rupee as under: Bids will be compared in Indian Rupees only. The exchange rate of foreign currency shall be applicable 28 days before the tender submission date. For conversion of foreign currency to Indian Rupee exchange rates published by Financial Benchmarks Private limited (www.fbil.org.in) 28 days before the date of bid submittal will be considered. In case the particular day happens to be a holiday the exchange rate published on the next working day will be considered. In case of works in foreign currency the effect of inflation is considered as included, as the exchange rate prevailing 28 days before tender submission is being considered for conversion to Indian Rupees.
5. In case of JV/Consortium, full value of the work, if done by the same JV shall be considered. However, if qualifying work (s) done by them in JV/Consortium having different constituents, then the value of work as per their percentage participation in such JV/Consortium shall be considered.

- c) The intending Tenderer / firm/ company / Joint Venture should have executed all the components within last five financial years and Each component should have been executed in any one year (Any continuous 12 months).

Component No.	Nature of Work	Minimum component of work
1	The launching activity of Prestressed concrete superstructure of length of minimum 4.00 KM with Heavy duty crane and Launching Girder of Elevated Viaduct / flyover / bridge for Metro Railway/ Railway/ High Speed Railway /Regional Railway/ Light Railway/ Road Project having pile foundation. (In maximum up to Two contracts) AND	4.00 Km
2	Completion of at least one bridge/ viaduct involving launching of steel/ PSC girder for at least one span of 40 m or more for a Metro Railway/ Railway/ Regional Railway/ Light Railway/ Road over the Railway running track. (In One contract and this can be met through Nominated/ Identified subcontractor who has experience in this type of work) AND	1 No.
3	Completed construction of earthwork in cutting and embankment for railway track Doubling (This can be met through Nominated/ Identified subcontractor who has experience in this type of work) AND	4,20,000 Cum
4	Cement concrete work (RCC and PSC) AND	1,06,000 Cum

- d) The intending Tenderer / firm/ company / Joint Venture should have executed all the components within last five financial years. (FY 2016-17 to FY 2020-21)

“Detailed Design Experience: Should have Completed the Detailed Design work of Elevated Metro viaduct for at least 5 Km including Pile, pile cap, Open foundations, RCC piers, super structure with pre-stressed concrete segmental work, steel composite girders in one contract (This can be met through Nominated/Identified subcontractor who has experience in this type of work)”

The client certificates along with work orders are mandatory for establishing the detailed design consultancy experience of the consultant. In case the required documents are not submitted, work will not be considered as a qualifying work.

NOTE: -

1. The criteria above applies to the Individual Tenderer/Firm/ company / Joint Venture also. Certificate regarding the same duly signed by an officer not below the rank of the Executive Engineer should be submitted along with the technical Tender.
2. The qualifications, capacity, and resources of proposed subcontractors will not be taken into account in assessing those of individual or joint venture Applicants, unless they are named specialist subcontractors.

3. For para 3.2 (c) 2, 3 and 3.2 (d): The prior consent of the Employer shall be obtained for replacement of proposed identified Subcontractors if any and for which the same qualification criteria as indicated in paras above are required.

3.3 Each Tenderer should further demonstrate:

- 3.3 a) KEY PLANT AND EQUIPMENT: Availability by owning at least 50% of the required following key and critical equipment's for this work and the remaining 50% can be deployed on lease/hire for all works provided, the relevant documents (Commitment agreements etc.,) for availability for this work are to be furnished:**

The intending Tenderer/firm/company/Joint venture should furnish details of ownership / lease certificates of the following minimum requirement of machineries:

PLANT AND EQUIPMENT

(I) KEY AND CRITICAL EQUIPMENTS

SI No.	Type of Equipment required for the work	Proposed to be Deployed (Minimum)	Remarks
1.	Piling Equipment Rotary Rig/Hydraulic Rig for soil boring and rock boring including diamond bits and core barrels for rock boring.	8 Nos	50% own+50% Lease/Hire
2.	Piling rig (Tripod) with conventional winch	16 Nos	50% own+50% Lease/Hire
3.	Fully Automatic and Computerized Batching Plant - 2 Nos. (1 of 60 Cum/h and other one of 45 Cum/h) minimum or equivalent capacity in different configuration at casting yard with a RO of suitable capacity for proper quality of water.	2 Nos	50% own+50% Lease/Hire
4.	Concrete boom placers	4 Nos	50% own+50% Lease/Hire
5.	Concrete pumps with sufficient pipes	6 Nos	50% own+50% Lease/Hire
6.	Transit Mixtures	20 Nos	50% own+50% Lease/Hire

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7.	Launching Girder to Launch Box segments as per site requirements (Maximum permissible age in years is 10 Years)	4 Nos	50% own +50% Hire/Lease
8.	The suitable launcher for U-girder launching fully automatic, capable of negotiating 200m radius curve and 4% gradient, speed of trolley carrying U-girder for launching with load 2km/hr. and without load 3km/hr. to be mobilized. The minimum of two numbers of LG for launching of U-girders with motorized bogies for handling and transportation of U-girders to be mobilized.)	2 Nos	Own/ Hire/Lease
9.	Crane of suitable capacity for Erection of LG girders, /U Girders.	4 Nos	50% own +50% Hire/Lease
10.	Cranes in casting yard/site of suitable capacity	4 Nos	50% own +50% Hire/Lease
11.	Gantry of suitable capacity in casting yard	6 Nos	50% own+50% Lease/Hire
	Road work, Embankment and cutting works.		
12.	Hydraulic excavator (1 cum bucket)	4 Nos	50% own+50% Lease/Hire
13.	Tippers/trucks (10 cum capacity)	20 Nos	50% own+50% Lease/Hire
14.	Dozer of suitable capacity	3 Nos	50% own+50% Lease/Hire
15.	Front end loader with suitable capacity	3 Nos	50% own+50% Lease/Hire
16.	Vibratory roller 8-ton capacity	2 Nos	50% own+50% Lease/Hire
17.	Smooth wheeled roller 8-ton capacity	2 Nos	50% own+50% Lease/Hire
18.	Water tanker of 6000 lit capacity	4 Nos	50% own+50% Lease/Hire
19.	Grader	2 Nos	50% own+50% Lease/Hire
20.	Back hoe loader of suitable capacity	3 Nos	50% own+50% Lease/Hire
21.	Plate Vibratory Roller	2 Nos	50% own+50% Lease/Hire

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22	Slope Compactor Roller	2 Nos	50% own+50% Lease/Hire
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(II) Other Plant and equipment to be deployed (The Tenderer has to furnish the details of Own basis and Lease/Hire basis for the following equipment

Sl. No.	Type of equipment required for the work	Proposed to be deployed (Minimum)	Remarks
1	Pile cap Shutters	18 sets	
2	Pier and pier cap Shutter, staging and supporting arrangement for all type of Piers	18 Sets	
3	Pre cast Post tension shutter staging support for Casting of Pier caps	2 Beds with Shutters	
4.	Pre cast post-tension I Girder Beds along with necessary shutter and support arrangements	2 Beds with Shutters	
5.	Portal shuttering & staging of required capacity in Viaduct	13 Nos	
6.	Minimum number of pre-casting beds for Box/U girders along with shutters and supporting for straight and curved spans.	12 Nos of long line and 12 Nos for S1 segments.	
7.	250 MT or more capacity suitable cranes for erection of I Girders / RCC Portals, super structures of Viaduct work	4 Nos	
8..	Trolley to transport U Girder of 200 Mt weight over the erected span	4 Nos	
9.	Trailers/MAV for carrying U Girder/Box segments of Suitable capacity as per site requirement	4 Nos	
10	Trailers/MAV for carrying I Girders/Pier caps and other Precast elements of Suitable capacity as per site requirement	2 Nos	
11	Gantry for parapet erection	3 sets	
12.	Man-lift for adequate height	10	
13.	Crash Barriers & Friction slab Shutters	8 Sets	

	Road work, Embankment and cutting works.		
14	Crane 5 MT capacity	2 Nos	
15.	Crane 35 MT capacity	2 Nos	
16.	Generators 125 KVA	4 Nos	
17	Pneumatic road roller	1 No	
18	Tandem road roller	1 No	
19	Survey equipment's: Total stations and auto level	3 sets	

3.3 b) LIQUID ASSETS: The Tenderer / firm/company/Joint Venture should furnish details of liquid assets and or availability of credit facilities of Rs. 148.00 Crores for the work mentioned above for meeting the required funds in the form of own funds /credit lines / certificate from scheduled Nationalized Bank. The Tenderer shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit and other financial means (independent of any contractual advance payment) sufficient to meet the construction cash flow requirements for the subject contract in the event of stoppage, startup, or other delays in payment, of the minimum estimated amount stated above, net of the applicant's commitments for other contracts.

The Bidder should have access to or has available liquid assets, lines of credit and other financial means to meet cash flow. The audited balance sheet and/or banking reference certified by Chartered Accountant with their stamp, signature and membership number shall be submitted by the Tenderer along with the Tender.

Banking reference should contain in clear terms the amount that bank will be in position to lend for this work to the applicant/member of the joint venture/Consortium. In case the Net Current Assets (as seen from the balance sheet) are negative, only the banking references will be considered. Otherwise, the aggregate of Net Current Assets and submitted banking references will be considered for working out the Liquidity.

The banking reference should be, from a scheduled Bank in India it should not be more than three months old as on date of submission of Bids.

In case of JV firm's overall liquidity of JV firm shall be assessed by arithmetic sum of liquidity of all members of JV as specified in JV matrix.

3.3 c) LIST OF MINIMUM KEY TECHNICAL PERSONNEL: List of Minimum Key Technical personnel required for the work are as under and should be enrolled in company/ firm/Joint Venture under Employment register and document should be uploaded. The

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Contractor shall have a competent team of Managers, Engineers, Technical staff etc. so as to complete the work satisfactorily as per various requirements of the contract. The Key Positions not limited to (and in addition to other manpower requirement as given in the Tender document) and corresponding qualification and experience are as under:

Sl. No.	Designation	Qualification	Experience level (For similar works)	Min. No. Required
1	Project Manager (Team Leader)	Bachelor's Degree/Post Graduate Degree in Civil Engineering	Minimum 18 years total experience and 5-year experience in the role of Project Manager in the execution of similar type of work	1
2	Deputy Project Manager/ Construction Manager	Bachelor's Degree in Civil Engineering	Minimum 12 years total experience and 5-year experience in the role of Construction Manager in the execution of similar type of work.	8
3	Design manager	Post Graduate Degree/ Bachelor's Degree in Structural Engineering	Minimum 15 years total experience and 10-year experience in the role of Design Manager in the execution of similar type of work	2
4	Deputy Project Manager/ Construction Manager for Mechanical & Electrical	Bachelor's Degree in Mechanical Engineering	Minimum 12 years total experience and 8-year experience in execution of similar type of work.	2
5	QA & QC Manager.	Bachelor's Degree in Civil Engineering	Minimum 12 years total experience and 8-year experience in the role of QA&QC Manager in the execution of similar type of work	2
6	Chief Safety and Health Manager	Bachelor's Degree in Civil Engineering & Diploma in Safety Course.	Minimum 10 years total experience and 8-year experience in the role of Chief Safety and Health Manager in the execution of similar type of work.	4
7	Traffic Coordinator	Bachelor's Degree in Civil/ Transportation Engineering	Minimum 10 years total experience and 5-year experience in the role of	4

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Sl. No.	Designation	Qualification	Experience level (For similar works)	Min. No. Required
			Traffic Coordinator in the execution of similar type of work.	
8	Interface manager	Bachelor's Degree in Civil/ Mechanical/ Electrical Engineering	Minimum 10 years total experience and 5-year experience in the role of Interface manager in the execution of similar type of work.	2
10	Geotechnical Engineer	Bachelor's Degree in Civil/ Geotechnical Engineering	Minimum 8 years total experience and 3-year experience in the role of Geotechnical Engineer in the execution of similar type of work.	2
11	Billing Engineer / Quantity Surveyor.	Graduate/ Diploma in Civil Engineering	Total minimum experience of 5 years with knowledge of computer applications for Degree and 8 years for Diploma with knowledge of Computer applications.	2
12	Procurement Specialist	Graduate/ Diploma in Civil Engineering	Minimum 5 years in relevant field.	02
13	Senior Civil Engineer	Bachelor's Degree in Civil Engineering	Total minimum 7 Years for graduate & 10 years for Diploma in relevant field.	15
14	Civil Engineer	Bachelor's Degree in Civil Engineering	Total minimum experience 5 Years	25
15	Electrical and Mechanical Engineer	Bachelor's Degree in Electrical and Mechanical Engineering	Total minimum experience 5 Years	05
16	Junior Civil Engineer	Diploma in Civil Engineering	Total minimum experience 4 Years	45
17	JE (Electrical and Mechanical)	Diploma in Electrical and Mechanical Engineering	Total minimum experience 4 Years	05
18	Safety Engineer/ Officers	Bachelor's Degree in Civil Engineer & Diploma in Safety Course	Total minimum experience 5 Years	10

Note: The CV's to be given for Serial No. 1 to 10 as per Form-6 of section-3 and Serial No. 11 to 18 the details to be given as per Form-5 of section-3 (Qualification information /Bidding Forms).

3.4 To qualify for a package of contracts made up of this and other contracts for which tenders are invited in this IFT, the Tenderer must demonstrate having experience and resources to meet the aggregate of the qualifying criteria for the individual contracts.

3.5 Sub-contractors' experience and resources shall not be taken into account in determining the Tenderer's compliance with the Qualifying Criteria.

3.6 BID CAPACITY: Tenderers who meet the above specified minimum qualifying criteria, will only be qualified, if their available Tender capacity is more than Rs. 697 Cr. The available tender capacity will be calculated as under:

Assessed available tender capacity = $(A*N*1.5 - B)$ Where,

A = Maximum value of civil engineering works executed in any one year during the last five financial years ending 31.03.2021 taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the works for which tenders are invited.

B = Value at current price level (updated up to the month previous to the Bid submission month) of existing commitments and on-going works to be completed during the next two and half years (*period of completion of the works for which Tenders are invited*).

Note: Updation of Price Level shall be done at 10% per year.

The statements showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the Employer in charge, not below the rank of an Executive Engineer or equivalent.

3.7 NETWORTH: The Bidder's net worth for the last Financial Year calculated as the difference between total assets and total liabilities **should be Positive.**

3.8 Even though the Tenderers meet the above criteria, they are subject to be disqualified if they have:

- made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or
- record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.; and/or
- participated in the previous Tender for the same work and had quoted unreasonably high tender prices and could not furnish rational justification.

3.9 ELIGIBILITY CRITERIA TABLE/MATRIX:

Requirement	Single Entity	Joint Venture			Submission Requirements
		Lead Partner	Other Partners	All partners combined	
Clause: 3.2.(a) (Annual construction turnover in at least two out of five financial years)	Must meet the requirement	Must meet 50% of the requirement	Must meet 25% of the requirement	Must meet the requirement	Form FIN-2
Clause: 3.2 (b) (I) One Similar work	Must meet the requirement	Must meet the requirement	Must have experience in similar work.	Must meet the requirement	Form at para 1.3/section:3
Clause: 3.2 (b) (II) One Similar work	Must meet the requirement	All Partners Combined Must Meet requirement			Form at para 1.3/section:3
Clause: 3.2 (c) 1 Construction of 4.00 Km PSC Super structure of viaduct (In maximum up to 02 no Contracts	Must meet the requirement	All Partners Combined Must Meet requirement			Form at para 1.4/section:3
Clause: 3.2 (c) 2 Construction of 40m Steel/PSC Girder	Must meet the requirement	Must Meet requirement by any JV partner. Or through Nominated sub-contractor.			Form at para 1.4/section:3
Clause: 3.2(c) 3 Earthwork in Cutting and Embankment for Railway track Doubling	Must meet the requirement	All Partners Combined Must Meet requirement. Or through Nominated sub-contractor.			Form at para 1.4/section:3
Clause: 3.2(c) 4 Cement Concrete work (RCC and PSC)	Must meet the requirement	All Partners Combined Must Meet requirement			Form at para 1.4/section:3
Clause: 3.2(d) Detailed Design Experience	Must meet the requirement	Must Meet requirement by any JV partner. Or through Nominated/Identified sub-contractor.			Form at para 1.4/section:3
Clause: 3.3 (I) Key and Critical Equipment's	Must meet the requirement	All Partners Combined Must Meet requirement.			Form at para 1.6/section:3

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Clause: 3.3 (II) Other plant and Equipment's	Must meet the requirement	All Partners Combined Must Meet requirement			Form at para 1.6/section:3
Clause: 3.3(b) Liquid Asset	Must meet the requirement	Must meet 50% of the requirement	Must meet 25% of the requirement	Must meet the requirement	Form at para 1.10/section:3
Clause: 3.3(c) Minimum Key Technical Staff	Must meet the requirement	All Partners Combined Must Meet requirement			Form No.5 & 6 of Section 3
Clause: 3.6 Bid capacity	Must meet the requirement	All Partners Combined Must Meet requirement			Form at para 1.5/section:3 and Form FIN-3/ section:3
Clause: 3.7 Net worth	Must meet the requirement	Must meet the requirement	Must meet the requirement	Must meet the requirement	Form FIN-1/ section:3

3.10 The applicant must attach with their application, a note giving a general description on the approach to the construction methods, technologies, quality assurance schemes proposed, deployment schedule of equipment proposed to be used, etc., for ensuring completion of the work as per specifications within the desired time-frame.

4. ONE TENDER PER TENDERER:

4.1 Each tenderer shall submit only one tender for one package. A tenderer who submits or participates in more than one Tender (other than as a sub-contractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Tenderer's participation to be disqualified.

5. COST OF TENDERING:

5.1 The tenderer shall bear all costs associated with the preparation and submission of his tender, and the Employer will in no case be responsible and liable for those costs.

6. SITE VISIT:

6.1 The Tenderer at his own responsibility and risk is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Tender and entering into a contract for construction of the Works. The cost of visiting the Site shall be at the Tenderer's own expense.

B -TENDER DOCUMENTS

7. CONTENT OF TENDER DOCUMENTS

7.1 The set of tender documents shall have all the Sections given in content page.

8. CLARIFICATION OF TENDER DOCUMENTS

8.1 A prospective tenderer requiring any clarification of the tender documents may notify the Employer in writing or by cable (hereinafter "cable" includes telex, E-Mail and facsimile) at the Employer's address indicated in the invitation to tender. The Employer will respond to any request for clarification which he receives earlier than 15 days prior to the deadline for submission of tenders. Copies of the Employer's response will be forwarded to all purchasers of the tender documents, including a description of the enquiry but without identifying its source.

8.2 Pre-Bid meeting:

8.2.1 The tenderer or his authorized representative is invited to attend a pre-tender meeting which will take place at office of **K-RIDE Bangalore**.

Venue: #8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road,
Opposite Orion Mall, Rajajinagar 1st Block,
Bengaluru-560010
Tel +91-7410004083

Date: 17/12/2021, **Time:** IST 11.30 Hrs.

8.2.2 The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

8.2.3 The tenderer is requested to submit any questions in writing or by cable to reach the Employer not later than one week before the meeting.

8.2.4 Minutes of the meeting, including the text of the questions raised (without identifying the source of enquiry) and the responses given will be published without delay to all purchasers of the tender documents. Any modification of the tender documents listed in Sub-Clause 7.1 which may become necessary as a result of the pre-tender meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause 9 and not through the minutes of the pre-tender meeting.

8.2.5 Non-attendance at the Pre-Tender meeting will not be a cause for disqualification of a Tenderer.

9. AMENDMENT OF TENDER DOCUMENTS

9.1 Before the deadline for submission of Tenders, the Employer may modify the tender documents by issuing addendum

9.2 Any corrigendum / addendum issued shall be part of the tender documents and shall be made available on the website or e-portal. The Provisions in corrigendum /addenda shall take priority over the Tender Documents issued previously.

- 9.3 To give prospective Tenderers reasonable time in which to take an addendum into account in preparing their tenders, the Employer shall extend as necessary the deadline for submission of Tenders, in accordance with Sub-Clause 16.2 below.

K-RIDE

C. PREPARATION OF TENDERS

10. DOCUMENTS COMPRISING THE TENDER

10.1 The Tender submitted by the Tenderer shall be in two covers (documents) and shall contain the documents as follows:

10.1.1 First Cover (Document):

- Earnest Money Deposit;
- Qualification Information as per formats given in Section 3;

10.1.2 Second Cover (Document):

- The Tender (in the format indicated in Section: 4) (as per Karnataka Public Procurement Portal)
- Priced Schedule (Section 9); online through Karnataka Public Procurement Portal, no hardcopy of commercials should be attached or disclosed. (As per Karnataka Public Procurement Portal)

And any other materials required to be completing and submitting by Tenderers in accordance with these instructions. The documents listed under Sections 3, 4, 6 and 9 shall be filled in without exception.

10.2 Tenderers submitting tenders together with other contracts stated in the IFT to form a package will so indicate in the tender together with any discounts/rebate offered for the award of more than one contract.

11. TENDER PRICES

11.1 The contract shall be for the whole works as described in Sub-Clause 1.1, based on the Price Schedule submitted by the Tenderer.

11.2 The Tenderer shall fill the total amount (both in figures and words) for each schedule of the Works described in the Price Schedule along with total tender price (both in figures and words). Schedules for which no amount or lumpsum price is entered by the Tenderer will not be paid by the Employer when executed and shall be deemed to be covered in the Priced schedule. Corrections, if any, shall be made by crossing out, initialing, dating and rewriting.

11.3 All duties, taxes, and other levies payable by the contractor under the contract, or for any other cause, shall be included in the Price schedule, prices and total Tender Price submitted by the Tenderer.

11.4 The amount quoted by the Tenderer shall be subject to adjustment during the performance of the Contract in accordance with the provisions of Clause of the Conditions of Contract.

12. TENDER VALIDITY

12.1 Tenders shall remain valid for a period not less than **one hundred and eighty days** after the deadline date for tender submission specified in Clause 16. A tender valid for a shorter period shall be rejected by the Employer as non-responsive.

- 12.2 In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the Tenderers may extend the period of validity for a specified additional period. The request and the Tenderers' responses shall be made in writing or by cable. A Tenderer may refuse the request without forfeiting his earnest money deposit. A Tenderer agreeing to the request will not be required or permitted to modify his tender, but will be required to extend the validity of his earnest money deposit for a period of the extension, and in compliance with Clause 13 in all respects.

13. EARNEST MONEY DEPOSIT (TENDER/BID SECURITY)

- 13.1 Earnest Money Deposit/ Tender security (as per Karnataka Public Procurement Portal). The Tenderer shall furnish, as part of his tender, earnest money deposit in the amount as shown in column 4 of the Table of IFT for this particular work. This earnest money deposit shall be in favour of Rail Infrastructure Development Company (Karnataka) Limited Payable at Bangalore and may be in the form of Banker's cheque/ Demand draft/Pay Order or Specified small saving instruments pledged to K-RIDE, Bangalore/ unconditional Bank guarantee, in favour of Rail Infrastructure Development Company (Karnataka) Limited Payable at Bangalore.
- 13.2 Instruments having fixed validity issued as earnest money deposit for the tender shall be valid for 45 days beyond the validity of the tender.
- 13.3 Any tender not accompanied by an acceptable earnest money deposit and not secured as indicated in Sub-Clauses 13.1 and 13.2 above shall be rejected by the Employer as non-responsive.
- 13.4 The earnest money deposit of unsuccessful Tenderers will be returned within 30 days of the end of the tender validity period specified in Sub-Clause 12.1.
- 13.5 The earnest money deposit of the successful Tenderer will be discharged when the Tenderer has signed the Agreement and furnished the required Performance Security.
- 13.6 The earnest money deposit may be forfeited:
- (A) If the Tenderer withdraws the Tender after tender opening during the period of tender validity;
 - (B) If the Tenderer does not accept the correction of the Tender Price, pursuant to Clause 24; or
 - (C) In the case of a successful Tenderer, if the Tenderer fails within the specified time limit to
 - (i) sign the Agreement; or
 - (ii) furnish the required Performance Security.

14. FORMAT AND SIGNING OF TENDER

Tenderer shall submit the Tender electronically before the submission date and time published in Karnataka Public Procurement Portal. The Tenderer must submit Technical and Financial Tender as described in ITT.

SECTION:2: - INSTRUCTIONS TO TENDERERS (ITT)

All pages of the tender where entries or amendments have been made shall be initialed by the person signing the tender. The Tender shall contain no alterations or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the Tenderer, in which case such corrections shall be initialed by the person signing the Tender.

Language of Tender	The language of the Tender: English
Technical Tender	Alternative technical solutions are not permitted.
Technical Tender Documents	All the Forms of Section 3: Qualification Information/Bidding Forms.
Alternative Bids/Tenders	Alternative Bids are not permitted.
Currencies of Tender and Payment	The amount (Lumpsum Price) shall be quoted by the Tenderer entirely in Indian Rupees (INR). For Evaluation and comparison purposes, the currencies of the Tender shall be converted in to Indian Rupees.
Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the Person signing the Tender	<p>The written confirmation of authorization to sign on behalf of the Tenderer shall consist of:</p> <ol style="list-style-type: none"> In case of Private/Public Companies, a POA from the Director of the Company who has been authorized by the Board of Directors through resolution to sign on behalf of the Company. Copy of Board Resolution shall also be submitted. In case of proprietorship Tenderers, Power of Attorney by the Proprietors. In case of partnership Tenderers, Power of Attorney duly signed by all the partners. In case of Limited Liability Partnership (LLP), a POA from the Director of the Company who has been authorized by the Board of Directors through resolution to sign on behalf of the Company. Copy of Board Resolution shall also be submitted. In case of Joint Venture, Power of Attorney duly signed by individual partners to the Lead partner as per the form given in Section-4 with stipulated documents.

The Bid shall be digitally signed by using class-III digital signature of a person who is dully authorized to sign on behalf of the bidder. This authorization shall consist of a written confirmation as specified in the BDS and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. If either the Letter of Technical Bid or Letter of Price Bid or Bid-Security Declaration (if applicable) is not signed, the Bid shall be rejected. All pages of the bid, except for un-amended printed literature, shall be signed or initialed by the person signing the bid.

- If the Tender is submitted by proprietary firm, it shall be signed by the proprietor above his full name, full name of his firm with his current address.

SECTION:2: - INSTRUCTIONS TO TENDERERS (ITT)

- II. If the Tender is submitted by a firm in partnership, it shall be signed by a partner holding the power of Attorney for the firm. A certified copy of the Partnership deed and power of attorney shall accompany the Tender; Alternatively, it shall be signed by all the partners.
- III. If the Tender is submitted by a limited company or a limited corporation, it shall be signed by a duly authorized person holding the power of attorney for the firm. A certified copy of the power of attorney shall accompany the Tender.
- IV. If a Tender is submitted by a Joint venture/Consortium, each firm in the Joint venture/Consortium shall furnish the evidence admissible in law /Power of Attorney to sign the Form of Tender and Lead member as stated in JV Agreement shall sign the Tender documents for submission of Tender.

Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Tender

K-RIDE

D. SUBMISSION OF TENDERS

15. SEALING AND MARKING OF TENDERS

Tenderer shall submit the Tender electronically before the submission date and time published.

16. DEADLINE FOR SUBMISSION OF THE TENDERS

16.1 Tenders must be submitted online through Karnataka Public Procurement Portal to the Employer on or before the date as specified in the Karnataka Public Procurement Portal and the submission of tender is the responsibility of the Tenderer.

16.2 The Employer may extend the deadline for submission of tenders by issuing an amendment in accordance with Clause 9, in which case all rights and obligations of the Employer and the Tenderers previously subject to the original deadline will then be subject to the new deadline.

17. LATE TENDERS

17.1 In online e-procurement system, the Tenderer shall not be able to submit the Tender after the Tender submission time and date as the icon for the task in the Karnataka Public Procurement Portal will not be available. Any Tender received by the Employer after the deadline prescribed in Clause 16 will be rejected.

17.2 "It shall be the responsibility of the tenderers to ensure that their tender is submitted in the Karnataka public procurement portal within the last date and time specified for the receipt of the tenders

18. MODIFICATION AND WITHDRAWAL OF TENDERS

18.1 Tenderer may modify and correct or upload any relevant document in the portal till Tender submission date and time, as published in the Karnataka Public Procurement Portal.

18.2 No Tender may be modified after the deadline for submission of Tenders.

18.3 Withdrawal or modification of a Tender between the deadline for submission of Tenders and the expiration of the original period of Tender validity specified in Clause 12.1 above or as extended pursuant to Clause 12.2 may result in the forfeiture of the earnest money deposit pursuant to Clause 13.

18.4 Tenderers may only modify the prices of their Tenders by submitting Tender modifications in accordance with this clause, or included in the original Tender submission.

E. TENDER OPENING AND EVALUATION

19. OPENING OF FIRST COVER (Document): Opening of First Cover (Document) of all Tenders and evaluation to determine qualified Tenderers:

19.1 The Employer will open the First Covers (Document) of all the Tenders received (except those received late or withdrawn), including modifications for First Cover (Document) made pursuant to Clause 18, in the presence of the Tenderers or their representatives who choose to attend as per Karnataka Public Procurement Portal on the date and the place specified in Clause 16. In the event of the specified date of Tender opening being declared a holiday for the Employer, the Tenders will be opened at the appointed time and location on the next working day.

19.2 DELETED

19.3 The Tenderer name, the presence or absence of earnest money deposit (amount, format and validity), the submission of qualification information and such other information as the Employer may consider appropriate will be announced by the Employer at the opening.

19.4 The Employer shall prepare minutes of the Tender opening, including the information disclosed to those present in accordance with Sub-Clause 19.3.

19.5 DELETED

19.6 The Employer will evaluate and determine whether each tender (a) meets the eligibility criteria defined in ITT Clause 2 is accompanied by the required earnest money deposit as per stipulations in ITT Clause 13 and meets the minimum qualification criteria stipulated in ITT Clause 3. The Employer will draw out a list of qualified Tenderers.

20. OPENING OF SECOND COVER (DOCUMENT) OF QUALIFIED TENDERERS AND EVALUATION:

20.1 The Employer will inform all the Qualified Tenderers the time, date and venue fixed for the opening of the Second Cover (Document) containing the priced Tenders published in Karnataka Public Procurement Portal. The Employer will open the Second Covers (Document) of Qualified Tenderers at the appointed time and date in the presence of the Tenderers or their representatives who choose to attend. In the event of the specified date of financial Tender opening being declared a holiday for the Employer, the Second Covers (Document) will be opened at the appointed time and location on the next working day.

20.2 DELETED

20.3 The Tenderers' names, the Tender prices, the total amount of each Tender, any discounts/rebate, Tender modifications and withdrawals, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. No Tender shall be rejected at Tender opening.

20.4 The Employer shall prepare minutes of the Second Cover (Document) Tender opening, including the information disclosed to those present in accordance with Sub-Clause 20.3.

21. PROCESS TO BE CONFIDENTIAL

- 21.1 Information relating to the examination, clarification, evaluation, and comparison of Tenders and recommendations for the award of a contract shall not be disclosed to Tenderers or any other persons not officially concerned with such process until the award to the successful Tenderer has been announced. Any effort by a Tenderer to influence the Employer's processing of Tenders or award decisions may result in the rejection of his Tender.

22. CLARIFICATION OF TENDERS

- 22.1 To assist in the examination, evaluation, and comparison of Tenders, the Employer may, at his discretion, ask any Tenderer for clarification of his Tender, including breakdowns of Lumpsum Price. The request for clarification and the response shall be in writing or by cable, but no change in the price or substance of the Tender shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Tenders in accordance with Clause 24.
- 22.2 No Tenderer shall contact the Employer on any matter relating to its Tender from the time of the Tender opening to the time the contract is awarded.

If they have any query/clarification related to e-Procurement on the Karnataka Public Procurement Portal, contact e-Procurement Help desk from 10:00 AM to 5:00 PM. Ph. No.: +91-8046010000/ 8068948777 or support@eprochelpdesk.com Karnataka Public Procurement Portal through query option on or before specified time.

- 22.3 Any effort by the Tenderer to influence the Employer in the Employer's Tender evaluation, Tender comparison or contract award decisions may result in the rejection of the Tenderers' Tender.

23. EXAMINATION OF TENDERS AND DETERMINATION OF RESPONSIVENESS

- 23.1 Prior to the detailed evaluation of Tenders, the Employer will determine whether each Tender; (a) has been properly signed; and; (b) is substantially responsive to the requirements of the Tender documents.
- 23.2 A Substantially responsive Tender is one which conforms to all the terms, conditions, and specifications of the Tender documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the Tender documents, the Employer's rights or the Tenderer's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Tenderers presenting substantially responsive Tenders.
- 23.3 If a Tender is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

24. CORRECTION OF ERRORS

- 24.1 Tenders determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:

- where there is a discrepancy between the amount in figures and in words, the lower of the two will govern.

24.2 The amount stated in the Tender will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the Tenderer, shall be considered as binding upon the Tenderer. If the Tenderer does not accept the corrected amount the Tender will be rejected, and the earnest money deposit may be forfeited in accordance with Sub-Clause 13.6 (b).

25. EVALUATION AND COMPARISON OF TENDERS

25.1 The Employer will evaluate and compare only the Tenders determined to be substantially responsive in accordance with Clause 23.

25.2 In evaluating the Tenders, the Employer will determine for each Tender the evaluated Tender Price by adjusting the Tender Price as follows:

(a) Making any correction for errors pursuant to Clause 24; and

(b) Making appropriate adjustments to reflect discounts/rebate or other price modifications offered in accordance with Sub Clause 18.5.

25.3 The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors which are in excess of the requirements of the Tender documents or otherwise result in unsolicited benefits for the Employer shall not be taken into account in Tender evaluation.

25.4 The estimated effect of the price adjustment conditions under Clause 40 of the Conditions of Contract, during the implementation of the Contract, will not be taken into account in tender Evaluation

25.5 If the tender of the successful tenderer is seriously unbalanced in relation to the Employer's estimate of the cost of the work to be performed under the contract, the Employer may require the Tenderer to produce detailed price analyses for any or all items of Priced Schedule, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the performance security set forth in Clause 29 be increased at the expense of the successful Tenderer to a level sufficient to protect the Employer against financial loss in the event of default of the successful Tenderer under the contract.

F. AWARD OF CONTRACT

26. AWARD CRITERIA

- 26.1 Subject to Clause 27, the Employer will award the Contract to the Tenderer whose Tender has been determined to be substantially responsive to the Tender documents and who has offered the lowest evaluated Tender Price, provided that such Tenderer has been determined to be (a) eligible in accordance with the provisions of Clause 2, and qualified in accordance with the provisions of Clause 3.

27. EMPLOYER'S RIGHT TO ACCEPT ANY TENDER AND TO REJECT ANY OR ALL TENDERS

- 27.1 Notwithstanding Clause 26, the Employer reserves the right to accept or reject any Tender, and to cancel the Tender process and reject all Tenders, at any time prior to the award of Contract, without thereby incurring any liability to the affected Tenderer or Tenderers or any obligation to inform the affected Tenderer or Tenderers of the grounds for the Employer's action.

28. NOTIFICATION OF AWARD AND SIGNING OF AGREEMENT

- 28.1 The Tenderer whose Tender has been accepted will be notified of the award by the Employer prior to expiration of the Tender validity period by cable, telex, e-mail or facsimile confirmed by registered letter. This letter (hereinafter and in the *Conditions of Contract* called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").
- 28.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of Performance Security in accordance with the provisions of Clause 29. Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.
- 28.3 The Agreement will incorporate all agreements between the Employer and the successful Tenderer. It will be kept ready for signature of the successful Tenderer in the office of Employer within 30 days following the notification of award along with the Letter of Acceptance. Within 20 days of receipt, the successful Tenderer will sign the Agreement and deliver it to the Employer.
- 28.4 Upon the furnishing by the successful Tenderer of the Performance Security, the Employer will promptly notify the other Tenderers that their Tenders have been unsuccessful.

29. PERFORMANCE SECURITY

- 29.1 Within 20 days of receipt of the Letter of Acceptance, the successful Tenderer shall deliver to the Employer a Performance Security in any of the forms given below for an amount equivalent to **3% of the Contract price plus additional security for unbalanced tenders (additional security at 50% of the estimated cost of the unbalanced component)** in accordance with Clause 25.5 of ITT and Clause 43 of the Conditions of Contract.
- Banker's cheque/Demand draft, /Pay Order/ BG in favour of K-RIDE, Bangalore or
 - A bank guarantee in the form given in Section 10; or
 - Specified Small Savings Instruments pledged to K-RIDE, Bangalore.

- 29.2 If the Performance Security deposit is provided by the successful tenderer in the form of Bank Guarantee, it shall be issued either by a Nationalized / Scheduled bank.
- 29.3 The Performance Security deposit if furnished in cash or demand draft can, if requested, be converted to interest bearing securities at the cost of the contractor.
- 29.4 Failure of the successful tenderer to comply with the requirements of sub-clause 29.1 and clause 29 of additional ITT, shall constitute sufficient grounds for cancellation of the Tender award and forfeiture of the Earnest money deposit.

30. ADVANCE PAYMENT AND SECURITY:

- 30.1 The Employer will provide an advance payment on the contract price as stipulated In the condition of contract subject to the maximum as stated In the contract data.

31. CORRUPT OR FRAUDULENT PRACTICES

- 31.1 "corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of the public official in the procurement process or in contract execution;
- "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Procurement Entity, and includes collusive practice among the tenderers either prior to or after tender submission, designed to establish tender prices at artificial non-competitive levels and to deprive the Procurement Entity of the benefits of free and open competition;". The debarment action shall be taken as per KTPP Act.
- 31.2 K-RIDE requires that the Tenderers/Suppliers/Contractors observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, K-RIDE:
- a) will reject a proposal for award if it determines that the Tenderer recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;
 - b) will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a K-RIDE contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a K-RIDE contract.
- 31.3 Furthermore, Tenderers shall be aware of the provision stated in sub-clause 50.2 of the Conditions of Contract.

32. PURCHASE PREFERENCE TO MAKE IN INDIA:

The provisions of revised 'Public Procurement (Preference to Make in India) Order 2017' issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry vide letter no. P-45021/2/2017-PP (BE-II) dated 28.05.2018 shall be applicable to the tendering process and award of the contract shall be done accordingly. In this connection, the minimum local content shall be 50% and the margin of purchase preference shall be 20%. For award of contract, para 3.c. of the revised 'Public Procurement (Preference to Make in India) Order 2017' shall be applicable in addition to the other provisions in the tendering documents in this regard.

- 33. APPEAL:** The Tenderer shall submit online appeal within 30 days period from the date of receipt of order to the Employer through the Karnataka Public Procurement Portal. The Employer may after giving opportunity to the parties pass such order as it deems fit and such order shall be final.

K-RIDE

ADDITIONAL INSTRUCTIONS TO TENDERERS
(THIS SHOULD BE READ IN CONTINUATION OF ITT)

ITT Clause Ref.	Description
2.3	<p>The following paras are added:</p> <p>Wherever the word JV is mentioned, it should be read as JV/Consortium.</p> <p>For any purpose herein, 'Joint Venture' means an ad hoc association of firms that pool their resources and skills to undertake a large or complex contract in the role of "Contractor," with all firms (partners in the JV) being legally liable, jointly and severally, for the execution of the Contract in the event of a partner's withdrawal.</p> <p>A Tenderer may be a natural person, private entity, government-owned entity, or any combination of them with a format intent to enter into an agreement or under an existing agreement in the form of a Joint venture or consortium. The Tenderer must ensure the following</p> <p>(a) In case of Single Entity:</p> <p style="padding-left: 40px;">(i) Submit Power of Attorney authorizing the signatory of the Tender to commit the Tenderer.</p> <p>(b) In case of Joint Venture/ Consortium:</p> <p style="padding-left: 40px;">(i) The number of partners in the JV/ Consortium shall not be more than three.</p> <p style="padding-left: 40px;">(ii) At the time of bidding, the tenderer (JV) to submit the JV Agreement, as per the form given in Section 3: Qualification and Information/Bidding Forms. On issue of LOA, the JV/Consortium Agreement should be registered and shall be submitted along with the performance security.</p> <p style="padding-left: 40px;">(iii) The JV/ Consortium shall nominate a Representative through Power of Attorney (Form given in Section 3) who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV/ Consortium during the Tendering process and, in the event the JV/ Consortium is awarded the Contract, during contract execution.</p> <p style="padding-left: 40px;">(iv) Submit Power of Attorney by individual partners to lead partners as per the form given in Section 3.</p> <p style="padding-left: 40px;">(v) In case a Joint Venture/ Consortium is the successful Tenderer, the appropriate Joint Venture/ Consortium Agreement for execution of work should be entered by the Joint Venture/ Consortium partners. The duly signed Joint Venture/ Consortium Agreement should be submitted along with the tender submission.</p> <p style="padding-left: 40px;">(vi) The lead member as aforesaid shall be authorized to incur liabilities and receive instructions for and on behalf of any and all the partners of the Joint venture/Consortium and the entire execution of the contract.</p> <p style="padding-left: 40px;">(vii) All members of the Joint venture/Consortium shall be Jointly and severally responsible for the execution of the Contract.</p> <p style="padding-left: 40px;">(viii) Change in constitution or percentage participation of JV/Consortium shall not be permitted at any stage after submission of Tenders</p> <p>(c) Only firms that are registered or incorporated in India are eligible to compete. Any Tenderer from a country which shares a land with India will be eligible to Tender in this tender only if the Tenderer is registered with the Competent Authority.</p> <p>(d) "Tenderer from a country which share a land border with India" for the purpose of</p>

this Order means: -

1. An entity incorporated, established or registered in such a country; or
2. A subsidiary of an entity incorporated, established or registered in such a country; or
3. An entity substantially controlled through entities incorporated, established or registered in such a country; or
4. An entity whose beneficial owner is situated in such a country; or
5. An Indian (or other) agent of such an entity; or
6. A natural person who is a citizen of such a country; or,
7. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

(e) The beneficial owner for the purpose of above clause will be as under:

- (i) In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person(s), has a controlling ownership interest or who exercises control through other means.

Explanation-

- a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five percent of share or capital or profits of the company;
- b. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue their shareholding or management rights or shareholders agreements or voting agreements;
- (ii) In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;
- (iii) In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profit of such association or body of individuals;
- (iv) Where no natural person is identified under (i) or (ii) or (iii) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;
- (v) In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

2.4

The Tenderer shall submit a Certificate stating that they have read the above clause using the appropriate Performa given in Section 3 - Form 3C1 & 3C2.

Tenderer having a conflict of interest shall be disqualified. The conflict of interest is detailed below.

A Tenderer or any of its constituents shall not have conflict of interest. All Tenderers found to have a

conflict of interest shall be disqualified. A Tenderer may be considered to be in a conflict of interest with one or more parties in this Tendering process, if, including but not limited to::

- (a) they have controlling shareholders in common; or
- (b) they receive or have received any direct or indirect subsidy from any of them; or
- (c) they have the same legal representative for purposes of this Tender; or
- (d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Tender of another Tenderer, or
- (e) any firm, either individually or in Joint Venture (JV)/ Consortium, submits more than one offer irrespective of whether the firm is quoting against this Tender. The Tenders submitted by two different Tenderers, having any common participant in JV/ Consortium formation or any common partner in partnership firms, or an individual will be treated as having conflict of interest or
- (f) a Tenderer who is Sub-contractor to another Tenderer will be treated as having conflict of interest. However, this does not limit the inclusion of the same sub-contractor in more than one Tender.
- (g) a Tenderer participated as a consultant in the preparation of the design or specifications of the contract that is the subject of the Tender; or
- (h) A Tenderer was affiliated for any period(s) during last two years before the date of issue of Invitation for Tenders with a firm or entity that has been hired (or is proposed to be hired) by the Employer as Engineer for the contract.

2.5

The Tenderer shall be disqualified if,

- (a) The Tenderer or any of its constituents has been blacklisted/ banned from business dealings with all Government Departments by the Government of Karnataka or by Ministry of Railways or by K-RIDE at any time till finalization of Tenders, except in cases where such blacklisting/ banning has been withdrawn by Competent Authority or has ceased or expired on the deadline for submission of the Tenders, for which satisfactory evidence is to be produced.
- (b) Any previous contract of the Tenderer or any of its constituents had been fully terminated or part terminated for its failure as a JV/ Consortium partner with forfeiture of its full Performance Security, by Rail Infrastructure Development Company (Karnataka) Ltd.(K-RIDE) at any time starting from 3 years before the deadline for submission of Tenders and up to one day before the date of opening of price Tenders;

Provided, however, there is no stay order or declaration by any Court against such termination of the contract by Rail Infrastructure Development Company (Karnataka) Ltd. or such termination of the contract has not been revoked by Rail Infrastructure Development Company (Karnataka) Ltd or competent authority of K-RIDE has not passed an order of non-applicability of disqualification of the Tenderer or any of its constituents despite such termination.

- (c) The Tenderer or any of its constituents has been imposed delay damages of 5% or more of contract value by K-RIDE due to delay in the implementation of any previous contract within the period of last 2 years before the deadline for submission of Tenders (Period of 2 years shall be reckoned from the date on which the total accrued amount of Delay Damages has reached 5% or more of the contract price) or such accrued delay damages has not been fully recovered before the deadline for submission of Tenders on account of contractor's request for deferring recovery to maintain cash flow and K-RIDE has acceded to the same in the interest of the project or the work under the previous contract in question has not been completed before the deadline for submission

	<p>of Tenders, unless imposition of such delay damages has been set aside by the Competent Authority.</p> <p>(d) The Tenderer or any of its constituents:</p> <p>(i) has suffered bankruptcy/insolvency or</p> <p>(ii) has any ongoing case of insolvency before the NCLT/ any applicable Court where Interim Resolution Professional (IRP) has been appointed or is at any later stage of the insolvency process, as on the deadline of submission of Tenders or thereafter till finalization of Tenders.</p> <p>(e) The Tenderer is found ineligible by the Employer, in accordance with ITB-3.</p> <p>(f) The Tenderer or its constituent(s) has been declared by K-RIDE to be a poor performer and the period of poor performance is still in force on the deadline for submission of Tenders.</p> <p style="text-align: center;">OR</p> <p>The Tenderer or its constituent(s) has been declared by K-RIDE to be a poor performer at any time after the deadline for submission of Tenders and upto one day before the date of opening of price Tenders.</p> <p>(g) The Tenderer or any of its constituents has changed its name or created a new business entity as covered by the definition of "Allied Firm" under para 1102 (iii) of Chapter XI of Vigilance Manual of Indian Railways (available on website of Indian Railways), consequent to having been banned from business dealings or suspended from business dealings or having been declared poor performer.</p> <p>The Tenderer shall submit an affidavit stating that they are not liable to be disqualified as per this sub clause using the Form PS3 given in Section-3: Qualification and Information/Bidding Forms. Non-submission of an affidavit by the Tenderer shall result in summary rejection of his Tender.</p> <p>Tenderers shall immediately inform the Employer in case they cease to fulfil eligibility in terms of ITT clause 2 above. In case the Tenderer fails to inform the Employer or submits a false affidavit, his Tender shall be summarily rejected and Tender security shall be forfeited. The Tenderer shall also be liable for Banning of Business dealings for a period up to five years</p>
<p>2.6</p>	<p>PARTNERS IN CASE OF JV/CONSORTIUM</p> <p>(i) Lead partner must have a minimum of 50% participation in the JV/Consortium.</p> <p>(ii) Partners having 25% or more percentage participation shall be termed as substantial partner/other Partners.</p> <p>(iii) In case of JV/Consortium, change in constitution or percentage participation shall not be permitted at any stage after the bid submission.</p> <p>The bidder, in case of JV/Consortium, shall clearly and unambiguously define the role and responsibilities for each partner in the JV agreement submitted as per Form JV/4 of Section-3, providing clearly that any abrogation/subsequent re-assignment of any responsibility by any partner of JV/Consortium in favor of other JV/Consortium partner or any change in constitution of partners of JV/Consortium (without written approval of Client) from the one given in JV agreement at tender stage, will be treated, as 'breach of contract condition' and/or 'concealment of facts' as the case may be and acted accordingly. All Members of the JV/ Consortium must have experience in execution of similar work.</p>

3.3(a)	<p>The following para is added:</p> <p>Materials, Equipment and Services</p> <p>The materials, equipment and services to be supplied under the Contract shall be from the approved sources as specified in Section 8A: Works Requirements and Price Schedule Section-9.</p>
7.3	<p>The following para is added:</p> <p>The Employer is not responsible for the completeness of the Bidding Document and their Addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.</p> <p>The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the bid.</p>
8.3	<p>The following para is added:</p> <p>The Pre-Tender meeting may also be attended through video conferencing (VC). Those Tenderers who wish to join the Video Conferencing shall send a request email on the email id (i.e. gmcivil4@kride.in) by 16/12/2021 up to 15:00 hours IST, so that a link for Video Conferencing can be sent by K-RIDE.</p> <p>Please note that the request received from the Tenderers (With details of the Company, its address, and the name and designation of the person attending the VC) will only be entertained. They should also mention the email id through which VC is desired to be joined.</p> <p>K-RIDE may allow maximum of two email ids for one company to participate in the VC. Any request for VC received after the given date and time for sending the link for VC will not be entertained.</p> <p>Prospective Tenderers will be able to join the VC through the link provided to them on Email ID. During this pre- Proposal meeting, prospective Tenderers may request for clarifications.</p>
10.3	<p>The following para is added:</p> <p>Documents Comprising the Tender</p> <ul style="list-style-type: none"> • The Tender shall comprise of Tender Security/Tender Security Declaration, Technical Tender and Price Tender. The Tenderer shall submit the Tender through Karnataka Public Procurement Portal. • On the stipulated date of opening of Tenders, initially, only the Technical Tenders are opened through Karnataka Public Procurement Portal. The Technical Tenders shall be evaluated by the Employer in accordance with the stipulated Qualification and Evaluation criteria. No amendments or changes to the Technical Tenders would be permitted after the opening of technical Tenders. • Tenderers who are qualified in the technical evaluation their price Tender shall be opened at a date and time advised by the Employer(K-RIDE) through e-tendering portal. The Price Tenders are evaluated and the Contract is awarded to the Tenderer whose Tender has been determined to be the lowest evaluated substantially responsive Tender. <p>The Technical Tender shall contain the following:</p> <ul style="list-style-type: none"> • All the Forms of Section-3: Qualification Information/Bidding Forms including letter of technical Bid (LTB) shall be scanned and uploaded. • The Tenderer shall furnish a commitment in Letter of Technical Bid (LTB) for deployment of

equipment and personnel as stipulated in Section 8A: Employers Work's Requirement.

- The Tenderer shall furnish commitment in LTB for submitting construction method statement for all major activities of work and get this approved from the engineer prior to the commencement of work on that activity in case of award of contract.
- The Tenderer shall furnish a commitment in Letter of Technical Bid (LTB) for adhering to mobilisation and construction schedule as stipulated in Section 8A: Employers Work's Requirement.
- **Tenderer should note that non-submission of the Letter of Technical Bid (LTB) by the Tenderer shall result in summary rejection of his Tender.**
- Tenderer shall submit the Approach and Methodology for performing the assignment by using appropriate Performa given in Section 3: Qualification Information/Bidding Forms.
- Scanned copy of Tender Security/Tender Security Declaration form (Section 3), in accordance with ITT Clause 13;
- Scanned copy of written confirmation authorizing the signatory of the Tender to commit the Tenderer, any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Tender.
- Scanned copy of documentary evidence with establishing the Tenderer's qualifications to perform the contract; To establish its qualifications to perform the Contract in accordance with Section 2: ITT the Tenderer shall submit as part of its technical Tender the information requested in the corresponding information sheets included in Section 3: Qualification Information/Bidding Forms.

Domestic Tenderers, individually or in joint ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility

- Scanned copy of Approach and Methodology - Performa given in Section-3: Qualification Information/Bidding Forms
- Scanned copy of Joint Venture Agreement entered into by all partners

The Price Tender shall contain the following:

- Scanned copy of Letter of Price Tender.
- All Section-3 Documents shall be scanned and submitted.
- Filled/completed schedules as required including Price Schedule in accordance with ITT Clauses should be submitted through Karnataka Public Procurement Portal only;
- The Tenderer shall submit through Karnataka Public Procurement Portal, separate Technical Proposal and Price Proposal for each individual contract package, using the appropriate Submission Sheets furnished in Section-3: Qualification Information/Bidding Forms. These Forms must be completed without any alterations to their format, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.
- The Tenderer shall submit, as part of the Price Tender, the Schedules, including the Price Schedule through Karnataka Public Procurement Portal only.

11.5

The following para is added:**Tender Prices and Discounts**

- The prices quoted by the Tenderer in the Letter of Price Tender (LPB) and in the Price Schedule shall conform to the requirements specified below.
- In the Price Schedule, the amount against each schedule are to be quoted. From this, price of such schedules has been worked out and indicated in the summary sheet in the Price Schedule. The Tenderer shall quote lumpsum amount in figures and words as per format for such schedule in the summary sheet. **If any Tenderer quotes more than one Amount for such schedules, its Tender shall be summarily rejected.**
- The Tenderer shall fill in the amount against each schedule of the price schedule. **Items against which no amount or price is entered by the Tenderer will not be paid for by the Employer when executed and shall be deemed to be covered by the lumpsum amount quoted in the Price Schedule.**
- The price to be quoted in the Letter of Price Tender, in accordance with ITT, shall be the total price of the Tender.
- The Tenderer shall quote any unconditional discounts/rebate and the methodology for their application (the discounts/rebate, and the methodology of their application, should be quoted on prices quoted in the Tender so that the discounts/rebate can be evaluated by simple arithmetic calculation during financial evaluation of the Tenders, to arrive at the net total price of the Tender. If the net total price cannot be calculated after application of the methodology of the discount(s) /rebate quoted, the Tender shall be considered as incomplete and will be rejected) in the Letter of Price Tender, in accordance with ITT. However, any conditional discount/rebate if any offered for award of contract package has to be quoted separately as applicable in Letter of Price Tenders. If Tenderer is not offering any discount/rebate for award of combination of contract package, then Tenderer has to quote NIL (zero) discount/rebate offered.
- The Tenderer can modify his/her Tender and resubmit it any number of times through Karnataka Public Procurement Portal before the deadline for submission of Tenders. Any other correspondence in connection with the Tender is not permissible and shall not be considered in Tender evaluation.
- Unless otherwise provided in the ITT and the Contract, the lumpsum amount quoted by the Tenderer are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract. In such a case, the indices and weightages for the price adjustment formulae shall be as specified in the Tables of Adjustment Data included in Contract Data.
- If so, indicated in ITT 1, Tenders are being invited for individual contracts or for any combination of contracts (packages). Tenderers wishing to offer any price reduction for the award of more than one Contract shall specify in their Tender the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts/rebate shall be submitted in accordance with ITT, provided the Tenders for all contracts are submitted and opened at the same time.
- All duties, taxes including GST, royalties, cess and other levies payable by the Contractor under the Contract, or for any other cause (including standard specifications), as of the date 28 days

	<p>prior to the deadline for submission of Tenders, shall be included in the lumpsum amount of Price Schedule and the total Tender Price submitted by the Tenderer. GST shall be paid by the Tenderer as applicable in accordance with the prevailing rules of Government of India.</p> <ul style="list-style-type: none"> • Tenderers should note that during the progress of the works, the foreign currency requirements of the outstanding balance of the Contract Price may be adjusted by agreement between the Employer and the Contractor in order to reflect any changes in foreign currency requirements for the Contract, in accordance with Sub-Clause 14/ITT (Currencies of Bid and Payment) of the Conditions of Contract. Any such adjustment shall be affected by comparing the percentages quoted in the Tender with the amounts already used in the Works and the Contractor's future needs for imported items. • Tenderer should note that non-submission of the Letter of Price Tender (LPB) and Summary sheet of Price Schedule by the Tenderer shall result in summary rejection of his Tender. • Online alternative Price Tender corresponding to the alternative Technical Tender, if permissible, in accordance with ITT Clause 14;
13.7	<p>The following para is added:</p> <p>In this tender, the tender security/ EMD need not be paid. Tender security declaration as per form BDF-1 has to be submitted.</p> <p>The Tender security shall be, at the Tenderer's option, in any of the following forms:</p> <p>(a) A Cashiers or Banker's certified cheque or Bank draft drawn on a Scheduled/Nationalized Bank in India in favour of "Rail Infrastructure Development Company (Karnataka) Ltd" payable at Bengaluru;</p> <p style="text-align: center;">or</p> <p>(b) An unconditional bank guarantee using the Form given in Section 3: Qualification Information and Bidding Forms. The bank guarantee shall be from a bank having minimum net worth of over INR 500 million from the specified banks as under:</p> <ul style="list-style-type: none"> (i) a Scheduled Bank in India, or (ii) a Foreign Bank having their operations in India, or (iii) a Foreign Bank which do not have operations in India is required to provide a counter-guarantee by State Bank of India, <p>(c) The Scheduled Bank issuing the Bank Guarantee must be on "Structure Financial Messaging System (SFMS)" platform. A separate advice of the BG shall be invariable be sent by the issuing bank to the Employer's Bank through SFMS and only after this the BG shall become operative and acceptable to the Employer.</p> <p>Further, the Tender Security in Original form along with a copy of "MT760COV (in case of Bank Guarantee message) / MT767COV (in case of Bank Guarantee amendment message) Report" sent by the BG issuing Bank Sealed in an envelope shall be submitted, as stated in ITT 15.</p> <p>The Issuing Bank shall send the SFMS to: Beneficiary: Rail Infrastructure Development Company (Karnataka) Limited (K-RIDE) Bank Name: Canara Bank Branch: Prime Corporate Branch Account No. 0430201012110</p>

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The Tender security shall be valid up to 45 days beyond tender validity, or up to the date mentioned in the letter of request for extension, if any under ITT 12.

In case the Tenderer has opted for Tender security in the form of an unconditional Bank Guarantee, the Tenderer should upload the scanned copy of Bank Guarantee with the Tender. The original Bank Guarantee should be delivered in person to the official nominated as indicated in the Tender data sheet within 5 working days of deadline of submission of Tenders. Non submission of scanned copy of Bank Guarantee with the Tender on e-tendering portal and/or non-submission of original Bank Guarantee within the specified period shall lead to summary rejection of Tender. The details of the BG, physically submitted should match with the details available in the scanned copy and the data entered during Tender submission time, failing which the Tender will be rejected.

- a. Unless otherwise specified in the BDS, any Tender not accompanied by an enforceable and compliant Tender security as required in accordance with ITT, shall be summarily rejected by the Employer as non-responsive.
- b. The Tender security of the Tenderer who have been determined to be unqualified for opening of their financial Tender shall be returned within 3 working days after the opening of financial Tender. The Tender security of unsuccessful Tenderers shall be returned within 7 working days after issue of LOA to the successful Tenderer.
- c. The Tender security of the unsuccessful Tenderer shall be returned as promptly as possible once the successful Tenderer has signed the Contract and furnished the required performance security.
- d. The Tender security may be forfeited:
 - (a) if a Tenderer withdraws its Tender during the period of Tender validity specified by the Tenderer on the Letter of Tenders, except as provided in ITT Clause 12 or
 - (b) if a Tenderer misrepresents or omits the facts in order to influence the procurement process;
 - (c) if the successful Tenderer fails to:
 - (i) sign the Contract in accordance with ITT Clause 28;
 - (ii) furnish a performance security in accordance with ITT 29;
 - (iii) accept the correction of its Tender Price pursuant to ITT 24; or
 - (iv) furnish a domestic preference security if so required.
 - (d) if the undertaking of the affidavit submitted by the Tenderer or its constituents in pursuance to ITT clause 2 or any of the declarations of Letter of Technical Tender or Letter of Price Tender submitted by the Tenderer has been found to be false at any stage during the process of Tender evaluation.
- e. The Tender Security of a JV/ Consortium shall be in the name of the JV/ Consortium that submits the Tender or the lead member of the JV/Consortium. If the JV/ Consortium has not been legally constituted at the time of Tendering, the Tender Security shall be in the names of all future partners as named in the letter of intent/ of JV/ Consortium mentioned in ITT Clause 2)

14	<p>The following para is added:</p> <p>The Tender, as well as all correspondence and documents relating to the Tender exchanged by the Tenderer and the Employer, shall be written in English. Supporting documents and printed literature that are part of the Tender may be in another language provided they are accompanied by an accurate translation of the relevant passages in English in which case, for purposes of interpretation of the Tender, such translation shall govern</p>
15	<p>The following para is added:</p> <p>Sealing and Marking of Tenders</p> <p>The Tenderer shall submit the technical Tender, Price Tender and the Tender Security/Tender Security Declaration through Karnataka Public Procurement Portal i.e., https://eproc.karnataka.gov.in. The original of the Technical Proposal, which will contain all Forms of Section 3 except Forms PS 2 and Price Schedule Section 9 and all other relevant data specified in the Tender document.</p> <p>The Price Bid, shall be submitted through Karnataka Public Procurement Portal only. This “PRICE BID” will contain only Forms PS 2 of Section 3 & Price Schedule and all other relevant data specified in this Tender document. All forms should be typed on the Tenderer’s letter head as per the exact format of the Forms.</p> <p>The above forms should be scanned and submitted through Karnataka Public Procurement Portal.</p> <p>No details about price proposal shall be disclosed directly or indirectly in the technical proposal failing which the Tender shall be rejected. Only Electronic Tender submission and opening procedure permitted.</p>
19.7	<p>The following para is added:</p> <p>Tender Opening</p> <ul style="list-style-type: none"> • The Employer shall conduct the opening of Technical Tenders through Karnataka Public Procurement Portal i.e., https://eproc.karnataka.gov.in on the date and at the time mentioned. • The date and time of the opening of Price Tenders will be announced through Karnataka Public Procurement Portal • At the end of the evaluation of the Technical Tenders, the Employer will intimate Tenderers who have submitted substantially responsive technical proposals and who have been determined as being qualified for award to attend the opening of the price Proposals. The date and time, of the opening of Price Tenders will be advised through email/e-procurement. Tenderers shall be given reasonable notice for the opening of Price Tenders. • The Employer will notify Tenderers in writing who have been rejected on the grounds of being substantially non-responsive to the requirements of the Tendering Document and who have been determined as being not qualified as a result of evaluation of technical proposal and their Price Tender shall not be opened. The Tender security of the Tenderers shall be returned as per due process. • The Employer shall conduct the opening of Price Tenders through Karnataka Public Procurement Portal i.e., https://eproc.karnataka.gov.in of all Tenderers who have submitted substantially responsive Technical Tenders and who have been determined qualified as a result of technical evaluation.

23.4	<p>The following para is added:</p> <p>Deviations, Reservations, and Omissions</p> <p>During the evaluation of Tenders, the following definitions apply:</p> <p>(a) "Deviation" is a departure from the requirements specified in the Tendering Document;</p> <p>(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Tendering Document; and</p> <p>(c) "Omission" is the failure to submit part or all of the information or documentation required in the Tendering Document.</p>
24.3	<p>The following para is added:</p> <p>Nonconformities, Errors, and Omissions</p> <ul style="list-style-type: none"> • Provided that a Tender is substantially responsive, the Employer may waive any nonconformities in the Tender that do not constitute a material deviation, reservation or omission. • Provided that a Tender is substantially responsive, the Employer may request the Tenderer to submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Tender related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the price of the Tender. Failure of the Tenderer to comply with the request may result in the rejection of its Tender.
24.4	<p>The following para is added:</p> <p>Correction of Arithmetical Errors and Omissions in Tender and Evaluation of Tender Price</p> <ol style="list-style-type: none"> 1. Provided that the Tender is substantially responsive, the Employer shall correct arithmetical errors and omissions in the Tender and then arrive at the Evaluated Tender Price on the following basis: <ol style="list-style-type: none"> (a) If there is a discrepancy between the price mentioned in the summary sheet of the Price Schedule and the price that is obtained by calculation i.e., addition of each schedule in the summary sheet of Price Schedule, then the quoted amount of each schedule shall prevail and the price shall be corrected accordingly. (b) if the amount has been quoted both in words and in figures and there is a discrepancy in such amount, then the lower of the two shall prevail and shall be considered for evaluation of the price of the schedule. (c) If the amount has been quoted either in words or in figures only, then the same shall be considered for evaluation of the price of the schedule. (d) If no amount has been indicated for any particular schedule in words, as well as in figures, irrespective of the fact whether the Tenderer has written or not written, in such cases, the lumpsum amount of the schedule shall be considered as zero and shall be calculated accordingly; (e) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected. (f) The amount for each schedule shall first be calculated after applying discount(s) /rebate to the Schedule and the net amount shall be rounded off to a Rupee. Thereafter, evaluated price of the schedules shall be added as the sum of amounts in grand summary sheet and sum of evaluated prices of all schedules shall be the overall Evaluated Tender Price. 2. If the Tenderer has submitted the lowest evaluated Tender does not accept the correction of

	errors and omissions as per above provisions, its Tender shall be disqualified and its Tender security shall be forfeited or its Tender-Securing Declaration executed.
25.6	<p>The following para is added:</p> <p>Conversion to Single Currency</p> <p>For evaluation and comparison purposes the currencies of the Tender shall be converted into Indian Rupees as stated in BDS.</p> <p>An Abnormally Low Tender is one in which the Tender price, in combination with other elements of the Tender, appears so low that it raises material concerns as to the capability of the Tenderer to perform the contract at the offered price. The Employer may in such cases seek written clarifications from the Tenderer, including detailed price analysis of its Tender price in relation to scope, schedule, allocation of risks and responsibilities, and any other requirements of the Tender document. If, after evaluating the price analyses, the Employer determines that the Tenderer has substantially failed to demonstrate its capability to deliver the contract at the offered price, the Employer may reject the Tender/ proposal.</p> <p>Additional Performance Security in case of abnormally low Tenders will have to be submitted.</p> <p>The calculation sheet is as below:</p> <p>If the bid, which results in the lowest Evaluated Bid Price is substantially on lower side and/or seriously unbalanced in the opinion of the Employer as per criteria defined below, the Employer may require the bidder to submit additional performance security as under: -</p> <p>a) If overall price quoted by the L1 bidder is below the engineer's estimated price by more than 10% and the difference between overall price quoted by the L1 and L2 is more than 5% of the estimated price, then the bid price of L1 bidder shall be treated as substantially on lower side and such bidder shall be bound to furnish additional performance security equal to the $(0.9 \times \text{engineer's estimated price} - \text{L1 price})$ or $(0.95 \times \text{L2 price} - \text{L1 price})$ whichever is lower, on this account. Example below demonstrates the method of calculation to arrive at additional performance security:</p> <p>Suppose overall price quoted by the L1 bidder is 17% below the estimated price and the overall price quoted by L2 bidder is 8% below the estimated price. In this case the overall price quoted by the L1 bidder is lower by more than 10% of the estimated price and also the difference between overall price quoted by the L2 and L1 bidder is more than 5% of the estimated price, hence the L1 bidder shall be required to furnish additional performance security for an amount equal to $\{0.9 \times \text{engineer's estimated price} - (1-17/100) \times \text{engineer's estimated price}\} = \{0.07 \times \text{engineer's estimated price}\} = 7\%$ of engineer's estimated price or $\{0.95 \times (1-8/100) \times \text{engineer's estimated price} - (1-17/100) \times \text{engineer's estimated price}\} = \{0.044 \times \text{engineer's estimated price}\} = 4.4\%$ of engineer's estimated price; whichever is lower.</p> <p>As per the above L1 bidder shall be required to submit additional performance security of 4.4% of engineer's estimated price.</p> <p>b) If for any bill/ schedule of quantities % age above or below quoted by the bidder on the estimated price is beyond 15% below the overall % age difference between the quoted contract price and the engineers estimated price, then the price for that particular schedule shall be treated as seriously unbalanced and bidder shall be bound to furnish additional performance security for such unbalanced price. Example below demonstrates the method of calculation to arrive at unbalanced price and additional performance security:</p> <p>Suppose for the L1 bidder overall % age difference between quoted contract price and the engineers estimated price;</p>

SECTION:2: - INSTRUCTIONS TO TENDERERS (ITT)

	<p>(Overall contract price – Overall estimated price) x 100 ÷ overall estimated price = + 4 %</p> <p>Maximum % age below permitted over estimated price of any bill / schedule in this case = +4 – 15 = -11%</p> <p>Suppose for the L1 bidder has quoted 20% below estimated price then the pricing shall be treated as unbalanced and the bidder shall be required to furnish additional performance security for an amount equal to (20 – 11) % of the estimated price.</p>
26.2	<p>The following para is added:</p> <p>Award Criteria</p> <ul style="list-style-type: none"> • The Employer shall award the Contract to the Tenderer whose Tender is substantially responsive to the Tendering Document, provided further that the Tenderer is determined to be qualified to perform the Contract satisfactorily and whose offer has been determined to be the lowest evaluated subject to ITT below. In case of more than one Tenders are evaluated to be lowest, Contract shall be awarded to the Tenderer having higher average annual construction turnover (calculated as total certified payments received for contracts in progress or completed) in equivalent INR within the last Two financial years. • The Employer has the right to review at any time prior to award of contract that the qualification criteria as specified in Section-3: Qualification Information and Bidding Forms are still being met by the Tenderer whose offer has been determined to be the lowest evaluated Tender. A Tender shall be rejected if the qualification criteria as specified in Section-3: Qualification Information and Bidding Forms are no longer met by the Tenderer whose offer has been determined to be the lowest evaluated Tender. In this event the Employer shall proceed to the next lowest evaluated Tender to make a similar reassessment of that Tenderer's capabilities to perform satisfactorily.
29.5	<p>The following para is added:</p> <p>Performance Security</p> <p>The successful Tenderers shall have to submit a Performance Guarantee (PG) Within twenty (20) days from the date of issue of Letter of Acceptance (LOA). Extension of time for submission of PG beyond 20 days up to 60 days from the date of issue of LOA may be given by the authority who is competent to sign the contract agreement. However, a penal interest of 12% of per annum shall be charged for the delay beyond 20 days, i.e. From 21nd day after the date of issue of LOA. Further if the 60th day happens to be declared holiday in the office of K-RIDE, submission of PG can be accepted on the next working day.</p> <p>In all other cases if the contractor fails to submit the requisite PG even after 60 days from the date of issue of LOA, the contract is liable to be terminate. In case contract is terminated K-RIDE shall be entitled to forfeit the Tender security and other dues payable against to the contract. In case the tenderer has not submitted by security on the strength of their registration as a start-up recognized by the Department of Industrial Policy and Promotion (DIPP) under Ministry of Commerce and Industry, DIPP shall be informed to this effect. The failed contractor shall be debarred from participating in re-tender for that work.</p> <p>Failure of the successful Tenderer to submit the above-mentioned Performance Security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the Tender security or execution of the Tender-Securing Declaration.</p> <p>The above provision shall also not apply to the furnishing of a Domestic Preference Security, if so required.</p>
New	LITIGATION HISTORY: (Please see Annexure Tendering Forms).

SECTION:2: - INSTRUCTIONS TO TENDERERS (ITT)

<p>Clause-1</p>	<p>The Tenderer/Tenderers should provide accurate information on any litigation or arbitration resulting from contracts completed or under its execution over the last five years as on date of submission of this tender.</p> <p>If the litigation started by the Tenderer without recourse to measures of Dispute Resolution and Arbitration as provided in the Contract or the litigation in respect of challenge of award of Arbitration by the Tenderer, will be treated as Litigation case indulged by the Tenderer for this Para of Litigation History. A consistent history of awards against the Applicant or any partner of a joint venture may result in failure of the application.</p> <p>Note: Tenderers including each of the partners of a Joint Venture, should provide information on any history of litigation or Arbitration resulting from contracts executed in the last 5 years as on date of submission of this tender. A separate sheet should be used for each partner of a Joint Venture</p>
<p>New Clause-2</p>	<p>Jurisdiction of Courts</p> <p>The Tendering process shall be governed by and construed in accordance with the laws of India and the Courts as indicated in Tender Data Sheet shall have exclusive jurisdiction over all the disputes/issues arising under, pursuant to and/ or in connection with the Tendering process. The Jurisdiction of Courts is Bengaluru, Karnataka</p>
<p>New Clause-3</p>	<p>Stamp duties and charges:</p> <p>The contractor has to bear the stamp duties and charges for agreements/ registration.</p>

SECTION-3

QUALIFICATION INFORMATION/BIDDING FORMS

INDEX**SECTION-3: QUALIFICATION INFORMATION/BIDDING FORMS**

This Section contains the forms which are to be completed by the Bidder and to be submitted as part of this Bid.

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34.	Undertaking from specialist sub-contractor	Form CL-2	92
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36.	Evidence of Availability of Credit Line Financial Resources	Form CL-4	94
37.	Work Experience Certificate	Form EXP-1	95

A) QUALIFICATION INFORMATION/BIDDING FORMS

1. QUALIFICATION INFORMATION

The information to be filled in by the Tenderer hereunder will be used for purposes of computing Tender capacity as provided for in Clause 2 of the Instructions to Tenderers. This information will not be incorporated in the Contract.

1.1. Constitution or legal status of Tenderer

Place of Registration: _____ [Attach copy]

Principal place of business: _____ [Attach Copy]

1.2. Total value of construction works executed and payments received in the preceding five Financial Years. (Rs. In Crores) (attach certificate from Statutory Auditors)

2016-2017: -----

2017-2018: -----

2018-2019: -----

2019-2020: -----

2020-2021: -----

K-RIDE

1.3. **Work performed as Contractor (in the same name) on works of similar nature over during the five financial years specified in 1.2 above.** (Refer para 3.2 b (I) and 3.2 b(II) of section :2 ITT)

Project Name	Name of Employer	Description of Work	Contract Number	Value of contract Rs. Cr.	Date of Issue of work order	Specified period of completion	Actual date of completion	If partner in a JV/ Consortium, specify participation in total contract amount	Remarks explaining reasons for delay in completion of work
1	2	3	4	5	6	7	8	9	10

Project Name	Name of Employer	Description of Work	Contract Number	Value of contract Rs. Cr.	Date of Issue of work order	Specified period of completion	Actual date of completion	If partner in a JV/ Consortium, specify participation in total contract amount	Remarks explaining reasons for delay in completion of work
1	2	3	4	5	6	7	8	9	10

Note:

- (1) If the qualifying work of similar nature is done by a joint venture/consortium, then Value shall be considered as per percentage participation by the member(s) in that joint venture/consortium.
- (2) Value of *similar nature of work completed shall be updated to 2021-22 price level as per table given below.

Financial year	2016-17	2017-18	2018-19	2019-20	2020-21
Indian Currency					
Foreign Currency					

- (3) For completed works, the value of work done shall be updated to current FY 2021-22 price level assuming 10% inflation for Indian rupees every year or part thereof up to the month previous to the Bid submission month. Credentials if submitted in foreign currency shall be converted into Indian currency i.e., Indian Rupee as under: Bids will be compared in Indian Rupees only. The exchange rate of foreign currency shall be applicable 28 days before the tender submission date. For conversion of foreign currency to Indian Rupee exchange rates published by Financial Benchmarks Private limited (www.fbil.org.in) 28 days before the date of bid submittal will be considered. In case the particular day happens to be a holiday the exchange rate published on the next working day will be considered. In case of works in foreign currency the effect of inflation

is considered as included, as the exchange rate prevailing 28 days before tender submission is being considered for conversion to Indian Rupees,

The bidder shall attach a copy of the Certificate(s) issued by the employer in support of the information being furnished in the above form, failing which the claim of the bidder shall be liable to be rejected (in case of experience as a sub-contractor, the employer shall be the owner of the Project who has engaged the main Contractor).

SEAL AND SIGNATURE

K-RIDE

1.4. Quantities of work executed as contractor (in the same name) during the last five financial years.

Year	Name of Work	Name of Employer	Quantity of work performed (As mentioned in Qualification of the Tenderer Clause 3.2)					Remarks (Indicate contract reference No., Award Date, Completion date, Role in contract, total contract amount, JV participation proportion)
			Completion of PSC Super structure launching (Km)	Completion of 40 m Pre-cast PSC girder/ steel I girder (No.)	Earthwork in cutting and embankment (In Cum)	RCC and PSC Concrete (In Cum)	Detailed Design Experience	
2016-2017								
2017-2018								
2018-2019								
2019-2020								
2020-2021								

Note:

- 1) Copy of Certificate(s) issued by the employer in support of the information being furnished above, shall be attached with each respective form, as per detailed requirements indicated in clause 3.2 (c) and 3.2 (d) of Section 2 failing which the claim of the bidder shall be liable to be rejected (in case of experience as a sub-contractor, the employer shall be the owner of the Project who has engaged the main Contractor).

SEAL AND SIGNATURE

1.5. Information on works for which Tenders have been submitted and works which are yet to be completed as on the date of this Tender.

(A) Existing commitments and on-going works:

Description of Work	Place & State	Contract No. & Date	Name and Address of Employer	Value of Contract (Rs. In Crores)	Stipulated period of completion	Value of works remaining to be completed (Rs. In Crores) (Attach certificate from Engineer in charge)	Anticipated date of completion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

(B) Works for which Tenders already submitted:

Description of Work	Place & State	Name and Address of Employer	Estimated value of works (Rs. In Crores)	Stipulated period of completion	Date when decision is expected	Remarks if any
(1)	(2)	(3)	(4)	(5)	(6)	(7)

- 1.6. The following items of equipment are considered essential for successfully carrying out the works. The Tenderer should furnish all the information listed below. (The item of the equipment required nos and capacity should match with those specified in ITT clause 3.3(a))

Item of Equipment	Requirement			Owned and available nos/Age/Capacity/Condition	Remarks (The details of hired/leased equipment details to be indicated)
	Nos	Capacity	Owned		

- 1.7. Reports on the financial standing of the tenderer, such as profit and loss statements and auditor's reports for the last five years;
- 1.8. Qualification and experience of the key technical and management personnel in permanent employment with the tenderer and those that are proposed to be deployed on this contract, if awarded.
- 1.9. Name, address, and telephone, telex, and fax numbers of the Tenderers' bankers who may provide references if contacted by the Employer.
- 1.10. Evidence of access to financial resources to meet the qualification requirement specified in ITT Clause 3.3 (b): Cash in hand, Letter of Credit etc. List them and attach certificate from the Banker in the suggested format given in Section 3, Form No.CL3 & CL4.
- 1.11. Proposals for subcontracting components of works amounting to more than 20% of the contract price.

Item of Work	Value of Sub-Contract	Identified Sub-Contractor (Name and Address)	Experience of similar works (Attach Certificates from the respective Employers)	Remarks (Undertaking from Specialist subcontractors to be provided as per Form CL-2)

- 1.13. The proposed methodology and program of construction, backed with equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications within the stipulated period of completion as per milestones.

APPROACH & METHODOLOGY PROPOSED FOR PERFORMING THE ASSIGNMENT

Name of Project: “

The approach and methodology will be detailed precisely under the following topics:

1. Understanding of the assignment
2. Work Breakdown structure/ Work plan.
3. Composition of the Team
4. Organizational set up/ Construction methodology for execution of the work as outline in Section 8A
5. Documentation and procedures to be prepared, adopted and furnished to K-RIDE (Rail Infrastructure Company (Karnataka) Limited.)
6. Reporting Procedure
7. Sourcing of Material

Note:

- i. The approach and methodology should be precise and relevant to the assignment. Include Bar charts.

B) ADDITIONAL QUALIFICATION INFORMATION/BIDDING FORMS

Form: PS1

LETTER OF TECHNICAL BID

(Seperately for each Package)
Date.....

Invitation for Bid No.:.....

To,
.....

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Tenderer (ITT);
- (b) We offer to execute the Works in conformity with the Bidding Documents;
- (c) Our bid shall be valid for a period of 180 days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (d) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;
- (e) If our bid is accepted, we commit to deploy key equipment and key personnel consistent with the requirements stipulated in Section 8A: Works Requirements.
- (f) If our bid is accepted, we commit to submit work method statements for all major activities and get these approved from the engineer prior to commencing work on such activities. We also understand that the work shall be executed as per the approved method statements and KEY DATES without any deviations and delay in completion.
- (g) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITT clause 2.4;
- (h) We declare that we are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process in accordance with ITT clause 2.2, other than alternative offers submitted in accordance with ITT clause 14;
- (i) We declare that we are not liable to be disqualified in Accordance with ITT clause 2.5, and we are enclosing the affidavit for the same as per the Performa given in the bid document.

- (j) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and
- (k) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and invocation of bid security declaration, the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.
- (l) We understand that we will be considered for participating for which we have submitted the bid security(ies) declaration form and we will be considered for award, subject to fulfilling the eligibility criteria as given in bidding document;
- (m) If our bid is accepted, we opt to take payment into the bank account, nominated by us.
- (n) We declare that the submission of this bid confirms that no agent, middleman or any intermediary has been, or will be engaged to provide any services or any other item of work related to the award and performance of this contract. We further confirm and declare that no agency commission or any payment which may be construed as an agency commission has been, or will be, paid and that the bid price does not include any such amount. We acknowledge the right of the Employer, if he finds to the contrary, to declare our bid to be noncompliant and if the contract has been awarded to declare the contract null and void
- (o) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.
- (p) A Power of Attorney to sign and submit this letter is attached.
- (q) Having inspected the site, examined the complete bid document including Employer's requirements, Conditions of Contract, Special Conditions of Contract, particular conditions of Contract, Technical Specifications, Safety, Health & Environment (SHE) manual, Eligibility Cum Qualification Criteria, Instructions to Bidder and Addenda/Corrigendum etc., thereto (if any) for above mentioned work and prepared the bid entirely in accordance with all the requirements of the bid document and agree entirely with them.
- (r) We here by confirm that we have visited the sites of work and have become conversant with the local conditions of working.
- (s) For the purpose of your evaluation, study, review and decision-making we are ready to let you inspect our business premises / site, etc.
- (t) We authorize K-RIDE or any of their authorized representative to approach, enquire, verify and check the matter furnished in our submission with the concerned client / owner of the Project / Contract and the concerned Banker of reference provided by us.
- (u) We undertake to hold in confidence all documents and information whether Technical or Commercial supplied to us at any time by or on behalf of K-RIDE in connection with this bid and without your written authority or as otherwise required by law not to publish or otherwise disclose the same.

- (v) If our bid is accepted, we agree to establish our project office in Bangalore.
- (w) We have submitted the Statement of Integrity, Eligibility, Social, and Environmental Responsibility signed and abide by the same.
- (x) We understand that this Bid shall be governed by and construed in all respects according to the laws for the time being force in India. The courts at Bangalore will have exclusive jurisdiction in the matter.
- (y) We undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988".

We hereby confirm that this Tender complies with the Tender validity and Earnest money deposit required by the Tender documents.

- (z) We confirm and declare that by virtue of our signature below, to the best of knowledge and belief that the information provided by us as required in this Bid Document, all supporting and explanatory information is truthful and exact.

Name.....

..... In the capacity

of.....

.....

Signed

.....

.....

Duly authorized to sign the Bid for and on behalf of

.....

Date

.....

.....

(SEAL AND SIGNATURE OF THE BIDDER)

LETTER OF PRICE BID

(To be separately given for each package on the Letter head of the Firm)

Date.....

Invitation for Bid No.....

To,
.....

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITT) 9;
- (b) We offer to execute the Work in conformity with the Bidding Documents;
- (c) The total price of our Bid is indicated in the Price Bid **Section 9: Price Schedule.**
- (d) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and
- (e) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and forfeiture of bid security/the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.
- (f) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name.....

In the capacity of

Signed

Duly authorized to sign the Bid for and on behalf of

Date

Seal

Form: PS 3**FORMAT FOR AFFIDAVIT TO BE SUBMITTED BY BIDDER ALONGWITH THE BID**

(To be separately given for each package)

*(To be executed in presence of Public Notary on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper has to be in the name of the bidder) ***

I **(Name and designation)** ** appointed as the attorney/authorized signatory of the bidder (including its constituents), M/s. _____ (hereinafter called the bidder) for the purpose of the Bid for the work of _____ as per the bid No. _____ of K-RIDE, do hereby solemnly affirm and state on behalf of the bidder including its constituents as under:

- *1. That the bidder or any of its constituents has not been Blacklisted/ banned for business dealings for all Government Departments or by Ministry of Railways or by K-RIDE at any time and/or no such blacklisting is in force as on the deadline for submission of bids.
- *2. That none of the previous contracts of the bidder or any of its constituents had been terminated/rescinded for Contractor's failure or part terminated for its failure as a JV/ Consortium partner with forfeiture of its full Performance Security, by Rail Infrastructure Development Company (Karnataka) Ltd. during the period of last 3 years before the deadline for submission of bids.

(Add Proviso of Clause 2, (ITT) suitably, if any Contract was so terminated).

- *3. The bidder or any of its constituents has not been imposed liquidated damages of 5% or more of contract value by any Government Department or by Ministry of Railways or by K-RIDE due to delay in the implementation of any previous contract (either in the capacity of a single entity or as constituent of any other JV/ Consortium) within the period of last 2 years before the deadline for submission of bid [*2 years shall be reckoned from the date on which imposed L.D. has exceeded 5% of the contract price*] and there are no such accrued delay damages which has not been fully recovered before the deadline for submission of bids on account of contractor's request for deferring recovery to maintain cash flow and K-RIDE has acceded to the same in the interest of the project and the work under the previous contract in question has been completed before the deadline for submission of bid, unless imposition of such delay damages has been set aside by the Competent Authority.
4. That the Bidder or any of its constituents is neither Bankrupt/Insolvent nor is in the process of winding-up nor is such a case pending before any Court on the deadline of submission of the bid.
- *5. That the name of the Bidder or any of its constituents is not on the list of "Poor Performer" of any Government Department or by Ministry of Railways or by K-RIDE as on the deadline for submission of bid.
6. We declare that the bidder or any of its constituents have not either changed their name or created a new business entity. Consequent to having been banned business dealings for specified period which is not over or suspended business dealings or having been declared as poor performer.

7. We declare and certify that balance sheets for last five financial years including that for the latest concluded financial year are being submitted.

OR

We declare and certify that balance sheet for the latest concluded financial year has not been finalized till date and that is why we are furnishing financial data for last five financial years ignoring the latest concluded financial year.

*(# - Delete whichever is not applicable) **.*

8. We declare and certify that we have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.
9. We declare that the information and documents submitted along with the bid by us are correct and we are fully responsible for the correctness of the information and documents, submitted by us.
10. We understand that in case we cease to fulfil the requirements of qualifying and eligibility criteria at any time after opening of bids and till finalization of bids, it will be our bounden duty to inform the Employer of our changed status immediately and in case of our failure to do so, our bid shall be rejected and bid security declaration form shall be forfeited. In case such failure comes to the notice of Employer at any time after award of the contract, it will lead to termination of the contract and forfeiture of Bid or Performance Security. We shall also be liable for Banning of Business dealings up to a period of five years.
11. We understand that if the contents of the affidavit are found to be false at any stage during bid evaluation, it will lead to rejection of our bid and forfeiture of the bid security. Further, we *[insert name of the bidder]* ** _____ and all our constituents understand that we shall be liable for banning of business dealings up to a period of five years.
12. We declare and certify that we have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.
13. We also understand that our offer will be evaluated based on the documents/credentials submitted alongwith the offer and same shall be binding upon us.
14. We declare that the information and the document submitted along with the tender by us are correct and we are fully responsible for the correctness of the information and documents, submitted by us.
15. We undersigned that if the certificate regarding Eligibility Criteria submitted by us are found to be forged/false or incorrect at any time during process for evaluation of tenders, it shall lead to forfeiture of the tender EMD besides banning of business for five years in K-RIDE. Further, we (Insert name of the Tenderer)** and all our constituents understand that our offer shall be summarily rejected.
16. We also understand that if the certificate submitted by us are found to be false/forged or incorrect at any time after the award of contract, it will lead to termination of the contract, along with forfeiture of EMD/SD and performance guarantee besides any other action provided in the contract including banning of business for five year in K-RIDE.

(SEAL AND SIGNATURE OF THE BIDDER)

Verification:

We above named tenderer do hereby solemnly affirm and verify that the contents of our above affidavit are true and correct. Nothing has been concealed and no part of it is false.

(SEAL AND SIGNATURE OF THE BIDDER)

*Modify the contents wherever necessary, in terms of sub-clause 2 ITT.

** The contents in Italics are only for guidance purpose and details as appropriate, are to be filled in suitably by Bidder.

Attestation before Magistrate/Public Notary

K-RIDE

BID SECURITY DECLARATION FORM

I, hereby submit a declaration that the tender submitted by the undersigned, on behalf of the tenderer.....
(Name of the Tenderer), shall not be withdrawn or modified during the period of validity or extended period of validity.

I, on behalf of the Tenderer..... **(Name of the Tenderer)**, also accept the fact that in case the tender is withdrawn or modified during the period of its validity/extended validity period or if we fail to sign the contract in case a contract is awarded to us or we fail to submit a performance security and Additional Performance security, if any, before the deadline fixed in the Tender Documents, then..... **(Name of the Tenderer)** will be debarred for participation in the tendering process for the procurement of this Procurement Entity for a period of **one year** from the date of default.

(Signature of the Authorised Signatory, Official Seal)

K-RIDE

**PRO-FORMA LETTER OF PARTICIPATION FROM EACH PARTNER OF JOINT VENTURE (JV)/
CONSORTIUM**

(On each Firm's Letter Head)

No.....

Dated:.....

From,

.....
.....

To,

The General Manager,
Rail Infrastructure Development Company (Karnataka) Limited,
"Samparka Soudha", 1st Floor,
B.E.P Premises (Opp. Orion Mall),
Rajajinagar 1st Block,
Bangalore - 560 010.

Gentlemen,

Re: ... "[Insert name of work]"

Ref: Your notice for Invitation for Bid (IFB)

1. We wish to confirm that our company/firm (delete as appropriate) has formed a Joint Venture/ Consortium by name of with for the purposes associated with IFB referred to above.
*(Members who are not the lead partner of the JV/Consortium should add the following paragraph) **
2. 'The JV/ Consortium is led by ... whom we hereby authorize to act on our behalf for the purposes of submission of Bid for and authorize to incur liabilities and receive instructions for and on behalf of any and all the partners or constituents of the Joint Venture/ Consortium.'

OR

*(Member(s) being the lead member of the group should add the following paragraph) **

2. 'In this group we act as leader and, for the purposes of applying for qualification, represent the Joint Venture/ Consortium.'
3. In the event of our group being awarded the contract, we agree to be jointly with..... (names of other members of our JV/ Consortium) and severally liable to the (K-RIDE) Rail Infrastructure Development Company (Karnataka) Limited, Bangalore, its successors and assigns for all obligations, duties and

responsibilities arising from or imposed by the contract subsequently entered into between Rail Infrastructure Development Company (Karnataka) Limited, Bangalore and our JV/ Consortium.

4. *I/We, further agree that entire execution of the contract shall be carried out exclusively through the lead partner.

Yours faithfully,

(Signature)

(Name of Signatory)

(Capacity of Signatory)

Seal

* Delete as applicable

K-RIDE

Form: JV/Consortium/2

**FORMAT FOR POWER OF ATTORNEY FOR AUTHORISED
SIGNATORY OF JOINT VENTURE (JV)/ CONSORTIUM PARTNERS**

POWER OF ATTORNEY

*(To be executed on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act.
The stamp paper to be in the name of the company who is issuing the power of Attorney)*

Know all men by these presents, we ... do hereby constitute, appoint and authorize Mr/Ms. who is presently employed with us and holding the position ofas our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our bid for the work of ...Including signing and submission of all documents and providing information/responses to Rail Infrastructure Development Company (Karnataka) Limited, Bangalore, representing us in all matters, dealing with Rail Infrastructure Development Company (Karnataka) Limited, Bangalore, in all matters in connection with our bid for the said project and if successful, till the whole of the bid process.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

Dated this the day of 20..

(Signature of authorized Signatory)

.....

(Signature and Name in Block letters of Signatory)

Seal of Company

Witness

Witness 1:

Name:

Address:

Occupation:

Witness 2:

Name:

Address:

Occupation:

**Notes:*

- i. To be executed by all the partners individually, in case of a Joint Venture/ Consortium.
- ii. The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.
- iii. Also wherever required, the executants(s) should submit for verification the extract of the charter documents and documents such as resolution/ power of attorney in favour of the person executing this power of attorney for the designation of power hereunder on behalf of the bidder.

Form: JV/Consortium/3

**FORMAT FOR POWER OF ATTORNEY TO
LEAD PARTNER OF JOINT VENTURE (JV)/ CONSORTIUM**

*(To be executed on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act.
The stamp paper to be in the name of the company who is issuing the power of Attorney)*

POWER OF ATTORNEY

Whereas Rail Infrastructure Development Company (Karnataka) Limited Bangalore, has invited Bids for the work of

Whereas, the members of the Joint Venture/ Consortium comprising of M/s., M/s., and M/s. are interested in submission of bid for the work of ... *[Insert name of work]* ... in accordance with the terms and conditions contained in the bidding documents.

Whereas, it is necessary for the members of the Joint Venture/ Consortium to designate one of them as the Lead Partner, with all necessary power and authority to do, for and on behalf of the Joint Venture/ Consortium, all acts, deeds and things as may be necessary in connection with the Joint Venture's/ Consortium's bid for the project, as may be necessary in connection the Joint Venture's/ Consortium's bid for the project.

NOW THIS POWER OF ATTORNEY WITNESSETH THAT:

We, M/s., hereby designate M/s., being one of the partners of the Joint Venture/ Consortium, as the lead partner of the Joint Venture/ Consortium, to do on behalf of the Joint Venture/ Consortium, all or any of the acts, deeds or things necessary or incidental to the Joint Venture's/ Consortium's bid for the contract, including submission of bid, participating in conferences, responding to queries, submission of information/ documents and generally to represent the Joint Venture/ Consortium in all its dealings with K-RIDE/ Railway or any other Government Agency or any person, in connection with the contract for the said work until culmination of the process of bidding till the contract agreement is entered into with the Rail Infrastructure Development Company (Karnataka) Limited, Bangalore and thereafter till the expiry of the contract agreement.

We hereby agree to ratify all acts, deeds and things lawfully done by lead member, our said attorney, pursuant to this power of attorney and that all acts deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us/ Joint Venture/ Consortium.

Dated this the Day of 202...

.....

(Signature)

.....

(Name in Block letters of Executant)

Seal of Company

Witness 1:
Name:
Address:
Occupation:

Witness 2:
Name:
Address:
Occupation:

Notes:

1. To be executed by all the Partners of the JV/Consortium except the lead Partner.
2. The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.

K-RIDE

Form: JV/Consortium/4

DRAFT FORMAT OF JOINT VENTURE/CONSORTIUM AGREEMENT

M/s having its registered office at (hereinafter referred to as) acting as the Lead Partner of the first part,

and

M/s having its registered office at (here in after referred to as) in the capacity of a Joint Partner of the other part.

The expressions of and shall wherever the context admit, mean and include their respective legal representatives, successors-in-interest and assigns and shall collectively be referred to as “the Parties” and individually as “the Party”

WHEREAS:

Rail Infrastructure Development Company (Karnataka) Limited (K-RIDE) [hereinafter referred to as “Employer”] has invited bids for ... “[Insert name of work]” Vide LOA No.....awarded contract.

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

1. The following documents shall be deemed to form and be read and construed as an integral part of this AGREEMENT.
 - i. Notice for Bid, and
 - ii. Bidding document
 - iii. Any Addendum/Corrigendum issued by Rail Infrastructure Development Company (Karnataka) Limited
 - iv. The bid submitted on our behalf jointly by the Lead Partner.
 - v. Letter of Acceptance issued by Rail Infrastructure Development Company (Karnataka) Ltd.
2. The ‘Parties’ have studied the documents and LOA issued to enter into Joint Venture/ Consortium as under and have agreed to participate.
3. M/sshall be the lead member of the JV/ Consortium for all intents and purpose and shall represent the Joint Venture/ Consortium in its dealing with the Employer. For the purpose of execution, the parties agree to nominate as the leader duly authorized to sign and submit all documents and enter into correspondence with the Employer.
4. The ‘Parties’ have resolved that the distribution of share and responsibilities between the JV/Consortium partners is as under

(a) Lead Partner Share %

Responsibilities

(I) Key Activities and %age execution assigned

i.

(II) Price Schedule No. and %age execution assigned

- i.
- ii.
- iii.

(b) Joint Venture/ Consortium Partner Share.....%

Responsibilities

(I) Key Activities and %age execution assigned

- i.

(II) Price Schedule No. and %age execution assigned

- i.
- ii.
- iii.

(c) Joint Venture/ Consortium Partner Share.....%

Responsibilities

(I) Key Activities and %age execution assigned

- i.

(II) Price Schedule No. and %age execution assigned

- i.
- ii.
- iii.

Note: In case any Bill or items of a Bill are proposed to be executed by more than one JV/ Consortium partner then indicate the breakup of that Item/Bill no. for each JV/ Consortium partner.

5. JOINT AND SEVERAL RESPONSIBILITIES

The Parties undertake that they shall be jointly and severally liable to the Employer in the discharge of all the obligations and liabilities as per the contract with the Employer and for the performance of contract awarded to their JV/Consortium.

6. ASSIGNMENT AND THIRD PARTIES

The parties shall co-operate throughout the entire period of this AGREEMENT on the basis of exclusivity and neither of the Parties shall make arrangement or enter into agreement either directly or indirectly with any other party or group of parties on matters relating to the Project except with prior written consent of the other party and the Employer.

7. EXECUTIVE AUTHORITY

The said Joint Venture/ Consortium through its authorized representative shall receive instructions, payments from the Employer. The management structure for the project shall be prepared by mutual consultations to enable completion of project to quality requirements within permitted cost and time.

8. GUARANTEES AND BONDS

Performance Security and other Securities of a JV/Consortium shall be in the name of the JV/Consortium that submits the bid.

9. BID SUBMISSION

Each Party shall bear its own cost and expenses for preparation and submission of the bid and all costs until conclusion of a contract with the Employer for the Project. Common expenses shall be shared by both the parties in the ratio of their actual participation.

10. INDEMNITY

Each party hereto agrees to indemnify the other party against its respective parts in case of breach/default of the respective party of the contract works of any liabilities sustained by the Joint Venture/Consortium.

11. For the execution of the respective portions of works, the parties shall make their own arrangements to bring the required finance, plants and equipment, materials, manpower and other resources.

12. DOCUMENTS & CONFIDENTIALITY

Each Party shall maintain in confidence and not use for any purpose related to the Project all commercial and technical information received or generated in the course of preparation and submission of the bid.

13. ARBITRATION

Any dispute, controversy or claim arising out of or relating to this agreement shall be settled in the first instance amicably between the parties. If an amicable settlement cannot be reached as above, it will be settled by arbitration in accordance with the Indian Arbitration and Conciliation Act 1996 or any amendments thereof. The venue of the arbitration shall be Bangalore.

14. VALIDITY

This Agreement shall remain in force till the defect liability period is over and Securities are released.

15. This AGREEMENT is drawn in number of copies with equal legal strength and status. One copy is held by M/s and the other by M/s. &M/s and a copy submitted with the Bid.

16. This AGREEMENT shall be construed under the laws of India.

17. NOTICES BETWEEN JVI CONSORTIUM PARTNERS

Notices shall be given in writing by fax confirmed by registered mail or commercial courier to the following fax numbers and addresses:

Lead Partner

.....
.....

(Name & Address)

Other Partner

.....
.....

(Name & Address)

IN WITNESS WHEREOF THE PARTIES, have executed this AGREEMENT the day, month and year first before written.

M/s.....

M/s.....

.....

.....

(Seal)

(Seal)

Witness

1.....(Name & Address)

2..... (Name & Address)


K-RIDE

Bidders Qualification

To establish its qualifications to perform the contract in accordance with Section 2 (Qualification Information) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

To establish its qualifications to perform the contract in accordance with Section 2 (Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information	
Bidder's legal name	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	

The bidder shall attach copies of the following original documents with the form:

1. In case of single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITT clause 2.
2. Authorization to represent the firm or JV/ Consortium named in above, in accordance with ITT clause 14.
3. In case of JV/ Consortium, JV/ Consortium agreement, in accordance with ITT clause 2.

SEAL AND SIGNATURE

Form ELI - 2: JV/ Consortium Information Sheet

Each member of a JV/ Consortium must fill in this form separately

JV / Consortium Information	
Bidder's legal name	
JV/ Consortium Partner's legal name	
JV/ Consortium Partner's country of constitution	
JV/ Consortium Partner's year of constitution	
JV/ Consortium Partner's legal address in country of constitution	
JV/ Consortium Partner's authorized representative information (name, address, telephone numbers, fax numbers, e-mail address)	
Bidder's Bank Details: (a) Name of the Bank and branch: (b) Account Number: (c) IFSC code: (d) Bank's Contact Number and Fax Number: (e) PAN: (f) GST Registration No:	

The bidder shall attach copies of the following original documents with the form:

1. Articles of incorporation or constitution of the legal entity named above, in accordance with ITT clause 2.
2. Authorization to represent the firm named above, in accordance with ITT clause 14.

Note: Following needs to be submitted by the bidder;

- (a) Affidavit in case of Proprietary firm.
- (b) Partnership Deed in case of partnership firm.
- (c) Memorandum & Article of Association in case of Public/Private limited company.
- (d) Authorization/POA in favour of authorised signatory of bidder to sign the bid.

SEAL AND SIGNATURE

Form FIN-1: Financial Situation

(Each Bidder or each member of a JV/Consortium must fill in this form separately)

NAME OF BIDDER/JV/CONSORTIUM PARTNER

	Financial Data for Last 5 Financial Years [Indian National Rupees]				
	Year 1:	Year 2:	Year 3:	Year 4:	Year 5:
1. Total Assets					
2. Current Assets					
3. Total Liabilities					
Current Liabilities					
5. Net Worth [= 1 – 3]					
6. Working Capital [= 2 - 4]					
7. Profit Before Tax (PBT)					

1. The bidder shall attach copies of the following original documents with the form

Copies of the audited balance sheets, including all related notes, and income statements for the last five years, as indicated above, complying with the following conditions.

- i. All such documents reflect the financial situation of the Bidder or partner to a JV/ Consortium, and not sister or parent companies.
- ii. Historic financial statements must be audited by a certified accountant.
- iii. Historic financial statements must be complete, including all notes to the financial statements.
- iv. Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

2. Contents of this form should be certified by a Statutory Auditor

- i. In the event that the audited accounts for the latest concluded Financial Year are not available, the Bidder shall furnish information pertaining to the last five financial years after ignoring the latest concluded financial year. In case, the bidder submits audited financial information for the last six or more years, only the figures for the latest five years shall be considered for evaluation.
- ii. Financial data for last five financial years has to be submitted by the bidder along with audited balance sheets. The financial information of the Bidder must be certified either by the Independent Financial Auditor (statutory Auditor) of the company appointed under the companies' Act.
- iii. In case any discrepancy in data is found between the balance sheet and the financial information submitted, the data as available in the balance sheet will be considered.

- iv. In case the audited balance sheet of the last financial year is not made available by the Bidder, he has to submit an affidavit certifying that 'The Balance Sheet has actually not been audited so far'. In such a case the financial data of previous '4' audited financial years will be taken into consideration for evaluation. If audited balance sheet of any year other than the last financial year is not submitted, then the bid will be considered as non-responsive
- v. In case the company's financial year is from Jan 19 to Dec 19, then it will be considered under financial year 2019 - 20 similar procedure will be applicable for other financial years also.

SEAL AND SIGNATURE OF THE BIDDER

Certified that all figures and facts submitted in this form have been furnished after full consideration of all observations/notes in Auditor's reports.

(Signature of Statutory Auditor)

Name of Statutory Auditor: _____

Registration No: _____

(Seal)

Form FIN-2: Annual Construction Turnover for the last 5 Financial years

Each Bidder or each member of a JV/ Consortium must fill in this form separately:

NAME OF BIDDER/JV/CONSORTIUM PARTNER:

Sl.No.	Year	Annual Turnover	Multiplying factor	Updated Annual turnover
		INR	INR	INR
1	2016-2017			
2	2017-2018			
3	2018-2019			
4	2019-2020			
5	2020-2021			

Annual Turnover Data for the Last 5 Financial Years (Construction only)			
Year	Amount Currency	Exchange Rate	Indian National Rupees Equivalent
Average Annual Construction Turnover for last 5 Financial Years			

1. The information supplied shall be substantiated by data in the audited balance sheets and profit and loss accounts for the relevant years and submitted as attachments to form Fin-1 in respect of the bidder or all partners constituting the bidder.
2. Contents of this form should be certified by a Statutory Auditor.
3. In the event that the audited accounts for the latest Financial Year are not available, the Bidder shall furnish information pertaining to last three financial years after ignoring the latest financial year. In case the bidder submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.

SEAL AND SIGNATURE

Form FIN-3: Current Contract Commitments / Works in Progress

Bidders and each partner to a JV/Consortium should provide information on their current commitments on all contract that have been awarded, or which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Contract Commitments

Sl.No.	Description of work	Contract No. & date	Name & address of Employer, Tel./Fax/ Email	Value of Contract in INR	Stipulated Period of completion	Value of Balance work	Anticipated date of Completion
1							
2							
3							
4							
5							
Total							

- For calculation of 'Updated contract value' in column 5 above, assume inflation as per multiplying Factors given in FIN-2.
- Bidder should provide information on their current commitments or all contracts that have been awarded or for which a letter of intent or acceptance has been received or for contracts approaching completion but for which a completion certificate is yet to be issued.
- The exchange rate of foreign currency shall be applicable 28 days before the tender submission date. For conversion of foreign currency to Indian Rupee exchange rates published by Financial Benchmarks Private limited (www.fbil.org.in) 28 days before the date of bid submittal will be considered. In case the particular day happens to be a holiday the exchange rate published on the next working day will be considered. In case of works in foreign currency the effect of inflation is considered as included, as the exchange rate prevailing 28 days before tender submission is being considered for conversion to Indian Rupees,

Note: Enclose Certificate(s) from Engineer(s) Incharge (not below the rank of Executive Engineer) for Value of outstanding work. In case it is not feasible to furnish certificate from all the units the bidder should record the following certificate on Fin 3:

"Certified that current commitments on all the contracts that have been awarded or for which a letter of intent or acceptance has been received or for the works in progress or the works approaching completion, value of outstanding work has been indicated in the above table correctly. It is further certified that if later on the employer discovers that information provided in the table is incorrect then the employer will treat our bid invalid and it will be liable for rejection"

SEAL AND SIGNATURE

FORM NO. 1

DELETED

K-RIDE

FORM NO. 2**CHECKLIST FOR CLAUSES PERTAINING TO SUMMARY****REJECTION OF BID**

We, the undersigned, declare that we have read and understood the content of ITT clauses section:2 mentioned below. We also understand that our bid shall be summarily rejected in case we fail to comply the requirements of undermentioned clauses:

ITT Clause No. Section 2	Reason for Summary Rejection	Form No.	Page No.
2.5	Non-submission of Affidavit	Form PS-3	67-68
11.5 & 22	Non-submission of immediate information to the Employer in case Bidder ceases to fulfill eligibility in terms of ITT.	-	33 & 44
ITT	Letter of Technical Bid	Form PS-1	63-65
11.5	Quoting more than one Lumpsum amount for any schedule	Price schedule- Section:9	1317-1319
11.5	Non-submission of Summary sheet of Price Schedule	Price schedule- Section:9	1315
11.5	Non-submission of the Letter of Price Bid (LPB) +	(Form:PS-2)	66
13	Bid not accompanied with bid security declaration	(BDF/1)	70
14	Bid not accompanied with power of attorney/General power of Attorney to sign on behalf of the bidders	JV/Consortium/1/2/3	28-30 & 71-75

SEAL AND SIGNATURE OF THE BIDDER

Form: 3 C 1

FORMAT FOR CERTIFICATE TO BE SUBMITTED BY BIDDER ALONGWITH THE BID
(On the letter head of the Firm)

We/I, _____, having registered office at _____ do hereby certify that "I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I certify that this bidder is not from such country or, if from such a country, has been registered with the Competent Authority. I hereby certify that this bidder fulfils all requirements in this regard and is eligible to be considered. (Where applicable, evidence of valid registration by the competent Authority shall be attached.)"

Dated this _____ day of _____, 2021

For- _____

Authorized Signatory Signature _____

Full Name: _____

Place: _____

(SEAL AND SIGNATURE OF THE BIDDER)

**FORMAT FOR CERTIFICATE TO BE SUBMITTED BY
BIDDER ALONGWITH THE BID FOR SUB CONTRACTING**

(On the letter head of the Firm)

We/I, _____, having registered office at _____ do hereby certify that "I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries; I certify that this bidder is not from such a country or, if from such a country, has been registered with the competent Authority and will not sub-contractor any work to a contractor from such countries unless such contractor is registered with the competent Authority. I hereby certify that his bidder fulfils all requirements in this regard and is eligible to be considered. (Where applicable, evidence of valid registration the Competent Authority shall be attached.)"

Dated this _____ day of _____, 2021

For- _____

Authorized Signatory Signature _____

Full Name: _____

Place: _____

K-RIDE

(SEAL AND SIGNATURE OF THE BIDDER)

Form 5

Key Personnel for the work

MINIMUM QUALIFICATION AND EXPERIENCE REQUIRED FOR KEY PERSONNEL TO BE DEPLOYED FOR THE WORK

Sl. No	Key Personnel	Qualifications & Total Experience	Particular Experience (Minimum requirement)	Minimum Number of Personnel Required	Name of the key personnel proposed	Qualification	Total number of years of experience	Number of Years in similar works experience
1	Project Manager	BE Civil with 18 years' experience	5 years as Project Manager or equivalent in Similar Nature of works	1				
2	Deputy Project Manager	BE Civil with 12 years' experience	5 years as Deputy Project Manager or equivalent in Similar Nature of works.	8				

Note: Further details to be updated as per clause 3.3 (c) of section 2 ITT.

(Signature)

(Name of Signatory)

(Capacity of Signatory)

Seal.....

Format of Curriculum Vitae (cv) for proposed key professional staff

Proposed Position:

Name of Firm:

Name of Staff:

Profession:

Date of Birth:

Years with Firm/Entity: Nationality:

Membership in Professional Societies:

Detailed Tasks Assigned:

Key Qualifications:

[Give an outline of staff member’s experience and training most pertinent to tasks on assignment. Describe degree of responsibility held by staff member on relevant previous assignments and give dates and locations.]

Education:

[Summarize college/university and other specialized education of staff member and degrees obtained.]

Employment Record:

[Starting with present position, list in reverse order every employment held. List all positions held by staff member since graduation, giving dates, names of employing organizations, titles of positions held, and locations of assignments. Also give types of activities performed and client references, where appropriate.]

Period	Name of Employing Organization	Name of the Project	Title / Position	Activity performed	Location of the Assignment

Languages:

[For each language, indicate proficiency: excellent, good, fair, or poor; in speaking, reading, and writing]

Certification:

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications, and my experience.

Date:

[Signature of staff member and authorized representative of the Firm] Day/Month/Year

Full name of staff member: _____

Full name of the authorized representative: _____

FORM CL-2

UNDERTAKING FROM NOMINATED/IDENTIFIED SUB-CONTRACTOR

(Refer Clause of EQC)

(On the Letterhead of Nominated/Identified sub-contractor)

I/We,.....(Legal Name of Nominated/Identified Subcontractor) hereby confirm that we are associating with(Legal name of the bidder) for the work of(Name of work as stated in Invitation for Bids {IFB}), for the key activity stated in clause 3.2 (c)/(d) of ITT (if applicable).

I/We hereby undertake that in case M/s.....(Legal name of the bidder) are awarded the work of(Name of work as stated in Invitation for Bids {IFB}),the key activity stated in clause 3.2 (c)/(d) of ITT shall be undertaken by us as per bid conditions (if applicable).

**STAMP & SIGNATURE OF AUTHORISED
SIGNATORY OF NOMINATED/IDENTIFIED SUB CONTRACTOR**

**STAMP & SIGNATURE OF AUTHORISED
SIGNATORY OF BIDDER**

Form CL-3

Availability of Financial Resources
(Section-2, ITT clause 3.3 (b))

Bidders must demonstrate sufficient financial resources, comprising of Working Capital supplemented by credit line statements or overdraft facilities to meet the Bidder's financial requirements for

- a) its current contract commitments, and
- b) the subject contract.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Financial Resources		
No.	Source of financing	Amount (equivalent)
1	Working Capital	
2	Credit Line	
Total Available Financial Resources		

^aTo be considered, Credit Line must be substantiated by a letter from the bank issuing the line of credit, specific for the subject contract, as prescribed. Any letter or document not complying with this requirement shall not be considered as supplementary financial resources.

Note:

In case the financial statement data is other than Indian Rupees, the equivalent Indian Rupees with the exchange rates as defined in the Section-2, ITT.

Form CL-4

Evidence of Availability of Credit Line Financial Resources

(Section-2 ITT, Clause:3(b))

[Each Bidder must fill out this form to demonstrate financial resources comprising credit line statements or overdraft facilities.]

Project Name:

Bidding Package Name and Identification Number: (to be filled in as indicated in ITT 1) ...

BANK CERTIFICATE

This is to certify that M/s is a reputed company with a good financial standing.

If the contract for the work, namely..... is awarded to the above firm, we shall be able to provide overdraft / credit facilities to the extent of Rs to meet their working capital requirements for executing the above contract.

___ Sd. ___

Name of Bank: _____

Senior Bank Manager _____

Address of the Bank _____

[In case of Joint Venture, change the text as follows:]

This is to certify that M/s who has formed a Joint Venture with M/s and M/s for participating in this bid, is a reputed company with a good financial standing.

If the contract for the work, namely..... is awarded to the above joint venture, we shall be able to provide overdraft / credit facilities to the extent of Rs..... to M/s to meet their working capital requirements for executing the above contract.

Form EXP-1**WORK EXPERIENCE CERTIFICATE**

To whom so ever it may concern
(Issued for the purpose of Quoting in K-RIDE tenders)

M/s/Sri (Name and address of the contractor) is a working contractor of this unit and was awarded the following work. The relevant details of the work are as under: -

Sl.No	Description	Details
1	Name of work	
2	Acceptance Letter No and Date	
3	Agreement Number, date and name of the agency	
4	Agreement value in Rupees (in words and figures)	
5	Due date of completion	
6	Actual date of completion of work	
7	Value of Final Bill if passed (in words)	
8	Work completed but Final measurements not recorded. a) Amount paid so far as in CC bill No.	
9	Work completed. Final measurements recorded with negative variation a) Amount so far paid as in CC bill No.	
10	Work completed. If Final measurements recorded with Positive variation which is not sanctioned yet. Original agreement value of Last sanctioned agreement value whichever is lower.	
11	Scope of work (Broad category of works i.e., the name of the work in the agreement on which work is	
12	Details of values of major components/ works executed in the completed work.	

Note:

The Certificate to satisfy similar work should be signed by an officer not lower than JAG officer in Railways and Executive Engineer rank or equivalent grade in other department of Govt. of India/State Government/PSUs of Government of India / State Undertaking and Competent Authority of Public Listed Company.

Signature :.....

Name of officer.....

Designation:

Address:

Office seal:

Phone/FAX No.:

Date :

--00--00--00--

SECTION-4

**FORM OF TENDER, LETTER OF ACCEPTANCE,
NOTICE TO PROCEED WITH THE WORK AND
AGREEMENT FORM ETC.,**

FORM OF TENDER, LETTER OF ACCEPTANCE, NOTICE TO PROCEED WITH THE WORK AND AGREEMENT FORM ETC.,

SL. NO.	TITLE	FORM NUMBER	PAGE NO.
1	LETTER OF ACCEPTANCE	FORM-1	100
2	ISSUE OF NOTICE TO PROCEED WITH THE WORK	FORM-2	101
3	AGREEMENT FORM	FORM-3	102

K-RIDE

FORM OF TENDER (DELETED)

Please refer Form PS-1 of Section 3: Qualification Information/Bidding Forms.

K-RIDE

LETTER OF ACCEPTANCE

(Letter head paper of the Employer)

_____ [date]

To: _____ [name and address of the Contractor]

Dear Sirs,

This is to notify you that your Tender dated _____ for execution of the **“Design and Construction of Elevated Viaduct of Length 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 km) including ramps and Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade Section of Length 17.551 km (CH:-0.964 Km to CH:-0.675 Km, CH: -0.050 km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other Related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding Station Buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”**.

Tender No: K-RIDE/BSRP/10/2021, Dated: -----for the Contract Price of Rupees_____.(_____[amount in words and figures], as corrected and modified in accordance with the Instructions to Tenderers is hereby accepted by our Agency.

You are hereby requested to furnish Performance Security plus additional security for unbalanced tenders in accordance with of Clause 25.5 of ITT, in the form detailed in Clause 29.1 of ITT and clause 43 of the conditions of contract for an amount of Rs._____(As defined in contract data) within 20 days of the receipt of this letter of acceptance valid up to 30 days from the date of expiry of Defects Liability Period i.e. up to and sign the contract.

Yours faithfully,

Authorized Signature

Name and Title of Signatory

Name of Agency.

ISSUE OF NOTICE TO PROCEED WITH THE WORK(Letter head of the Employer)

_____ (Date)

To

_____ (name and address of the Contractor)

Dear Sirs:

With reference to LOA, for the construction “**Design and Construction of Elevated Viaduct of Length 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 km) including ramps and Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade Section of Length 17.551 km (CH:-0.964 Km to CH:-0.675 Km, CH: -0.050 km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other Related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding Station Buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)**”. A Tender Price of Rs. _____, you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully,

(Signature, name and title of signatory authorized to sign
on behalf of Employer)

AGREEMENT FORM

Agreement

This agreement, made the _____ day of _____, 20____, between _____ (Name and Address of Employer) (herein after called "the Employer") of the _____ one part and _____ [name and address of contractor] (herein after called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor execute "**Design and Construction of Elevated Viaduct of Length 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 km) including ramps and Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade Section of Length 17.551 km (CH:-0.964 Km to CH:-0.675 Km, CH: -0.050 km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other Related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding Station Buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)**". Tender No.K-RIDE/BSRP/10/2021, Dated: _____ (herein after called "The Works") and the Employer has accepted the Tender by the Contractor for the execution and completion of such Works and the remedying of any defects therein at a contract price of Rupees.....

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:
 - i) Letter of Acceptance;
 - ii) Notice to proceed with the works;
 - iii) Contractor's Tender;
 - iv) Contract Data;
 - v) Conditions of contract (including Special Conditions of Contract and Particular Condition of Contract)
 - vi) Specifications;
 - vii) Drawings;
 - viii) Price Schedule; and

ix) Any other document listed in the Contract Data as forming part of the contract.

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of _____

was hereunto affixed in the presence of:

Signed, Sealed and Delivered by the said _____

in the presence of:

Binding Signature of Employer _____

Binding Signature of Contractor _____

K-RIDE

SECTION – 5

CONDITIONS OF CONTRACT(CC) AND SPECIAL CONDITIONS OF CONTRACT (SCC)

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CONDITIONS OF CONTRACT

A. GENERAL

1. DEFINITIONS

- 1.1 Terms which are defined in the Contract Data are not also defined in the Conditions of Contract but keep their defined meanings. Bold letters are used to identify defined terms.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Tender.

Compensation Events are those defined in Clause 38 hereunder.

The **Completion Date** is the date of completion of the Works as certified by the Employer in accordance with Sub Clause 46.1.

The **Contract** is the contract between the Employer and the Contractor to execute, complete and maintain the Works. It consists of the documents listed in Clause 2.2 below.

The **Contract Data** defines the documents and other information which comprise the Contract.

The **Contractor** is a person or corporate body or Joint Venture whose Tender to carry out the Works has been accepted by the Employer.

The **Contractor's Tender** is the completed Tender document submitted by the Contractor to the Employer.

The **Contract Price** is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

Days are calendar days; **months** are calendar months.

A **Defect** is any part of the Works not completed in accordance with the Contract.

The **Defects liability period** is the period named in the Contract Data and calculated from the Completion Date.

The **Employer** is the party who will employ the Contractor to carry out the Works.

Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

The **Initial Contract price** is the Contract Price listed in the Employer's Letter of Acceptance.

The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised only by the Employer by issuing an extension of time.

'**Joint Venture**' means an ad hoc association of firms that pool their resources and skills to undertake a large or complex contract in the role of "Contractor," with all firms (partners in the JV) being legally liable, jointly and severally, for the execution of the Contract in the event of a partner's withdrawal.

Materials are all supplies, including consumables, used by the contractor for incorporation in the Works.

Plant is any integral part of the Works which is to have a mechanical, electrical, electronic or chemical or biological function.

The **Site** is the area defined as such in the Contract Data.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Employer.

The **Start Date** is given in the Contract Data. It is the date when the Contractor shall commence execution of the works. It does not necessarily coincide with any of the Site Possession Dates.

A Subcontractor is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract which includes work on the Site.

A **Variation** is an instruction given by the Employer which varies the Works.

The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

2. INTERPRETATION

2.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Employer will provide instructions clarifying queries about the Conditions of Contract.

2.2 The documents forming the Contract shall be interpreted in the following order of priority:

- (1) Agreement
- (2) Letter of Acceptance, notice to proceed with the works
- (3) Contractor's Tender
- (4) Contract Data
- (5) Conditions of Contract
- (6) Specifications
- (7) Drawings
- (8) Price schedule and
- (9) any other document listed in the Contract Data as forming part of the Contract.

3. LAW GOVERNING CONTRACT

3.1 The law governing the Contract is the Laws of India supplanted by the Karnataka Local Acts.

4. EMPLOYER'S DECISIONS

4.1 Except where otherwise specifically stated, the Employer will decide contractual matters between the Employer and the Contractor.

5. DELEGATION

5.1 The Employer may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

6. COMMUNICATIONS

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6.1 Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

7. SUBCONTRACTING:

7.1 The Contractor may subcontract with the approval of the Employer but may not assign the Contract without the approval of the Employer in writing. Subcontracting does not alter the Contractor's obligations.

8. OTHER CONTRACTORS

8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer.

9. PERSONNEL

9.1 The Contractor shall employ the technical personnel (of number and qualifications) as may be stipulated by K-RIDE from time to time during the execution of the work. The technical staff so employed shall be available at site as may be stipulated by the Employer.

9.2 If the Employer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

10. EMPLOYER'S AND CONTRACTOR'S RISKS

10.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. EMPLOYER'S RISKS

11.1 The Employer is responsible for the excepted risks which are:

- (a) Rebellion, riot commotion or disorder unless solely restricted to employees of the Contractor or his Sub Contractors arising from the conduct of the Works; or
- (b) a cause due solely to the design of the Works, other than the Contractor's design; or
 - (i) could not have reasonably foreseen; or
 - (ii) could reasonably have foreseen, but against which he could not reasonably have taken at least one of the following measures;
 - (A) prevent loss or damage to physical property from occurring by taking appropriate measures or
 - (B) insure against such loss or damage

12. CONTRACTOR'S RISKS

- 12.1 All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the excepted risks are the responsibility of the Contractor.

13. INSURANCE:

- 13.1 The Contractor shall prior to commencing the works, effect and thereafter maintain insurances, in the joint names of the Employer and the Contractor, (cover from the first working day after the Start Date to the end of Defects Liability Period), in the amounts stated in the Contract Data:

- (a) for loss of or damage to the Works, Plants and Materials and the Contractor's equipment;
- (b) for liability of both Parties for loss, damage, death and injury to third parties or their property arising out of the Contractor's performance of the Contract including the Contractor's liability for damage to the Employer's property other than the Works and
- (c) for liability of both Parties and of any Employer's representative for death and injury to the Contractor's personnel except to the extent that liability arises from the negligence of the Employer, any Employer's representative or their Employees.

- 13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Employer for his approval before the Start Date. All such insurance shall provide for compensation to be payable to rectify the loss or damage incurred. All payments received from insurers relating to loss or damage shall be held jointly by the Parties and used for the repair of the loss or damage or as compensation for loss or damage that is not to be repaired.

- 13.3 If the Contractor fails to effect or keep in force any of the insurances referred to in the previous sub-clauses or fails to provide satisfactory evidence, policies or receipts, the Employer may without prejudice to any other right or remedy, effect insurance for the cover relevant to such default and pay the premiums due and recover the same as a deduction from any other monies due to the Contractor. If no payments is due, the payment of the premiums shall be a debt due.

- 13.4 Alterations to the terms of an insurance shall not be made without the approval of the Employer.

- 13.5 Both Parties shall comply with any conditions of the insurance policies.

14. SITE INVESTIGATION REPORTS:

- 14.1 The Contractor, in preparing the tender, shall rely on any site investigation reports referred to in the Contract data, supplemented by any information available to the Tenderer.

15. QUERIES ABOUT THE CONTRACT DATA

- 15.1 The Employer will clarify queries on the Contract Data.

16. CONTRACTOR TO CONSTRUCT THE WORKS

- 16.1 The Contractor shall construct the Works in accordance with the Specification and Drawings.

17. THE WORKS TO BE COMPLETED BY THE INTENDED COMPLETION DATE

17.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the program submitted by the Contractor, as updated with the approval of the Employer, and complete them by the Intended Completion Date.

18. APPROVAL BY THE EMPLOYER:

18.1 The Contractor shall submit Specification and drawings showing the proposed Temporary Works to the Employer, who is to approve them if they comply with the Specifications and Drawings.

18.2 The Contractor shall be responsible for the design of Temporary Works and Permanent works.

18.3 The Employer's approval shall not alter the Contractor's responsibility for design of the Temporary Works and Permanent works.

18.4 The Contractor shall obtain approval of Designers to design of the Temporary and Permanent Works..

18.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Employer before their use.

19. SAFETY

19.1 The Contractor shall be responsible for the safety of all activities on the Site.

20. DISCOVERIES

20.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site is the property of the Employer. The Contractor is to notify the Employer of such discoveries and carry out the Employer's instructions for dealing with them.

21. POSSESSION OF THE SITE

21.1 The Employer shall give possession of all parts of the Site to the Contractor progressively, If possession of a part is not given by the date stated in the Contract Data the Employer is deemed to have delayed the start of the relevant activities and this will be compensation event.

22. ACCESS TO THE SITE

22.1 The Contractor shall allow the Employer and any person authorized by the Employer access to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured / fabricated / assembled for the works.

23. INSTRUCTIONS

23.1 The Contractor shall carry out all instructions of the Employer which comply with the applicable laws where the Site is located.

24 PROCEDURE FOR RESOLUTION OF DISPUTES:

- 24.1 If the Contractor is not satisfied with the decision taken by the Employer, the dispute shall be referred by either party to Arbitration within 30 days of the notification of the Employer's decision.
- 24.2 If neither party refers the dispute to Arbitration within the above 30 days, the Employer's decision will be final and binding.
- 24.3 The Arbitration shall be conducted in accordance with the arbitration procedure stated in the Special Conditions of Contract.

K-RIDE

B. TIME CONTROL

25. PROGRAM

- 25.1 Within the time stated in the Contract Data the Contractor shall submit to the Employer for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works.
- 25.2 The Employer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Employer again at any time. A revised Program is to show the effect of Variations and Compensation Events.

26. EXTENSION OF THE INTENDED COMPLETION DATE

- 26.1 The Employer shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date.
- 26.2 The Employer shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Employer for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information.

27. DELAYS ORDERED BY THE EMPLOYER

- 27.1 The Employer may instruct the Contractor to delay the start or progress of any activity within the Works.

28. MANAGEMENT MEETINGS

- 28.1 The Employer may require the Contractor to attend a management meeting. The business of a management meeting shall be to review the progress achieved and the plans for remaining work.
- 28.2 The responsibility of the parties for actions to be taken is to be decided by the Employer either at the management meeting or after the management meeting and stated in writing to be distributed to all who attended the meeting.

C. QUALITY CONTROL

29. IDENTIFYING DEFECTS

- 29.1 The Employer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Employer may instruct the Contractor to search for a Defect and to uncover and test any work that the Employer considers may have a Defect.

30. TESTS

- 30.1 If the Employer instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect the test shall be a Compensation Event.

31. CORRECTION OF DEFECTS

- 31.1 The Employer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion and is defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.
- 31.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Employer's notice.

32. UNCORRECTED DEFECTS

- 32.1 If the Contractor has not corrected a Defect within the time specified in the Employer's notice, the Employer will assess the cost of having the Defect corrected, and the Contractor will pay this amount.

D. COST CONTROL

33. Price Schedule:

- 33.1 The Price Schedule shall contain items of the Design and construction, installation, testing, and commissioning work to be done by the Contractor.
- 33.2 The Price Schedule is used to calculate the Contract Price. The Contractor is paid as per stage wise payment of work done as per Price Schedule.

34. VARIATIONS

- 34.1 The Employer shall have power to order the Contractor to do any or all of the following as considered necessary or advisable during the progress of the work by him
- (a) Increase or decrease of any item of work included in the Price Schedule.;
 - (b) Omit any item of work;
 - (c) Change the character or quality or kind of any item of work;
 - (d) Change the levels, lines, positions and dimensions of any part of the work;
 - (e) Execute additional items of work of any kind necessary for the completion of the works; and
 - (f) Change in any specified sequence, methods or timing of construction of any part of the work.
- 34.2 The Contractor shall be bound to carry out the work in accordance with any instructions in this connection, which may be given to him in writing by the Employer and such alteration shall not vitiate or invalidate the contract.
- 34.3 Variations shall not be made by the Contractor without an order in writing by the Employer, provided that no order in writing shall be required for increase or decrease in the quantity of an item appearing in the Price Schedule so long as the work executed conforms to the approved drawings.
- 34.4 The Contractor shall promptly request in writing to the Employer to confirm verbal orders and the officer issuing oral instructions shall confirm it in writing within 30 days of request, failing which the work shall be carried out as though there is no variation. In case variation is approved it shall be accompanied with Price Schedule failing which the contractor shall be responsible for deviation if any.

35. PAYMENTS FOR VARIATIONS

- 35.1 Payment for increase/ decrease in the quantities of components of schedules A & B shall be made as per the details provided in the notes of Annexure 1 & 2 of Price Schedule. The Contractor shall execute and be bound for variations of all change of scope of orders till the price does not exceed 25% of the Contract Price as specified in LOA/Original agreement.
- 35.2 The rates for additional, substituted or altered item of work, Contractor shall be requested to submit his quotation for the items supported by analysis of the rate or rates claimed, within 7 days.
- 35.3 If the Contractor's quotation is determined unreasonable, the Employer may order the Variation

and make a change to the Contract Price which shall be based on Employer's own forecast of the effects of the Variation on the Contractor's costs.

- 35.4 Under no circumstances the Contractor shall suspend the work on the plea of non-settlement of rates for items falling under this Clause.

36. SUBMISSION OF BILLS FOR PAYMENT

- 36.1 The Contractor shall submit to the Employer monthly bills of the value of the work completed less the cumulative amount paid previously.

- 36.2 The Employer shall check the Contractor's bill and determine the value of the work executed which shall comprise of (i) value of the quantities of the items as per stage payment of Price Schedule and (ii) valuation of Variations and Compensation Events.

- 36.3 The Employer may exclude any item paid in a previous bill or reduce the proportion of any item previously paid in the light of later information.

37. PAYMENTS

- 37.1 Payments shall be adjusted for deductions for advance payments other than recoveries in terms of contract and taxes, at source as applicable under law. The Employer shall pay the Contractor within 60 days of submission of bill. The Contractor shall be liable to pay liquidated damages for shortfall in progress.

- 37.2 Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed to be covered in lumpsum Price of the Contract.

38. COMPENSATION EVENTS:

- 38.1 The following are Compensation Events unless they are caused by the Contractor:

- (a) The Employer orders a delay or does not issue drawings, specifications or instructions required for execution of works on time.
- (b) The Employer instructs the Contractor to uncover or to carry out additional tests upon work which is then found to have no Defects.
- (c) The Employer gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.
- (d) The effect on the Contractor of any of the Employer's Risks.
- (e) The Employer unreasonably delays issuing a Certificate of Completion.

Other Compensation Events listed in the Contract Data or mentioned in the Contract

- 38.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date is extended. The Employer shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

- 38.3 As soon as information demonstrating the effect of each Compensation event upon the Contractor's forecast cost has been provided by the Contractor, it is to be assessed by the Employer and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Employer shall adjust the Contract Price based on Employer's own forecast. The Employer will assume that the Contractor will react competently and promptly to the event.
- 38.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Employer.

39. TAX

- 39.1 The rates quoted by the Contractor shall be deemed to be inclusive of the sales, GST and other taxes that the Contractor will have to pay for the performance of this Contract. The Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law.

40. PRICE ADJUSTMENT:

**CHANGE IN COSTS - PRICE ADJUSTMENT
PRICE ADJUSTMENT CLAUSE FOR WORKS CONTRACTS**

Contract price shall be adjusted for increase or decrease in rates and prices of labour, materials, fuels and lubricants in accordance with the following principles and procedures and as per formula given here under.

- (a) The price Adjustment shall apply for the work done from the date of commencement up to the end of original period of completion and shall not apply to work carried out beyond the stipulated period of completion for reasons attributable to the Contractor.
- (b) The Price adjustment shall be determined during each quarter from the formula given in contract data.
- (c) Following expression and meanings are assigned to the work done during the quarter:

R=Total value of work done during the month shall include the value of materials on which secured advance has been granted, if any during the month less the value of materials in respect of which the secured advance has been recovered, if any, during the month. This excludes the cost of work on items for which rates were fixed under Variations Clause 35/PCC for which the escalation will be regulated as mutually agreed at the time of fixation of rate. It will also exclude the value of work done during the month which was programmed to be done prior to this month as per work schedule in the agreement.

- (d) To the extent that full compensation for any rise or fall in costs to the contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates included in the contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

41. LIQUIDATED DAMAGES

- 41.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the Contract Data for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the Contract Data). The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages does not affect the Contractor's liabilities.
- 41.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Employer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment of bill.

42. ADVANCE PAYMENTS:

- 42.1 The Employer shall make payment to the Contractor of the amounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an unconditional bank guarantee in a form acceptable to the Employer issued by a Nationalized/Scheduled Bank in amounts equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. The advance payments shall be repaid with prevailing bank interest.
- 42.2 The Contractor is to use the advance payment only to pay for Mobilization expenses required specifically for execution of the Works. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Employer
- 42.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuation of the work done, variations, price adjustments, compensation events or liquidated damages

43. SECURITIES:

- 43.1 The Performance Security (including additional security for unbalanced tenders) shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and type of instrument acceptable to the Employer. The Performance Security as indicated in the contract data shall be valid until a date 30 days from the date of expiry of Defects Liability Period and the additional security for unbalanced tenders shall be valid until a date 30 days from the date of issue of the certificate of completion. The security deposit will be released against BG.

44. COST OF REPAIRS:

- 44.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. FINISHING THE CONTRACT

45. COMPLETION

45.1 The Contractor shall request the Employer to issue a Certificate of Completion of the Works and the Employer will do so upon deciding that the Work is completed.

46. TAKING OVER

46.1 The Employer shall take over the Site and the Works within seven days of issuing a certificate of Completion.

47. FINAL ACCOUNT

47.1 The Contractor shall supply to the Employer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Employer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within 90 days of receiving the Contractor's account if it is correct and complete. If it is not, the Employer shall issue within 90 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Employer shall decide on the amount payable to the Contractor and make payment within 60 days of receiving the Contractor's revised account.

48. AS BUILT DRAWINGS AND /OR OPERATING AND MAINTENANCE MANUALS

48.1 If "As Built Drawings" (Completion Drawing) and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the Contract Data.

48.2 If the Contractor does not supply the Drawings by the dates stated in the Contract Data, or they do not receive the Employer's approval, the Employer shall withhold the amount stated in the Contract Data from payments due to the Contractor.

49. TERMINATION

49.1 The Employer may terminate the Contract if the other party causes a fundamental breach of the Contract.

49.2 Fundamental breaches of Contract include, but shall not be limited to the following:

- (a) the Contractor stops work for 45 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Employer;
- (b) - "DELETED"-
- (c) The Contractor becomes bankrupt or goes into liquidation other than for a reconstruction or amalgamation;
- (d) - "DELETED"-

SECTION – 5: CONDITIONS OF CONTRACT(CC) AND SPECIAL CONDITIONS OF CONTRACT (SCC)

- (e) the Employer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Employer;
- (f) the Contractor does not maintain a security which is required;
- (g) the Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined in the Contract data; and
- (h) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in the executing the Contract.

For the purpose of this paragraph: “corrupt practice” means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution. “Fraudulent practice” means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among Tenderers (prior to or after Tender submission) designed to establish Tender prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition.”

- 49.3 When either party to the Contract gives notice of a breach of contract to the Employer for a cause other than those listed under Sub Clause 49.2 above, the Employer shall decide whether the breach is fundamental or not.
- 49.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.
- 49.5 If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure and leave the Site as soon as reasonably possible.

50. PAYMENT UPON TERMINATION

- 50.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Employer shall prepare bill for the value of the work done less advance payments received up to the date of the bill, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law and less the percentage to apply to the work not completed as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.
- 50.2 If the Contract is terminated at the Employer's convenience, the Employer shall prepare bill for the value of the work done, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract, and less taxes due to be deducted at source as per applicable law and make payment accordingly.

51. PROPERTY

- 51.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a contractor's default.

52. RELEASE FROM PERFORMANCE

- 52.1 If the Contract is frustrated by any event entirely outside the control of either the Employer or the Contractor the Employer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which commitment was made.

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F. SPECIAL CONDITIONS OF CONTRACT

1. LABOUR :

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

The Contractor shall, if required by the Employer, deliver to the Employer a return in detail, in such form and at such intervals as the Employer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Employer may require.

2. COMPLIANCE WITH LABOUR REGULATIONS:

During continuance of the Contract, the Contractor and his sub-contractors shall abide at all times by all existing labour enactments and rules made there under, regulations, notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, Employer shall have the right to deduct any money due to the Contractor including his amount of security deposit. The Employer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

3. PROTECTION OF ENVIRONMENT:

The Contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation. During continuance of the contract, the Contractor and his sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.

4. CLAIMS, DISPUTES AND ARBITRATION

4.1 Contractor's Claims

If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not

SECTION – 5: CONDITIONS OF CONTRACT(CC) AND SPECIAL CONDITIONS OF CONTRACT (SCC)

later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Sub-Clause shall apply.

The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Engineer. Without admitting the Employer's liability, the Engineer may, after receiving any notice under this Sub-Clause, monitor the record-keeping and/or instruct the Contractor to keep and provide further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

Within 45 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

- (a) this fully detailed claim shall be considered as interim;
- (b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and
- (c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Engineer.

Within 45 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within such fixed period of time.

Each Payment Certificate shall include such amounts for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

The Engineer shall proceed in accordance with Sub-Clause: [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Sub-Clause: [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

The requirements of this Sub-Clause are in addition to those of any other Sub-Clause which may apply to a claim. If the Contractor fails to comply with this or another Sub-Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Sub-Clause.

4.2 Amicable Settlement

In case any dispute between the Engineer and the Contractor for which claim has already been made by the contractor, remains unresolved, the Contractor shall, then, give notice of dissatisfaction and intention to commence arbitration to the Employer duly specifying the subject of the dispute or difference as also the amount of claim item wise. The Parties shall make attempts to settle the dispute amicably before the commencement of arbitration as per procedure set by K-RIDE. However, unless both Parties agree otherwise, demand for arbitration may be made by the Contractor after ninety days from the day on which a notice of dissatisfaction and intention to commence arbitration was given, even if no attempt at amicable settlement has been made.

Procedure for Amicable Settlement in contracts

1. Amicable Settlement Committee at senior management level shall make an attempt to resolve the issues/disputes within 90 days of request by the Contractor.
2. The committee shall comprise of the following: -
 - (i) GM /K-RIDE directly in-charge of the project;
 - (ii) Concerned finance officer, and
 - (iii) GM /K-RIDE (in the same order) directly in-charge of the project of other discipline(s) in case the issues involve other discipline(s) of the engineering
3. Whenever the Contractor submits a request for amicable settlement, MD/K-RIDE should forward the same to concerned GM /K-RIDE (in the same order) directly in-charge of the project. GM /K-RIDE on receipt of the same shall issue a note to the concerned finance officer and concerned GM/K-RIDE of other discipline in case the issues involved other discipline(s) of engineering, about the request for amicable settlement to be dealt by them and fix a date in consultation with them for a hearing. The date should then be communicated to the MD/K-RIDE, GM/ /K-RIDE of other department (if the issues involved their department) and Contractor for presenting their case before the Amicable Settlement Committee.
4. This being an additional workload like arbitration, the Committee members shall be paid fee by K-RIDE at the rates payable to the Arbitrators of K-RIDE.

4.3 Arbitration

Any dispute, in respect of which amicable settlement has not been reached, arising between the Employer and the Domestic or Foreign Contractor related to any matter arising out of or connected with this contract, then the contractor shall be entitled to demand in writing that the dispute or difference be referred to arbitration.

Only such dispute(s) or difference(s) in respect of which the demand had been made for amicable settlement under GCC 4.2 but could not be settled, shall be referred to arbitration.

The Arbitration proceedings shall commence from the day, a written and duly quantified demand for arbitration is received by Managing Director, Rail Infrastructure Development Company (Karnataka) Limited, Bangalore /K-RIDE).

The disputes so referred to arbitration shall be settled in accordance with the Indian Arbitration & Conciliation Act, 1996 and any statutory modification or re-enactment thereof.

Any dispute or difference or claim arising out of, or in connection with, or relating to the present contract or the breach, termination or invalidity thereof shall be referred and settled under the Arbitration Centre – Karnataka (Domestic and International) Rules 2012, by one or more arbitrators appointed in accordance with its rules.

4.3.1 Procedure for Appointment of Arbitrators: The arbitrators shall be appointed as per following procedure:

Any dispute or difference or claim arising out of, or in connection with, or relating to the present contract or the breach, termination or invalidity thereof shall be referred and settled under the Arbitration Centre – Karnataka (Domestic and International) Rules 2012, by one or more arbitrators appointed in accordance with its rules.

4.3.2 Arbitration proceedings shall be held at Bangalore, India or at a place where K-RIDE's (dealing the contract) office is located, and the language of the arbitration proceedings and that of all documents and communications between the Parties shall be in English.

4.3.3 Where the Arbitral award is for the payment of money, no interest shall be payable on whole or any part of the money for any period till the date on which the award is made.

4.3.4 The fees and other charges of the conciliator/arbitrators shall be as per the fee structure fixed by the employer with reference to the Rules of Arbitration Centre – Karnataka (Domestic and International) Rules 2012. The cost of arbitration shall be borne equally by the respective parties.

4.3.5 Performance under the contract shall continue during the arbitration proceedings and payments due the Contractor by the Employer shall not be withheld, unless they are the subject matter of the arbitration proceeding.

4.3.6 Excepted matters:

The following are the list of excepted matters in arbitration.

- a. Assistance by Employer for the Stores to be obtained by the Contractor.
- b. Illegal Gratification.
- c. Meaning and intent of specifications and Drawings.
- d. Rates for Non-tendered items of works.
- e. Signing of "No claim Certificate"
- f. Measurement of works.
- g. Provisions of Payment of Wages Act 1936.
- h. Provisions of Contract Labour (Regulation and Abolition) Act, 1970.
- i. Provisions of Employees Compensation Act 1923.
- j. Provisions of Mines Act 1952.
- k. Right of Employer to determine the Contract
- l. Payment on determination of Contract by Employer.
- m. Bonus clause as per clause 26.14 of PCC

5.1 JURISDICTION OF COURTS

The Contract Agreement shall be subject to exclusive jurisdiction of Courts as indicated in the Contract Data. The Jurisdiction of Courts is **Bengaluru, Karnataka**

5.2 Settlement through Court

It is a term of this contract that the Contractor shall not approach any Court of Law for settlement of such disputes or differences unless an attempt has first been made by the parties to settle such disputes or differences through Dispute resolution as above.

6. If K-RIDE wishes to engage third party consultants for quality control assessment, apart from the K-RIDE quality control and field tests, the Contractor should co-operate with both Quality control authorities and the third party.
7. Defect liability period will be ONE Year from the date of commercial operations of the Section/Corridor.
8. Royalty Charges shall be recovered as per the prevailing rates by the Department of Mines & Geology, if not paid by the Contractor.
9. As per GO No. CD/300/ LET/ 2006: Dated 18-12-2007, 1% cess will be deducted from the bill as per labour welfare act.
10. All the works are to be carried out as per the Standard specification Issued from time to time.

SECTION – 6
CONTRACT DATA

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K-RIDE

SECTION 6: CONTRACT DATA

Items marked "N/A" do not apply in this Contract.

The following documents are also part of the Contract:

Clause Reference

- The Methodology and Program of Construction (25 of GCC)
- Site Investigation Reports (14 of GCC)
- The Schedule of Key and Critical Equipment to be deployed on the work as per agreed program of construction. (3.3 of ITT, 25 GCC)

The Employer is:

Name: K-RIDE

(1.1 of GCC)

Address: K-RIDE, Bangalore

Name of authorized Representative: K-RIDE

“NAME OF WORK: “Design and Construction of Elevated Viaduct of Length 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 km) including ramps and Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade Section of Length 17.551 km (CH:-0.964 Km to CH:-0.675 Km, CH: -0.050 km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other Related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding Station Buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.

The proposed work is in connection with the Corridor- 2 of Suburban railway work between Benniganahalli and Chikkabanavara from approx. Km: (-) 0.964 to 24.425 (Including sidings).

The start date shall be the date of issue of notice to proceed with the work. [1.1 of GCC]

The Intended Completion Date for the whole of the Works is 27 MONTHS INCLUDING MONSOON with the following milestones - [17, 26 of GCC]

MILESTONE DATES:

Physical works to be completed as per Milestones

i) FOR VIADUCT PORTION:

Key Dates No. (Mile stone)	Description of stage (Physical works to be completed)	Period from the date of issue of notice to proceed with the work (In days)
KD 1	Completion of 1 st working pile	90
KD 2	Start of casting of Box girder segments	110
KD-3	Casting of first pier after approval of mark up	120
KD 4	Start of Erection of box girder/ U girder	190
KD 5	Partial access of Viaduct (for a minimum length of 3 km) to track contractor for laying track	400
KD 6	Partial access of viaduct (for a minimum length of 3 km) to S&T and Electrical contractors for their respective works	450
KD 7	Access of viaduct in entire length to track contractor for laying track.	630
KD 8	Access of viaduct in entire length to S&T and Electrical contractors for their respective works.	730
KD 9 (Taking over date)	Completion of Entire Work as per the contract	825 Days (27 months)

ii) FOR 'AT-GRADE' PORTION:

Key Dates No. (Mile stone)	Description of stage (Physical works to be completed)	Period from the date of issue of notice to proceed with the work
KD 1	Start of earthwork in embankment /cutting	60
KD 2	Completion of 2 km of embankment /cutting	130
KD-3	Start of one minor bridge	80
KD 4	Completion of 15 minor bridges	270
KD 5	Partial access of section (for a minimum length of 4 km) to track contractor for laying track	470

KD 6	Partial access of section (for a minimum length of 4 km) to S&T and Electrical contractors for their respective works	550
KD 7	Access of section in entire length to track contractor for laying track.	630
KD 8	Access of section in entire length to S&T and Electrical contractors for their respective works.	710
KD 9 (Taking over)	Completion of Entire Work as per the contract	825 Days (27 Months)

The work front/ Possession of site will be provided progressively.

The site is located in Bangalore and the alignment is from Benniganahalli to Chikkabanavara. The index map drawing is attached.

The Defect Liability period is One year.

The insurance requirement is as below.

SI No.	Type of Cover	Minimum cover for Insurance
(i)	Works and Plant and materials	The sum stated in the Agreement plus 20%
(ii)	Loss or damage to equipment	Full replacement cost
(iii)	Loss or damage to property of Third Party	Full replacement cost
(iv)	Personal injury or death insurance	Rs. 10 Cr. For occurrence without any limit for number of occurrences. The Contractor to take appropriate policy.
	(a) for Third Party	
	(b) for Contractor's employees or labour	In accordance with the statutory requirements applicable to Karnataka.

PRICE ADJUSTMENT:

CHANGE IN COSTS - PRICE ADJUSTMENT

PRICE ADJUSTMENT CLAUSE FOR WORKS CONTRACTS: Refer Particular Conditions of Contract, Clause: Price adjustment clause

The liquidated damages for the whole of the works are

The liquidity damages for each Key dates/milestone has been indicated at Annexure-1 of Works/Employers requirement section for not achieving the Key Date/ Milestone for each Day. The maximum amount of liquidated damages for the whole of the works is Ten percent of final contract price: [GCC 41]

The amounts of the advance payment are:

[GCC 42]

Nature of Advance	Amount Rs.	Conditions to be fulfilled
Mobilization	5% of the contract price (In Two Installments)	On submission of unconditional bank guarantee (further details are in Particular conditions of contract)

(The advance payment will be paid to the contractor no later than 30 days after fulfillment of the above condition.)

Repayment of advance payment for mobilization:

The recovery of the Mobilization and Plant and Machinery Advances shall be made from each bill in equal monthly instalments commencing after 15% of contract value is billed and recovery to be completed within 85% of the contract value and the recovery shall be made at the rate 10% of the amount the Interim payment certificate until such time as loan has been repaid, always provided that the loan shall be completely repaid prior to the expiry of the original time for completion pursuant to Clauses 17 and 26.

The date by which “as-built” drawings (in suitable scale) in 2 sets are required is within 30 days of issue of certificate of completion of Whole or Section of the Work as the case may be. [GCC 48]

The following events shall also be fundamental breach of the contract: [GCC 49.2]

The contractor has contravened Sub-clause 7.1 and Clause 9 of Condition of contract.

The percentage to apply to the value of the work not completed representing the Employer's additional cost for completing the works shall be **30%** [GCC 50.1]

Jurisdiction of Courts:

Jurisdiction of Courts is Bengaluru, Karnataka

SECTION-7

PARTICULAR CONDITIONS OF CONTRACT (PCC)

PARTICULAR CONDITIONS OF CONTRACT (PCC)

The following Particular Conditions of Contract (PCC) shall supplement the Conditions of Contract CC/GCC/SCC/Contract Data. Whenever there is a conflict, the provisions herein shall prevail over those in the CC/GCC/SCC/Contract Data. The conditions indicated in PCC will be on priority as compared to the conditions of CC/GCC/SCC/Contract Data.

CC/SCC REFERENCE CLAUSE	DESCRIPTION
Clause-1/CC Definitions	<p>The following paras are added to the Existing CC Clauses.</p> <p>“Contract Agreement” The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless they agree otherwise.</p> <p>“Letter of Acceptance” means the letter of formal acceptance, signed by the Employer, of the Letter of Bid, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression “Letter of Acceptance” means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.</p> <p>“Letter of Bid” means the document entitled letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.</p> <p>“Drawings” means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.</p> <p>“Schedules” means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bid, as included in the Contract. Such document may include the Price schedule, data, lists, and schedules of rates and/or prices.</p> <p>“Bid/Tender” means the Letter of Technical Bid and Letter of Price Bid and all other documents which the Contractor submitted with the Letter of Technical Bid and Letter of Price Bid, as included in the Contract.</p> <p>“Employer’s Requirements” means the document entitled ‘Employer’s Requirements’ as part of Works Requirements and as included in the Contract, and any additions and modifications to such document in accordance with the Contract. Such document specifies the purpose, scope, and/or design and/or other technical criteria, for the works.</p> <p>Parties and Persons</p> <p>“Party” means the Employer or the Contractor, as the context requires.</p> <p>“Engineer” means the person nominated by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under New-Clause 3.4 [Replacement of the Engineer]. The person nominated to act as an engineer may be an employee of Rail Infrastructure Development Company (Karnataka) Ltd (K-RIDE) or an employee of a Project Management Consultancy firm engaged by K-RIDE for project management as per the discretion of the Employer.</p> <p>“Contractor’s Representative” means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under New-Clause 4.3 [Contractor’s Representative], who acts on behalf of the Contractor.</p>

“Employer’s Representative” means the person named by the Employer in the Contract or appointed from time to time by the Employer who acts on behalf of the Employer.

“Employer’s Personnel” means the Engineer, the assistants referred to in New-Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer’s Personnel.

“Contractor’s Personnel” means the Contractor’s Representative and all personnel whom the Contractor utilises on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.

“Base Date” means the date 28 days prior to the deadline for submission of bids.

“Tests on Completion” means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under Clause 30 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.

“Day” means any (working or non-working) calendar day from 00:00 hrs. to 24:00 hrs.

“Time Periods” Any reference to time period commencing “from” the specified day or date “till” or “until” a specified day shall include both such days.

Any reference to **“Time”** shall be according to Indian Standard Time (IST).

Money and Payments

“Accepted Contract Amount” means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects. In the Letter of Acceptance, the Accepted Contract Amount shall have two components i.e. (i) the base amount including GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).

“Cost” means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

“Final Statement” means the statement defined in Sub-Clause 37.12 [Application for Final Payment Certificate].

“Foreign Currency” means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.

“Local Currency” means the currency in Indian Rupees.

“Statement” means a statement submitted by the Contractor as part of an application, under Clause 37 and 40 [Contract Price and Payment], for a payment certificate

Works and Goods

“Contractor’s Equipment” means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor’s Equipment excludes Temporary Works, Employer’s Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.

“Goods” means Contractor’s Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

“Permanent Works” means the permanent works to be executed by the Contractor under the Contract.

“Section” means a part of the Works specified in the Contract Data as a Section (if any).

“Temporary Works” means all temporary works of every kind (other than Contractor’s Equipment) required on Site for the execution and completion of the Permanent Works and the remedying of any defects.

Other Definitions

“Contractor’s Documents” means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

“Country” means India, the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.

“Employer’s Equipment” means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

“Laws” means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

“Site” means the places where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

“Unforeseeable” means not reasonably foreseeable and against which adequate preventive precautions could not reasonably be taken by an experienced contractor by the date for submission of the Bid.

“Railway” means a railway, or any portion of a railway for public carriage of passengers and goods as defined in the Railways ACT 1989. Any reference to railway means the Indian Railways and the respective Zonal Railway

(a) References to any legislation or any provision thereof shall include amendment or re-enactment or consolidation of such legislation or any provision thereof so far as such amendment or re-enactment or consolidation applies or is capable of applying to any transaction entered into hereunder;

(b) References to laws of India or Indian law or regulation having the force of law shall include the laws, acts, ordinances, rules, regulations, bye laws or notifications which have the force of law in the territory of India and as from time to time may be amended, modified, supplemented, extended or re-enacted;

(c) **References to a “person”** and words denoting a natural person shall be construed as a reference to any individual, firm, company, corporation, society, trust, government, state or agency of a state or any association or partnership (whether or not having separate legal personality) of two or more of the above and shall include successors and assigns;

(d) **References to “construction” or “building” include**, unless the context otherwise requires, survey and investigation, design, developing, engineering, procurement, supply of plant, materials, equipment, labour, delivery, transportation, installation, processing, fabrication,

testing, and commissioning of the Railway Project, including maintenance during the Construction Period, removing of defects, if any, and other activities incidental to the construction and “construct” or “build” shall be construed accordingly;

(e) The damages payable by either Party to the other of them, as set forth in this Agreement, whether on per diem basis or otherwise, are mutually agreed genuine pre-estimated loss and damage likely to be suffered and incurred by the Party entitled to receive the same and are not by way of penalty (the “Damages”);

“**Agreement**” means this Agreement, its Recitals, the Schedules hereto and any amendments thereto made in accordance with the provisions contained in this Agreement;

“**Applicable Laws**” means all laws, brought into force and effect by GOI or the State Government(s) including rules, regulations and notifications made thereunder, and judgements, decrees, injunctions, writs and orders of any court of record, applicable to this Agreement and the exercise, performance and discharge of the respective rights and obligations of the Parties hereunder, as may be in force and effect during the subsistence of this Agreement;

“**Applicable Permits**” means all clearances, licenses, permits, authorisations, no objection certificates, consents, approvals and exemptions required to be obtained or maintained under Applicable Laws in connection with the construction of the Railway Project during the subsistence of this Agreement;

“**Defect**” means any defect or deficiency in Construction of the Works or any part thereof, which does not conform with the Specifications and Standards;

“**Encumbrances**” means, in relation to the Railway Project, any encumbrances such as mortgage, charge, pledge, lien, hypothecation, security interest, assignment, privilege or priority of any kind having the effect of security or other such obligations, and shall include any designation of loss payees or beneficiaries or any similar arrangement under any insurance policy pertaining to the Railway Project, where applicable herein but excluding utilities referred to in Clause 9.1;

“**EPC**” means engineering, procurement and construction

“**Good Industry Practice**” means the practices, methods, techniques, designs, standards, skills, diligence, efficiency, reliability and prudence which are generally and reasonably expected from a reasonably skilled and experienced contractor engaged in the same type of undertaking as envisaged under this Agreement and which would be expected to result in the performance of its obligations by the Contractor in accordance with this Agreement, Applicable Laws and Applicable Permits in reliable, safe, economical and efficient manner;

“**Government Instrumentality**” means any department, division or sub-division of the Government or the State Government and includes any commission, board, authority, agency or municipal and other local authority or statutory body, including panchayat, under the control of the Government or the State Government, as the case may be, and having jurisdiction over all or any part of the Railway Project or the performance of all or any of the services or obligations of the Contractor under or pursuant to this Agreement;

“**Important Bridge**” means a bridge having a linear waterway of 300 metres or a total water way of 1000 sqm or more;

“Intellectual Property” means all patents, trademarks, service marks, logos, get-up, trade names, internet domain names, rights in designs, blue prints, programmes and manuals, drawings, copyright (including rights in computer software), database rights, semi-conductor, topography rights, utility models, rights in know-how and other intellectual property rights, in each case whether registered or unregistered and including applications for registration, and all rights or forms of protection having equivalent or similar effect anywhere in the world;

“Major Bridge” means a bridge having a linear waterway of 18 meters or more or which has a clear opening of 12 meters or more in spans;

“Material Adverse Effect” means a material adverse effect of any act or event on the ability of either Party to perform any of its obligations under and in accordance with the provisions of this Agreement and which act or event causes a material financial burden or loss to either Party;

“Minor Bridge” means a bridge having a linear waterway of less than 18 meters or which has a clear opening of less than 12 meters or in spans;

“Power Block” means the length of the railway line between two railway stations, on which the overhead equipment (OHE) is de-energized and earthed to enable the Contractor to execute construction or maintenance works

“Project Assets” means all physical and other assets relating to (a) tangible assets such as civil works and equipment including [foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road over-bridges, drainage works, traffic signals, sign boards, kilometer-stones, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices]; and (b) Project Facilities situated on the Site;

“Right of Way” means the constructive possession of the Site free from encroachments and encumbrances, together with all way leaves, easements, unrestricted access and other rights of way, howsoever described, necessary for construction of the Railway Project in accordance with this Agreement;

“Specifications and Standards” means the specifications and standards relating to the quality, quantity, capacity and other requirements for the Railway Project, as set forth in Schedule-D, and any modifications thereof, or additions thereto, as included in the design and engineering for the Railway Project submitted by the Contractor to, and expressly approved by, the Authority;

“Sub-contractor” means any person or persons to whom a part of the Works has been subcontracted by the Contractor and the permitted legal successors in title to such person, but not an assignee to such person;

“Works” means all works including survey and investigation, design, engineering, procurement, construction, Plant, Materials, temporary works and other things necessary to complete the Railway Project in accordance with this Agreement; and

“WPI” means the wholesale price index for various commodities as published by the Ministry of Commerce and Industry, GOI and shall include any index which substitutes the WPI, and any reference to WPI shall, unless the context otherwise requires, be construed as a reference to the WPI published for the period ending with the preceding month.

<p>Clause-1/CC</p>	<p>The following paras are added to the Existing CC Clauses.</p> <p>Employers Name and Address: K-RIDE (Rail Infrastructure Development Company (Karnataka) Limited) (A Joint venture of GoK and MoR) #8 , 1st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall Rajaji Nagar 1st Block Bangalore – 560010 Tele: +91 7410004083</p> <p>Employers Representative and address: General Manager/Civil (Projects/Corridor-2) K-RIDE, K-RIDE (Rail Infrastructure Development Company (Karnataka) Limited) #8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall Rajaji Nagar 1st Block Bangalore – 560010 Tele: +91 7410004083 E – Mail: gmcivil4@K-RIDE.in</p>
<p>Clause -2.1/CC Interpretation.</p>	<p>The following paras are added to the Existing CC Clauses.</p> <p>(a) provisions including the word “agree,” “agreed” or “agreement” require the agreement to be recorded in writing;</p> <p>(b) “written” or “in writing” means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and</p> <p>(c) the word “tender” is synonymous with “bid”, and “tenderer” with “bidder” and the words “tender documents” with “bidding documents”</p>
<p>Clause-2.2/CC. Priority of Documents</p>	<p>Replace the existing sub clause 2.2 of CC</p> <p>The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:</p> <ol style="list-style-type: none"> 1. Contract Agreement (if any), 2. Letter of Acceptance, notice to proceed to works, 3. Letter of bid/Contractor tender, 4. Addendum/Corrigendum including Reply to pre bid queries, 5. Schedules (including Priced Schedule), 6. Particular Conditions of Contract, 7. Conditions of Contract/SCC and Contract Data 8. Works/Employer’s Requirements, 9. Technical Specifications, 10. Drawings, 11. any other documents forming part of the Contract.

	If an ambiguity or discrepancy is found in the documents, the Engineer shall issue necessary clarification or instruction.
Clause-6.1/CC, Communications	<p>The following para is added to the existing CC clause:</p> <p>Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be: in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and delivered, sent or transmitted to the address for the recipient's communications as stated in the Contract Data.</p>
Clause- 7/CC	<p>The following paras are added to the Existing CC Clauses.</p> <p>7.1 Definition of nominated/identified Subcontractor</p> <p>In the Contract, "Nominated Subcontractor/ Identified subcontractor" means a Subcontractor:</p> <ul style="list-style-type: none"> (a) who is stated in the Contract as being a nominated Subcontractor, or (b) whom the Engineer, under Clause 7/CC [Sub-contracting], instructs the Contractor to employ as a Subcontractor. <p>Sub-contractors</p> <p>The Contractor shall not subcontract the whole of the Works. The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor.</p> <p>Unless otherwise stated in the Conditions of Contract:</p> <ul style="list-style-type: none"> (a) The Contractor shall not be required to obtain consent to suppliers solely of Materials, or to a subcontract for which the Subcontractor is named in the Contract or as specifically provided in the Contract data or value of any sub-contract for Works, provided that such works are not for the key activities. (b) The prior consent of the Engineer shall be obtained to other proposed Subcontractors and/or suppliers. While submitting his proposal in this regard, the Contractor shall ensure that; <ul style="list-style-type: none"> (i) Total value of Works requiring such consent for subcontracting shall not be more than 50% (fifty per cent) of the Contract Price; (ii) The proposed subcontractor must have executed works of 40% of value of the proposed subcontract through a single contract during last seven years; and (iii) No banning/blacklisting/declaration as poor performer by K-RIDE is in force on the proposed subcontractor (on the date of grant of consent by the Engineer); (iv) No contract of the proposed subcontractor has been terminated by K-RIDE during the last two years (to be reckoned from the date of grant of consent by the Engineer); (v) The Contractor shall submit the proposal for subcontracting with the name, particulars and the relevant experience of the proposed subcontractor. (c) The Contractor shall give the Engineer not less than 28 days' notice of the intended date of the commencement of each Subcontractor's work, and of the commencement of such work on the Site; (d) Each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under New-Clause 4.23/PCC [Assignment of

	<p>Benefit of Subcontract] (if or when applicable) or in the event of termination under Sub-Clause 49.7/PCC. [Termination by Employer]; and</p> <p>(e) On getting consent from the Engineer, the Contractor shall provide to the Engineer copy of the agreement entered with such subcontractor.</p> <p>The Contractor shall ensure that the requirements imposed on the Contractor by New-Clause 1.6/PCC [Confidential Details] apply equally to each Subcontractor.</p> <p>Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.</p> <p>The Contractor shall endeavor to resolve all matters and payments amicably and speedily with the sub-contractors.</p> <p>The Contractor shall indemnify and hold the Employer harmless against and from any claim of subcontractors or suppliers of the materials.</p> <p>The Contractor shall release payment to the Sub-contractors/Suppliers promptly and shall endeavor to resolve all issues amicably and speedily with the Sub-contractors/Suppliers, so that the execution of work is not affected in any manner whatsoever.</p> <p>In case a Sub-contractor/Supplier represents to the Engineer in writing with supporting documents, stating that he has not received payment due as per the agreement/work or purchase order for the works executed by such Sub-contractor or supplies made by such Supplier, which have been covered in previous Payment Certificates and the Engineer finds such representation having merit, the Engineer, before issuing next Payment Certificate, may forward a copy of the representation to the Contractor requesting the Contractor to supply reasonable evidence that the amount stated to be outstanding by the Sub-contractor/Supplier for the works executed or supplies made, which have been covered in previous Payment Certificates has been paid and if not, why the same is not payable. The Engineer may recommend to make payment to the Sub-contractor/Supplier unless the Contractor submits reasonable evidence to the Engineer:</p> <ul style="list-style-type: none"> (i) that the amount claimed has been paid, or (ii) satisfying the Engineer in writing that the Contractor is entitled to withhold or that the amount is not payable. <p>On the recommendation of the Engineer, the Employer may (at his sole discretion) directly pay to the Sub-contractor/Supplier the amount due for and on behalf of the Contractor, part or all of such amounts previously certified (less applicable deductions) as are found due to the Sub-contractor/Supplier by the Engineer. The Employer shall adjust the amount paid directly to the Sub-contractor/Supplier from any amount due by it to the Contractor. The Contractor shall repay the amount, in case no amount is found due by the Employer to the Contractor.</p> <p>That the payment by Employer, on behalf of the Contractor to its Sub-contractor/Supplier, shall not alter any terms of agreement between the Employer and the Contractor and nor the same shall result in any privity of contract between the Employer and the Sub-contractor/Supplier.</p> <p>Assignment of Contractor's and Sub-contractor's Obligations:</p> <p>The Contractor shall not assign a right or benefit under the Contract without first obtaining Employer's prior written consent, otherwise than by:</p> <ul style="list-style-type: none"> A. a charge in favor of the Contractor's bankers of any money due or to become due under the Contract, or
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B. assignment to the Contractor's insurers (in cases where the insurers have discharged the Contractor's loss or liability) of the Contractor's right to obtain relief against any other party liable.

If a Subcontractor's obligations extend beyond the expiry date of Defects Liability Period, then the Contractor shall assign the benefits of such obligations to the Employer.

In the event that a sub-contractor of any tier provides to the Contractor or any other sub-contractor a warranty in respect of Plant, Materials or services supplied in connection with the Works, or undertakes a continuing obligation of any nature whatsoever in relation to such Plant, Materials or services (including without limitation an obligation to maintain stocks of spare parts) extending for a period exceeding that of the Defects Liability Period or where there is more than one Defects Liability Period exceeding that of the latest Defects Liability Period, and if the Engineer so directs in writing within 21 days of the expiry of the Defects Liability Period or the latest Defects Liability Period (as the case may be), the Contractor shall immediately assign or obtain the assignment of the benefit of such warranty or obligation to the Employer or at the direction of the Employer, to any third party.

Specialist Subcontracting

If an Applicant intends to subcontract any highly specialized elements of the Works to specialist subcontractors, such elements and the proposed subcontractors shall be clearly identified, and the experience and capacity of the subcontractors shall be described in the relevant Information Forms.

Acceptable Substitutes

With reference to subcontracting & specialist subcontracting, the Employer may require Applicants to provide more information about their proposals. If any proposed subcontractor is found ineligible or unsuitable to carry out an assigned task, the Employer may request the Applicant to propose an acceptable substitute, and may conditionally pre-qualify the Applicant accordingly, before issuing an invitation to tender.

7.2 Objection to Nomination

The Contractor shall not be under any obligation to employ a nominated Subcontractor against whom the Contractor raises reasonable objection by notice to the Engineer as soon as practicable, with supporting particulars. An objection shall be deemed reasonable if it arises from (among other things) any of the following matters, unless the Employer agrees to indemnify the Contractor against and from the consequences of the matter:

- (a) there are reasons to believe that the Subcontractor does not have sufficient competence, resources or financial strength;
- (b) the subcontract does not specify that the nominated Subcontractor shall indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, his agents and employees; or
- (c) the subcontract does not specify that, for the subcontracted work (including design, if any), the nominated Subcontractor shall:
 - (i) undertake to the Contractor such obligations and liabilities as will enable the Contractor to discharge his obligations and liabilities under the Contract, and
 - (ii) Indemnify the Contractor against and from all obligations and liabilities arising under or in connection with the Contract and from the consequences of any failure by the Subcontractor to perform these obligations or to fulfil these liabilities.

	<p>7.3 Payments to nominated Subcontractors</p> <p>The Contractor shall pay to the nominated Subcontractor the amounts which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with Clause 34/PCC, except as stated in Sub-Clause 7.4/PCC [Evidence of Payments].</p> <p>7.4 Evidence of Payments</p> <p>Before issuing a Payment, Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received (Within 7 days of receipt of previous payment by the contractor) all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor, submits this reasonable evidence to the Engineer, or</p> <ul style="list-style-type: none"> (i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and (ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement, <p>then the Employer may (at his sole discretion) pay, direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in sub-paragraphs (a) or (b) above. The Contractor shall then repay, to the Employer, the amount which the nominated Subcontractor was directly paid by the Employer.</p> <p>7.5 Assignment of Benefit of Subcontract</p> <p>If a Subcontractor's obligations extend beyond the expiry date of the relevant Defects Notification Period and the Engineer, prior to this date, instructs the Contractor to assign the benefit of such obligations to the Employer, then the Contractor shall do so. Unless otherwise stated in the assignment, the Contractor shall have no liability to the Employer for the work carried out by the Subcontractor after the assignment takes effect.</p>
<p>Clause11/CC</p>	<p>The clause 11 of CC is modified as under:</p> <p>Risk and Responsibility</p> <p>11.1 Indemnities</p> <p>The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, Employers Representative and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:</p> <ul style="list-style-type: none"> (a) bodily injury, sickness, disease or death, of any person including railway user whatsoever arising out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless and to the extent that any such damage or loss is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel,, their respective agents, or anyone directly or indirectly employed by any of them.

The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (1) bodily injury, sickness, disease or death, which is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (2) the matters for which liability may be excluded from insurance cover, as described in sub-paragraphs (d)(i), (ii) and (iii) of Sub-Clause 13.8/PCC [Insurance Against Injury to Persons and Damage to Property].

11.2 Contractor's Care of the Works

The Contractor shall take full responsibility for the care of the Works and Goods from the Commencement Date until the Taking-Over Certificate is issued (or is deemed to be issued under Sub-Clause 46.1/PCC [Taking Over of the Works and Sections]) for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued (or is so deemed to be issued) for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer.

After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work which is outstanding on the date stated in a Taking-Over Certificate, until this outstanding work has been completed.

If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in Sub-Clause 11.3/PCC [Employer's Risks], the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

The Contractor shall be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.

11.3 Employer's Risks

The risks referred to herein below, in so far as they directly affect the execution of the works in the Country, are:

- (a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,
- (b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within the Country,
- (c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel,
- (d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity,
- (e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,
- (f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract, and

- (g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible.

11.4 Consequences of Employer's Risks:

If and to the extent that any of the risks listed in Sub-Clause 11.3/PCC above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shall promptly give notice to the Engineer and shall rectify this loss or damage to the extent required by the Engineer.

If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause [Extension of Time for Completion], and
- (b) In the case of sub-paragraphs (f) and (g) of Sub-Clause 11.3/PCC [Employer's Risks], Cost shall be payable.

After receiving this further notice, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine these matters.

11.5.1 Intellectual and Industrial Property Rights

In this Sub-Clause, "infringement" means an infringement (or alleged infringement) of any patent, registered design, copyright, trade mark, trade name, trade secret or other intellectual or industrial property right relating to the Works; and "claim" means a claim (or proceedings pursuing a claim) alleging an infringement.

Whenever a Party does not give notice to the other Party of any claim within 28 days of receiving the claim, the first Party shall be deemed to have waived any right to indemnity under this Sub-Clause.

The Employer shall indemnify and hold the Contractor harmless against and from any claim alleging an infringement which is or was:

- (a) an unavoidable result of the Contractor's compliance with the Contract, or
- (b) a result of any Works being used by the Employer:
 - (i) for a purpose other than that indicated by, or reasonably to be inferred from, the Contract, or
 - (ii) in conjunction with anything not supplied by the Contractor, unless such use was disclosed to the Contractor prior to the Base Date or is stated in the Contract.

The Contractor shall indemnify and hold the Employer harmless against and from any other claim which arises out of or in relation to (i) the manufacture, use, sale or import of any Goods, or (ii) any design for which the Contractor is responsible.

If a Party is entitled to be indemnified under this Sub-Clause, the indemnifying Party may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it. The other Party shall, at the request and cost of the indemnifying Party, assist in contesting the claim. This other Party (and its Personnel) shall not make any admission which might be prejudicial to the indemnifying Party, unless the indemnifying Party

failed to take over the conduct of any negotiations, litigation or arbitration upon being requested to do so by such other Party.

11.5.2 Copyright

As between the Parties, the Contractor shall retain the copyright and other Intellectual Property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor. The Contractor shall be deemed (by signing this Agreement) to give to the Authority a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

- (a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,
- (b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and
- (c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by this Agreement, including replacements of any computers supplied by the Contractor:

11.5.2.1 The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Authority for purposes other than those permitted under this Clause.

11.5.2.2 As between the Parties, the Authority shall retain the copyright and other Intellectual Property rights in this Agreement and other documents made by (or on behalf of) the Authority. The Contractor may, at its cost, copy, use, and obtain communication of these documents for the purposes of this Agreement. They shall not, without the Authority's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the contract.

11.6 Limitation of Liability

Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, provided that this exclusion shall not apply to any obligation of the Contractor to pay Delay Damages to the Employer under Sub-Clause 26.6/PCC [Delay Damages].

The total liability of the Contractor to the Employer, under or in connection with the Contract other than under New-Clause 4.37/PCC [Electricity, Water and Gas], New Clause 4.38/PCC [Employer's Equipment and Free-Issue Material], Sub-Clause 11.1/PCC [Indemnities] and Sub-Clause 11.5/PCC [Intellectual and Industrial Property Rights], shall not exceed the sum as specified in the Contract Data or if nothing is specified in the Contract Data, the accepted Contract Amount.

This Sub-Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

Maximum total liability of Contractor is accepted contract amount.

	<p>11.7 Use of Employer's Accommodation/ Facilities</p> <p>The Contractor shall take full responsibility for the care of the Employer provided accommodation and facilities, if any, as detailed in the Specification, from the respective dates of hand-over to the Contractor until cessation of occupation (where hand-over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works).</p> <p>If any loss or damage happens to any of the above items while the Contractor is responsible for their care arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at his own cost, rectify the loss or damage to the satisfaction of the Engineer.</p>
<p>Clause 13/CC</p>	<p>The following paras are added to the Existing CC Clauses.</p> <p>INSURANCE</p> <p>13.6 General Requirements for Insurances</p> <p>In this Clause, "insuring Party" means, for each type of insurance, the Party responsible for effecting and maintaining the insurance specified in the relevant Sub-Clause.</p> <p>Wherever the Contractor is the insuring Party, each insurance shall be effected with insurers and in terms approved by the Employer. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this Clause.</p> <p>If a policy is required to indemnify joint insured, the cover shall apply separately to each insured as though a separate policy had been issued for each of the joint insured. If a policy indemnifies additional joint insured, namely in addition to the insured specified in this Clause, (i) the Contractor shall act under the policy on behalf of these additional joint insured except that the Employer shall act for Employer's Personnel, (ii) additional joint insured shall not be entitled to receive payments directly from the insurer or to have any other direct dealings with the insurer, and (iii) the insuring Party shall require all additional joint insured to comply with the conditions stipulated in the policy.</p> <p>The Contractor shall provide to the Authority, within 30 days of the Appointed Date, evidence of professional liability insurance maintained by its Design Director and/or consultants to cover the risk of professional negligence in the design of Works. The professional liability cover shall be for a sum of not less than [3% (three per cent)] of the Contract Price and shall be maintained until the end of the Defects Liability Period.</p> <p>Waiver of subrogation</p> <p>All insurance policies in respect of the insurance obtained by the Contractor pursuant to this Insurance clause shall include a waiver of any and all rights of subrogation or recovery of the insurers thereunder against, inter alia, the Authority, and its assigns, successors, undertakings and their subsidiaries, Affiliates, employees, insurers and underwriters, and of any right of the insurers to any set-off or counterclaim or any other deduction, whether by attachment or otherwise, in respect of any liability of any such person insured under any such policy or in any way connected with any loss, liability or obligation covered by such policies of insurance.</p> <p>Cross liabilities</p> <p>Any such insurance maintained or effected in pursuance of this Insurance clause shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Authority as separately insured.</p>

Accident or injury to workmen

Notwithstanding anything contained in this Agreement, it is hereby expressly agreed between the Parties that the Authority shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or Sub-contractor, save and except as for death or injury resulting from any act, omission or default of the Authority, its agents or servants. The Contractor shall indemnify and keep indemnified the Authority from and against all such claims, proceedings, damages, costs, charges, and expenses whatsoever in respect of the above save and except for those acts, omissions or defaults for which the Authority shall be liable.

Insurance against accident to workmen

The Contractor shall effect and maintain during the Agreement such insurances as may be required to insure the Contractor's personnel and any other persons employed by it on the Railway Project from and against any liability incurred in pursuance of this Insurance clauses Provided that for the purposes of this para, the Contractor's personnel/any person employed by the Contractor shall include the Sub-contractor and its personnel. Provided further that in respect of any persons employed by any Sub-contractor, the Contractor's obligations to insure as aforesaid under this para shall be discharged if the Sub-contractor shall have insured against any liability in respect of such persons in such manner that the Authority is indemnified under the policy. The Contractor shall require such Sub-contractor to produce before the Authority, when required, such policy of insurance and the receipt for payment of the current premium within 10 (ten) days of such demand being made by the Authority.

Application of insurance proceeds

The proceeds from all insurance claims, except for life and injury, shall be applied for any necessary repair, reconstruction, reinstatement, replacement, improvement, delivery or installation of the Railway Project and the provisions of this Agreement in respect of construction of Works shall apply mutatis mutandis to the Works undertaken out of the proceeds of insurance.

Compliance with policy conditions

The Contractor expressly acknowledges and undertakes to fully indemnify the Authority from and against all losses and claims arising from the Contractor's failure to comply with conditions imposed by the insurance policies effected in accordance with this Agreement.

Periods for submission of insurance:

- a) evidence of insurance: Before start date of work.
- b) relevant policies: Before start date of work.

Each policy insuring against loss or damage shall provide for payments to be made in the currencies required to rectify the loss or damage. Payments received from insurers shall be used for the rectification of the loss or damage.

The relevant insuring Party shall, within the respective periods stated in the Contract Data (calculated from the Commencement Date), submit to the other Party:

- (a) evidence that the insurances described in this Clause have been effected, and

(b) copies of the policies for the insurances described in Sub-Clause 13.7/PCC [Insurance for Works and Contractor's Equipment] and Sub-Clause 13.8/PCC [Insurance against Injury to Persons and Damage to Property].

(c) If the contractor fails to submit evidence and copies of the policies as mentioned in (a) & (b) above to prove that the policies have been obtained within the period specified in the contract data, and submits the same later on and from the submitted evidence it is found that the policies have not been obtained within the period specified, the Employer shall recover double the cost of the premium for the period the policies have been delayed.

When each premium is paid, the insuring Party shall submit evidence of payment to the other Party. Whenever evidence or policies are submitted, the insuring Party shall also give notice to the Engineer.

Each Party shall comply with the conditions stipulated in each of the insurance policies. The insuring Party shall keep the insurers informed of any relevant changes to the execution of the Works and ensure that insurance is maintained in accordance with this Clause.

Neither Party shall make any material alteration to the terms of any insurance without the prior approval of the other Party. If an insurer makes (or attempts to make) any alteration, the Party first notified by the insurer shall promptly give notice to the other Party.

If the insuring Party fails to effect and keep in force any of the insurances it is required to effect and maintain under the Contract, or fails to provide satisfactory evidence and copies of policies in accordance with this Sub-Clause, the other Party may (at its option and without prejudice to any other right or remedy) effect insurance for the relevant coverage and pay the premiums due. The insuring Party shall pay double the amount of these premiums to the other Party, and the Contract Price shall be adjusted accordingly.

Nothing in this Clause limits the obligations, liabilities or responsibilities of the Contractor or the Employer, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor and/or the Employer in accordance with these obligations, liabilities or responsibilities. However, if the insuring Party fails to effect and keep in force an insurance which is available and which it is required to effect and maintain under the Contract, and the other Party neither approves the omission nor effects insurance for the coverage relevant to this default, any moneys which should have been recoverable under this insurance shall be paid by the insuring Party.

Payments by one Party to the other Party shall be subject to New-Clause 2.4/PCC [Employer's Claims] or Sub-Clause 4.1/SCC [Contractor's Claims], as applicable.

The Contractor shall be entitled to place all insurance relating to the Contract (including, but not limited to the insurance referred to Clause 13/CC/PCC with insurers from any eligible source country.

13.7 Insurance for Works and Contractor's Equipment

The Contractor shall insure the Works, Plant, Materials, including those issued by the Employer and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit, subject to a

maximum value indicated in Contract Data. This insurance shall be effective from the date by which the evidence is to be submitted under sub-paragraph (a) of Sub-Clause 13.6/PCC [General Requirements for Insurances], until the date of issue of the Taking-Over Certificate for the Works.

The insuring Party shall maintain this insurance to provide cover until the date of issue of the Performance Certificate, for loss or damage for which the Contractor is liable arising from a cause occurring prior to the issue of the Taking-Over Certificate, and for loss or damage caused by the Contractor in the course of any other operations (including those under New-Clause 6/PCC [Defects Liability]).

The insuring Party shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.

Unless otherwise stated in the Conditions of Contract/SCC, insurances under this Sub-Clause:

- (a) shall be effected and maintained by the Contractor as insuring Party,
- (b) shall be in the joint names of the Parties, who shall be jointly entitled to receive payments from the insurers, payments being held or allocated between the Parties for the sole purpose of rectifying the loss or damage,
- (c) shall cover all loss and damage from any cause not listed in Sub-Clause 11.3/PCC [Employer's Risks],
- (d) shall also cover loss or damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works, and loss or damage from the risks listed in sub-paragraphs (c), (g) and (h) of Sub-Clause 11.3/PCC [Employer's Risks], excluding (in each case) risks which are not insurable at commercially reasonable terms, with deductibles per occurrence of not more than the amount stated in the Contract Data (if an amount is not so stated, this sub-paragraph (d) shall not apply), and
- (e) may however exclude loss of, damage to, and reinstatement of:
 - i) part of the Works which is in a defective condition due to a defect in its design, materials or workmanship (but cover shall include any other parts which are lost or damaged as a direct result of this defective condition and not as described in sub-paragraph (ii) below),
 - ii) a part of the Works which is lost or damaged in order to reinstate any other part of the Works if this other part is in a defective condition due to a defect in its design, materials or workmanship,
 - iii) a part of the Works which has been taken over by the Employer, except to the extent that the Contractor is liable for the loss or damage, and
 - iv) [DELETED]

If, more than one year after the Base Date, the cover described in sub-paragraph (d) above ceases to be available at commercially reasonable terms, the Contractor shall (as insuring Party) give notice to the Employer, with supporting particulars. The Employer shall then (i) be entitled subject to New-Clause 2.4/PCC [Employer's Claims] to payment of an amount equivalent to such commercially reasonable terms as the Contractor should have expected to have paid for such cover, and (ii) be deemed, unless he obtains the cover at commercially

reasonable terms, to have approved the omission under Sub-Clause 13.6/PCC [General Requirements for Insurances].

13.8 Insurance against injury to Persons and Damage to Property

The insuring Party shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except things insured under Sub-Clause 13.7/PCC [Insurance for Works and Contractor's Equipment]) or to any person (except persons insured under Sub-Clause 13.9/PCC [Insurance for Contractor's Personnel]), which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

This insurance shall be for a limit per occurrence of not less than the amount stated in the Contract Data, with no limit on the number of occurrences. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

Unless otherwise stated in the Special Conditions of Contract, the insurances specified in this Sub-Clause:

- (a) shall be effected and maintained by the Contractor as insuring Party,
- (b) shall be in the joint names of the Parties,
- (c) shall be extended to cover liability for all loss and damage to the Employer's property including Railways Property (except things insured under Sub-Clause 13.7/PCC) arising out of the Contractor's performance of the Contract, and
- (d) may however exclude liability to the extent that it arises from:
 - (i) the Employer's right to have the Permanent Works executed on, over, under, in or through any land, and to occupy this land for the Permanent Works,
 - (ii) damage which is an unavoidable result of the Contractor's obligations to execute the Works and remedy any defects, and
 - (iii) a cause listed in Sub-Clause 11.3/PCC [Employer's Risks], except to the extent that cover is available at commercially reasonable terms.

13.9 Insurance for Contractor's Personnel

The Contractor shall abide by the provisions of ESIC Act, 1948 (extended from time to time) to take care of insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness or disease. In addition, the contractor shall also maintain insurance against liability for claim of death of any person employed by the Contractor or any other of the Contractor's Personnel.

The Employer and the Engineer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.

The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.

Maximum number of deductibles for insurance of Employer's risks: Nil

<p>Clause- 22/CC. Right of Access to the Site</p>	<p>The following para is added to the existing CC clause:</p> <p>The Employer shall give the Contractor right of access to, and possession of, all parts of the Site within the time (or times) stated in the Contract Data. The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Specification. However, the Employer may withhold any such right or possession until the Performance Security has been received.</p> <p>If no such time is stated in the Contract Data, the Employer shall give the Contractor right of access to, and possession of, the Site within such times as may be required to enable the Contractor to proceed in accordance with the programme submitted under Sub-Clause 25.3/PCC [Programme].</p> <p>If the Contractor suffers delay as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled to:</p> <p>(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and</p> <p>After receiving this notice, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine these matters.</p> <p>However, if and to the extent that the Employer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time or new rates.</p> <p>Right of access to the work site will be provided to the successful Contractor. A minimum corridor of 9m will be available. The Contractor to note this while making Launching plans. The Contractor shall prepare, at his cost, approach roads to the site of work and this cost will not be reimbursed by the Employer. The Employer reserves the right to make use of these service roads for themselves or other Contractors working on the project, as and when necessary, without any payment to the Contractor. The barricading to the extent feasible subject to a maximum of 9m width (LHS+RHS) shall be permitted for carrying out the works and suitable barricading width for off-road structures in stages as per the approved sequence of construction. The employer shall grant the contractor right of access to, and/ or possession of the site progressively for the completion of works. The contractor will draw/ modify the schedule for completion of work according to progressive possession/ right of such sites.</p>
<p>Clause 25 of CC</p>	<p>The following paras are added to the Existing CC Clauses.</p> <p>25.3 Programme</p> <p>The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under Sub-Clause 26.3/PCC [Commencement of Works]. The program shall include the physical and Financial Progress vis-à-vis program and forecast cash flow adopting Project Management Software Primavera/Sure Track/MS Project or as mutually agreed. The program must identify the milestones, interface requirements and program reporting elements. The Contractor shall supply, free of cost one set of authorized software to the Engineer and the soft copy of structured program for the project. This shall be updated every month. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include:</p>

	<ul style="list-style-type: none"> (a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design (if any), Contractor's Documents, procurement, manufacture of Plant, delivery to Site, construction, erection and testing, (b) each of these stages for work by each nominated Subcontractor (as defined in Clause 7/PCC [Nominated Subcontractors]), (c) the sequence and timing of inspections and tests specified in the Contract, and (d) a supporting report which includes: <ul style="list-style-type: none"> (i) a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and (ii) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on the Site for each major stage. <p>Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.</p> <p>The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under Sub-Clause 34.2/PCC [Procedure for change of scope].</p> <p>If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer within 15 days in accordance with this Sub-Clause.</p>
<p>Clause 26 of CC</p>	<p>The following paras are added to the Existing CC Clauses.</p> <p>26.3 Commencement of Works</p> <p>The Engineer shall give the Contractor not less than 7 days' notice of the Commencement of work. Unless otherwise stated in the Special Conditions of Contract, the Commencement of work shall be within the number of days after the Contractor receives the Letter of Acceptance as specified in Contract Data.</p> <p>The Contractor shall commence the execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay.</p> <p>26.4 Time for Completion</p> <p>The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including:</p> <ul style="list-style-type: none"> (a) achieving the passing of the Tests on Completion, and

- (b) completing all work which is stated in the Contract as being required for whole of the Works or Section(s) to be considered to be completed for the purposes of taking-over under Sub-Clause 46.1/PCC [Taking Over of the Works and Sections].

26.5 Extension of Time for Completion

The Contractor shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 46.1/PCC [Taking-Over of the Works and Sections] is or will be delayed by any of the following causes:

- a) Delay in providing the Right of Way, [approval of GAD by road authorities,] environmental/ forest clearances, in accordance with the provisions of this Agreement;
- b) Change of Scope, unless an adjustment to the Scheduled Completion Date has been agreed under change of scope.
- c) Variation (unless an adjustment to the Time for Completion has been agreed under Sub-Clause 34.2/PCC [Procedure for change of scope]) or other substantial change in the quantity of an item of work included in the Contract,
- d) a cause of delay giving an entitlement to extension of time under a Sub-Clause of these Conditions,
- e) exceptionally adverse climatic conditions and occurrence of Force Majeure event.
- f) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions, or
- g) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors.

If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with Sub-Clause 4.1/SCC [Contractor's Claims]. When determining each extension of time under Sub-Clause 4.1/SCC the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

26.6 Delays Caused by Authorities

If the following conditions apply, namely:

- (a) the Contractor has diligently followed the procedures laid down by the relevant legally constituted public authorities in the Country,
- (b) these authorities delay or disrupt the Contractor's work, and
- (c) the delay or disruption was Unforeseeable,

then this delay or disruption will be considered as a cause of delay under sub-paragraph (b) of Sub-Clause 26.5/PCC [Extension of Time for Completion].

26.7 Rate of Progress

If, at any time:

- (a) actual progress is too slow to complete within the Time for Completion, and/or

(b) progress has fallen (or will fall) behind the current programme under Sub-Clause 25.3/PCC [Programme],

other than as a result of a cause listed in Sub-Clause 26.5/PCC [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under Sub-Clause 25.3/PCC [Programme], a revised programme and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion.

Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur additional costs, the Contractor shall subject to New-Clause 2.4/PCC [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under Sub-Clause 26.8/PCC below

26.8 Extension of Time for Completion with Delay Damages

If the Contractor fails to comply with Sub-Clause 26.4/PCC [Time for Completion for entire work or for specified section wise completion period], and he is not entitled to an extension of time under sub clause 26.5/PCC then the employer may grant extension of time with delay damage in such case, the Contractor shall subject to New-Clause 2.4/PCC [Employer's Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum stated in the Contract Data, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate. However, the total amount due under this Sub-Clause shall not exceed the maximum amount of delay damages (if any) stated in the Contract Data.

Further, if the contractor fails to achieve physical/financial targets as per the agreed programme for a consecutive period of 3 months without any valid reasons, other than attributable to the contractor, a provisional recovery of delay damages shall be made from the next interim payment certificate @ 1/10th of the sum of delay damages stated in the contract data, for the entire period of 3 months. Such recovery shall continue from the further interim payment certificates till the contractor is able to make good the shortfall and achieve the cumulative targets as per agreed programme. On achieving the cumulative progress targets as per agreed programme, the entire amount recovered till that month, shall be refunded to the contractor in the next interim payment certificate. In case the contractor is unable to make good the shortfall and achieve the cumulative targets resulting in delay in completion of the project, then the provisional recoveries made shall be adjusted against the delay damages to be finally imposed on the contractor.

These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under Sub-Clause 49.7/PCC [Termination by Employer] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under the Contract.

26.9 Suspension of Work

The Engineer may at any time instruct the Contractor to suspend progress of part or all of the Works. During such suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.

The Engineer may also notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following Sub-Clauses 26.10, 26.11 and 26.12 of PCC shall not apply.

26.10 Consequences of Suspension

If the Contractor suffers delay and/or incurs Cost from complying with the Engineer's instructions under Sub-Clause 26.9/PCC [Suspension of Work] and/or from resuming the work, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine these matters.

The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure in accordance with Sub-Clause 26.9/PCC [Suspension of Work].

If suspension is ordered by the Engineer for reasons other than those mentioned in Sub Clause 26.9/PCC then the Contractor's entitlement is in the table below. However, Engineer's decision is final and binding in regard to defining suspension and specifying the suspension period. Contractor has no right to claim or appeal against this decision

Sr. No	Suspension Period	Extension of Time	Compensation for the suspension period	Remarks
1	Up to 60 days	NO	NO	Engineer may give extension of time in exceptional circumstances
2	60-90 days	YES	NO	Extension of time as considered proper by the Engineer
3	Above 90 days	YES	<p>A. As per Daily rate of wages for idle labour/employees</p> <p>B. 70% of the rate for hire charges for idle plant and machinery (excluding cost of fuel and lubricants)</p> <p>C. 15% above all these items to cover overhead costs</p>	Compensation as assessed by the Engineer on submission of documentary proof by the Contractor to Engineer's satisfaction

26.11 Payment for Plant and Materials in Event of Suspension

The Contractor shall be entitled to payment of the value (as at the date of suspension) of Plant and/or Materials, if:

- (a) the work on Plant or delivery of Plant and/or Materials has been suspended for more than 28 days,
- (b) the Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Engineer's instructions, and
- (c) Such materials or plant is received at site

26.12 Prolonged Suspension

If the suspension under Sub-Clause 26.9/PCC [Suspension of Work] has continued for more than 84 days, the Contractor may request the Engineer's permission to proceed. If the Engineer does not give permission within 28 days after being requested to do so, the Contractor may, by giving notice to the Engineer, treat the suspension as an omission under Clause 34/PCC [Variations and Adjustments] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice.

26.13 Resumption of Work

	<p>After the permission or instruction to proceed is given, the Contractor and the Engineer shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the suspension</p> <p>26.14 Bonus for early completion:</p> <p>In the event that the Project Completion Date occurs prior to the Scheduled Completion Date, the Contractor shall be entitled to receive a payment of bonus equivalent to 1% (one per cent) of the Contract Price for per month (part of the month to be excluded) by which the Project Completion Date precedes the Scheduled Completion Date, but subject to a maximum of 3% (three per cent) of the Contract Price. Provided, however, that the payment of bonus, if any, shall be made only after the issue of the Completion Certificate. For the avoidance of doubt, the Parties agree that for the purpose of determining the bonus payable hereunder, the Contract Price shall always be deemed to be the amount and shall exclude any revision thereof for any reason.</p> <p>If the Contractor achieves completion of the whole of the Works prior to the intended Completion Date prescribed in Contract data (Extension of time pursuant to Clause 26.5/PCC or any other clause of these conditions will not be considered), the Employer shall pay to the Contractor a sum stated in the Contract data as bonus for early completion, for every calendar month which shall elapse between the date of completion of all items of works as stipulated in the contract, including variations ordered by the Engineer and the time prescribed in Clause 26.4.</p> <p>For the purpose of calculating bonus payments, the time given in the Bid for completion of the whole works is fixed and unless otherwise agreed, no adjustment of the time by reasons of granting an extension of time pursuant to clause 26.5/PCC or any other clause of these conditions will be allowed. Any period falling short of completed month shall be ignored for the purpose of computing the period relevant for the payment of bonus.</p> <p>Amount of bonus for early completion 1% of initial Contract Price per month (part of the month to be excluded) for completion of whole works.</p> <p>Maximum limit of bonus 3% of Contract Price.</p> <p>(For earlier completion of the work as a whole from the stipulated original date of completion as per contract, a bonus payment of as above shall be paid to the contractor. The engineer's decision is final and binding on the contractor so far as bonus payment to the contractor is concerned).</p>
	<p>26.15 Suspension of unsafe Construction Works</p> <ol style="list-style-type: none"> 1. Upon recommendation of the Authority's Engineer to this effect, or on its own volition in cases of emergency or urgency, the Authority may by notice require the Contractor to suspend forthwith the whole or any part of the Works if, in the reasonable opinion of the Authority's Engineer or the Authority, as the case may be, such work threatens the safety of the Users and or other persons on or about the Railway Project. 2. The Contractor shall, pursuant to the notice under the above clause , suspend the Works or any part thereof for such time and in such manner as may be specified by the Authority and thereupon carry out remedial measures to secure the safety of suspended works, the Users, other persons and vehicles on or about the Railway Project including

	<p>pedestrians. The Contractor may by notice require the Authority's Engineer to inspect such remedial measures forthwith and make a report to the Authority recommending whether or not the suspension hereunder may be revoked. Upon receiving the recommendations of the Authority's Engineer, the Authority shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary in the reasonable opinion of the Authority, and the procedure set forth in this Clause shall be repeated until the suspension hereunder is revoked.</p> <ol style="list-style-type: none"> 3. Subject to the provisions of the contract, all reasonable costs incurred for maintaining and protecting the Works or part thereof during the period of suspension (the "Preservation Costs"), shall be borne by the Contractor. 4. If suspension of Works is for reasons not attributable to the Contractor, the Authority's Engineer shall determine any Time Extension to which the Contractor is reasonably entitled.
<p>Clause-30/CC</p>	<p>The following paras are added to the Existing CC Clauses.</p> <p>30.2 Contractor's Obligations:</p> <p>30.2.1 The Contractor shall carry out the Tests on Completion in accordance with this Clause and New-Clause 5.4/PCC [Testing], after providing the documents in accordance with sub-paragraph (d) of New--Clause 4.1/PCC [Contractor's General Obligations].</p> <p>The Contractor shall give to the Engineer not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.</p> <p>In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.</p> <p><u>Contractor's Obligations:</u> The Contractor shall carry out the Tests on Completion at his own cost in accordance with the Contract and shall provide the documents in accordance with New-Clauses 3.1/PCC and the Contractor shall give, to the Engineer, 21days' notice of the date after which the Contractor will be ready to carry out the Tests on Completion. Unless otherwise agreed, such Tests shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.</p> <p>Unless otherwise stated in Conditions of Contract/SCC, the Tests on Completion shall be carried out in the following sequence</p> <ol style="list-style-type: none"> (a) pre-commissioning test, which shall include appropriate instructions and ("dry" or "cold") functional tests to demonstrate that each item of the Plant and Work can safely undertake the next stage (b) Commissioning Test shall include the specified operational tests to demonstrate Works or Sections can be operated safely and as specified under all available operating condition

(c) trial operation which shall demonstrate that the Works or Section perform reliably and in accordance with the Contract

The Contractor at his own cost shall arrange all tools, equipment, gadgets, facilities or as deemed necessary by the Engineer for such tests, in considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed the Tests on Completion described in sub-paragraphs (a) (b) or (c), the Contractor shall provide the Engineer and the Employer with a certified report of the results of all such Tests

30.3 Delayed Tests

If the Tests on Completion are being unduly delayed by the Employer, New-Clause 5.4/PCC [Testing] (fifth paragraph) and/or Sub-Clause 46.3/PCC [Interference with Tests on Completion] shall be applicable.

If the Tests on Completion are being unduly delayed by the Contractor, the Engineer may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.

If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

30.4 Retesting

If the Works, or a Section, fail to pass the Tests on Completion, New-Clause 5.5/PCC [Rejection] shall apply, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions

30.5 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated under Sub-Clause 30.4/PCC [Retesting], the Engineer shall be entitled to:

- (a) order further repetition of Tests on Completion under Sub-Clause 30.4;
- (b) if the failure deprives the Employer of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the Employer shall have the same remedies as are provided in sub-paragraph (c) of New-Clause 6.4/PCC [Failure to Remedy Defects]; or
- (c) issue a Taking-Over Certificate, if the Employer so requests.

In the event of sub-paragraph (c), the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the Employer may require the reduction to be (i) agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or (ii) determined and paid under New-Clause 2.4 [Employer's Claims] and New-Clause 3.5 [Determinations].

30.6 Contractor's obligations

	<p>Notwithstanding the provisions of New-clauses 4.1/PCC, clause 30.2 to 30.5/PCC the provisions in subsequent sub-clauses shall apply for works of Permanent Way, signaling and telecommunication and railway electrification excluding General Electrical Services.</p> <p>(a) The Contractor shall be responsible for the execution of temporary and/or permanent works which may require the prior sanction/approval of Commissioner of Railway Safety (CRS) in accordance with extant rules for “The Railways opening for Public Carriage of Passengers” was amended from time to time. And applicable as and when the works are undertaken. The Contractor shall initiate the process for approval at least 63 (sixty-three) days prior to undertaking such works which require the approval of Commissioner of Railway Safety (CRS) and furnish draft documentation to the Engineer.</p> <p>(b) The Contractor shall ensure that existing services and operations for public carriage of passengers or goods, are not affected except those, which are essentially required to be regulated for execution of works. Such items of works shall be planned and coordinated through the Engineer.</p> <p>(i) Prior to the commencement of commercial operations of passenger traffic, the Employer may permit freight train operations to Railway after certification by the authorized person of Zonal Railway. The Contractor shall be responsible for maintaining the facilities ensuring safety of operations as per specifications.</p>
<p>Clause 34/CC</p>	<p>The following paras are added to the Existing CC Clause 34.</p> <p>34.1 Change of scope.</p> <p>34.1.1 The Authority may, notwithstanding anything to the contrary contained in this Agreement, require the Contractor to make modifications or alterations to the Works (“Change of Scope”) before the issue of the Completion Certificate either by giving an instruction or by requesting the Contractor to submit a proposal for Change of Scope involving additional cost or reduction in cost. Any such Change of Scope shall be made and valued in accordance with the provisions of this Article 34.</p> <p>34.1.2 Change of Scope shall mean:</p> <ol style="list-style-type: none"> a) change in specifications of any item of Works; b) omission of any work from the Scope of the Project c) any additional work, Plant, Materials or services which are not included in the Scope of the Project, including any associated Tests on completion of construction. <p>34.1.3 If the Contractor determines at any time that a Change of Scope will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Authority of executing, maintaining or operating the Railway Project, (iii) improve the efficiency or value to the Authority of the completed Railway Project, or (iv) otherwise be of benefit to the Authority, it shall prepare a proposal with relevant details at its own cost. The Contractor shall submit such proposal, supported with the relevant details including the amount of reduction in the Contract Price, if any, to the Authority to consider such Change of Scope. The Authority shall, within 15 (fifteen) days of receipt of such proposal, either accept such Change of Scope with modifications, if any, and initiate proceedings therefor in accordance with this Article or reject the proposal and inform the Contractor of its decision. For the avoidance of doubt, the Parties agree that the Contractor shall not undertake any Change of Scope without a Change of Scope Order being issued by the Authority, save and except any Works necessary for meeting any Emergency</p> <p>34.2 Procedure for Change of Scope</p>

- 34.2.1 In the event of the Authority determining that a Change of Scope is necessary, it may direct the Authority's Engineer to issue to the Contractor a notice specifying in reasonable detail the works and services contemplated thereunder (the "Change of Scope Notice").
- 34.2.2 Upon receipt of a Change of Scope Notice, the Contractor shall, with due diligence, provide to the Authority and the Authority's Engineer such information as is necessary, together with preliminary documentation in support of:
- (a) the impact, if any, which the Change of Scope is likely to have on the Project Completion Schedule if the works or services are required to be carried out during the Construction Period; and
 - (b) the options for implementing the proposed Change of Scope and the effect, if any, each such option would have on the costs and time thereof, including the following details:
 - (i) break down of the quantities, unit rates and cost for different items of work;
 - (ii) proposed design for the Change of Scope; and
 - (iii) proposed modifications, if any, to the Project Completion Schedule of the Railway Project.
- For the avoidance of doubt, the Parties expressly agree that, subject to the provisions of Clause 34.4.2 the Contract Price shall be increased or decreased, as the case may be, on account of Change of Scope.
- 34.2.3 The Contractor's quotation of costs for the Change of Scope shall be determined on the following principles:
- (a) For works of similar nature compared to the Works being executed, the quotation shall be based on the rate for the work inclusive of all labour, Materials, equipment, incidentals, overheads and profit derived in accordance with the provisions and the price adjustment in accordance with relevant clause shall apply to the rates so worked out.
- The rate may be decided on the following basis:
- i. Cost of Materials at current market price, as actually utilised in the final finished Permanent Works, including a reasonable percentage for wastage and transportation.
 - ii. Cost of enabling works if any (unless provided for separately) worked out on the above basis but with less stringent quality. Specifications minus salvage value of serviceable material released after completion of work and cost of material released as scrap.
 - iii. Cost of labour actually used at the site of work at rates under Payment of Minimum Wages Act for the area of work for each category of worker, further enhanced by a percentage of 10% of the aforesaid rates to account for labour not directly utilised at Site and other ancillary and incidental expenses on labour.
 - iv. Hire charges for Plant & Machinery, scaffolding, shuttering, forms, etc., required to be used at the site of the work. The tools used by the various trades shall not be counted as Plant & Machinery for this purpose.

	<p>v. An amount of 10% of items (i), (ii), (iii) and (iv) above to allow for Contractor's overheads, profits and taxes. This percentage shall also apply to estimated cost of Materials supplied free to the Contractor.</p> <p>vi. In all cases where extra items of work are involved, for which there are no rates in the accepted Price schedule the Contractor shall give a notice to the Engineer, of at least 7 days before the need for their execution arises.</p> <p>(b) For works not similar in nature to the Works being executed, the cost of work shall be derived on the basis of applicable schedule of rates for the relevant zone of the Railways, LAR's of Metro Rail Projects, and such rates shall be indexed with reference to the WPI once every year at the commencement of the financial year, with the base being the month and year of the publication of the said schedule of rates; provided, however, that for any item not included in the schedule of rates, the prevailing market rates as determined in accordance with Good Industry Practice by the Authority's Engineer shall apply.</p> <p>34.2.4 Upon reaching an agreement, the Authority shall issue an order (the "Change of Scope Order") requiring the Contractor to proceed with the performance thereof. In the event that the Parties are unable to agree, the Authority may:</p> <p>(a) issue a Change of Scope Order requiring the Contractor to proceed with the performance thereof at the rates and conditions approved by the Authority till the matter is resolved in accordance with Article Dispute resolution (Clause 4 of SCC) ; or</p> <p>(b) proceed in accordance with Clause 34.5</p> <p>34.2.5 The provisions of this Agreement, insofar as they relate to Works and Tests, shall apply mutatis mutandis to the works undertaken by the Contractor under this clause 34.</p> <p>34.3 Payment for Change of Scope</p> <p>Payment for Change of Scope shall be made in accordance with the payment schedule specified in the Change of Scope Order.</p> <p>34.4 Restrictions on Change of Scope</p> <p>34.4.1 No Change of Scope shall be executed unless the Authority has issued the Change of Scope Order save and except any Works necessary for meeting any Emergency.</p> <p>34.4.2 Unless the Parties mutually agree to the contrary, the total value of all Change of Scope Orders shall not exceed 25% of the Contract Price.</p> <p>34.4.3 Notwithstanding anything to the contrary in this Article 34, no change arising from any default of the Contractor in the performance of its obligations under this Agreement shall be deemed to be Change of Scope, and shall not result in any adjustment of the Contract Price or the Project Completion Schedule.</p> <p>34.5 Power of the Authority to undertake works</p> <p>34.5.1 In the event the Parties are unable to agree to the proposed Change of Scope Orders in accordance with Clause 34.2, the Authority may, after giving notice to the Contractor and considering its reply thereto, award such works or services to any person on the basis of open competitive bidding from amongst bidders who are pre-qualified for undertaking the additional work; provided that the Contractor shall have the option of matching the first ranked bid in terms of the selection criteria, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Contractor</p>
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shall be entitled to exercise such option only if it has participated in the bidding process and its bid does not exceed the first ranked bid by more than 10% (ten per cent) thereof. It is also agreed that the Contractor shall provide assistance and cooperation to the person who undertakes the works or services hereunder, but shall not be responsible for rectification of any Defects and/or maintenance of works carried out by other agencies.

34.5.2 The works undertaken in accordance with this Clause 34.5 shall conform to the Specifications and Standards and shall be carried out in a manner that it should not cause any disruption to the Project and also minimise adverse effect to main contractor. The provisions of this Agreement, insofar as they relate to Works and Tests, shall apply mutatis mutandis to the works carried out under this Clause 34.5.

VARIATIONS AND ADJUSTMENTS.

34.6 Right to Vary

Variations may be initiated by the Employer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by making a request to the Contractor to submit a proposal.

The Contractor shall execute and be bound for variations of all change of scope of orders till the price does not exceed 25% of the Contract Price as specified in LOA/Original agreement

34.7 Adjustments for Changes in Legislation

Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract.

If the Contractor suffers (or will suffer) delay and/or incurs (or will incur) additional Cost as a result of these changes in the Laws or in such interpretations, made after the Base Date, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with New-Clause 3.5 [Determinations] to agree or determine these matters.

In case there is a decrease in cost as a result of changes of Law by Legislation after the Base Date, the Engineer shall proceed in accordance with New-Clause 3.5 (determination) to agree or determine these matters without waiting for Contractor's / Employer's Notice.

Notwithstanding the foregoing, the Contractor shall not be entitled to such an extension of time if the same shall already have been taken into account in determining an extension and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the table of adjustment data in accordance with the provisions of Sub-Clause PVC/Contract Data.

<p>Clause 37/CC</p>	<p>The clause 37 of CC is replaced with the following.</p> <p>Payments.</p> <p>37.0 Procedure for estimating the payment for the Works</p> <ol style="list-style-type: none"> 1. The Authority shall make interim payments to the Contractor, as certified by the Authority's Engineer on completion of a stage, for a length, number or area as specified, and valued in accordance with the proportion of the Contract Price assigned to each item and its stage and payment procedure in Lumpsum Price schedule and contract price weightages. 2. The Contractor shall base its claim for interim payment for the stages completed till the end of the month for which the payment is claimed, valued in accordance with para 1 supported with necessary particulars and documents in accordance with this Agreement. 3. Any reduction in the Contract Price arising out of Change of Scope or the Works withdrawn, as the case may be, shall not affect the amounts payable for the items or stage payments thereof which are not affected by such Change of Scope or withdrawal. The Parties further agree that the adjustments arising out of the aforesaid modifications shall be carried out in a manner that the impact of such modifications is restricted to the said Change of Scope or withdrawal, as the case may be, and does not alter the payments due for and in respect of items or stage payments which do not form part of such Change of Scope or withdrawal. <p>4. Stage Payment Statement for Works</p> <p>The Contractor shall submit a statement (the "Stage Payment Statement"), in 3 copies, by the 7th (seventh) day of a month to the Authority's Engineer in the prescribed form, showing the amount calculated in accordance with Para 3 above to which the Contractor considers itself entitled for the completed stage(s) of Works. The Stage Payment Statement shall be accompanied with the progress reports and any other supporting documents. The Contractor shall not submit any claim for payment of incomplete stages of work. In the event that there is no claim for a month in accordance with the provisions of this Para 4, the Contractor shall submit a nil claim to the Authority's Engineer.</p> <p>5. Stage Payment for Works</p> <ol style="list-style-type: none"> i. Within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to para 4 above, the Authority's Engineer shall broadly determine the amount due to the Contractor and recommend the release of 80% of the amount so determined as part payment against the Stage Payment Statement, pending issue of the Interim Payment Certificate by the Authority's Engineer. Within 10 (ten) days of the receipt of recommendation of the Authority's Engineer ii. Within 15 (fifteen) days of the receipt of the Stage Payment Statement referred to in para 4, the Authority's Engineer shall determine and shall deliver to the Authority and the Contractor an IPC certifying the amount due and payable to the Contractor, after adjusting the payments already released to the Contractor against the said statement. For the avoidance of doubt, the Parties agree that the IPC shall specify all the amounts that have been deducted from the Stage Payment Statement and the reasons therefor. iii. In cases where there is a difference of opinion as to the value of any stage, the opinion of the Authority's Engineer shall prevail and interim payments shall be made
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to the Contractor on this basis; provided that the foregoing shall be without prejudice to the Contractor's right to raise a Dispute.

- iv. The Authority's Engineer may, for reasons to be recorded, withhold from payment:
 - (a) the estimated value of work or obligation that the Contractor has failed to perform in accordance with this Agreement and in respect of which the Authority's Engineer had notified the Contractor; and
 - (b) the estimated cost of rectification of any Works which have not been constructed in accordance with this Agreement.
- v. Payment by the Authority shall not be deemed to indicate the Authority's acceptance, approval, consent or satisfaction with the work done.
- vi. In the event the amounts released by the Authority under para 5 (i) exceed the amount finally determined by the Authority's Engineer pursuant to para 5 (ii) to para 5 (iv), the difference thereof shall be accounted for in the next IPC.

Time of payment

The Authority shall pay to the Contractor any amount due under any payment certificate issued by the Authority's Engineer in accordance with the provisions of the contract.

37.1 Application for Interim Payment Certificates

Payments shall be adjusted for deductions for advance payments other than recoveries in terms of contract and taxes, at source as applicable under law. The Contractor shall be liable to pay liquidated damages for shortfall in progress. Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

The Contractor shall submit a Statement in six copies to the Engineer in accordance with the payment procedure specified by the Engineer, after the end of each month, in a form approved by the Engineer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with New-Clause 4.39/PCC [Progress Reports] and Record Measurement Sheets.

The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:

- (a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month (including Variations but excluding items described in sub-paragraphs (b) to (g) below);
- (b) any amounts to be added and deducted for changes in legislation and changes in cost, in accordance with Sub-Clause 34.7/PCC [Adjustments for Changes in Legislation] and Sub-Clause PVC/Contract Data [Adjustments for Changes in Cost];
- (c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract Data to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract Data;
- (d) Any amounts to be added and deducted for the advance payments and repayments in accordance with sub clause 42.0/PCC [Advance Payment];
- (e) any amounts to be added and deducted for Materials in accordance with New-Clause 13/PCC [Materials intended for the Works];

- (f) any other additions or deductions which may have become due under the Contract or otherwise, including those under Clause 4.1/SCC [Claims, Disputes and Arbitration]; and
- (g) the deduction of amounts certified in all previous Payment Certificates.
- (h) for invoicing as per GST Laws, the estimated contract value of the Works executed in terms of (a) above and any amounts added or deducted as per (b), l to (g) above is to be broken up in two components i.e. (i) the base amount excluding GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).
- (i) Statement of interim payments certificates should be submitted by the Contractor to the Engineer by the 7th day of each month for the work executed upto the end of the previous month.
- (j) An amount to be deducted for the payments to be made to different Departments towards payments liable to be made by the Contractor

37.2 Schedule of Payments

If the Contract includes a schedule of payments specifying the installments in which the Contract Price will be paid, then unless otherwise stated in this schedule:

- (a) the installments quoted in this schedule of payments shall be the estimated contract values for the purposes of sub-paragraph (a) of Sub-Clause 37.1/PCC [Application for Interim Payment Certificates];
- (b) New-Clause 13/PCC [Provisional payment against material at site] shall not apply; and
- (c) if these installments are not defined by reference to the actual progress achieved in executing the Works, and if actual progress is found to be less than that on which this schedule of payments was based, then the Engineer may proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine revised installments, which shall take account of the extent to which progress is less than that on which the installments were previously based.

If the Contract does not include a schedule of payments, the Contractor shall submit non-binding estimates of the payments which he expects to become due during each quarterly period. The first estimate shall be submitted within 42 days after the Commencement Date. Revised estimates shall be submitted at quarterly intervals, until the Taking-Over Certificate has been issued for the Works.

37.3 Issue of Interim Payment Certificates

No amount will be certified or paid until the employer has received and approved the performance security. Thereafter, the Engineer shall within two days after receiving a statement and supporting documents (including Contractor's certificate in terms of Sub-Clause 1.22/SCC, issue to the Employer a provisional interim payment certificate which shall state the amount which the Engineer determines to be due after preliminary check as per K-RIDE's procedure order. After this the Engineer shall, within 28 days after receiving a statement and supporting documents, issue to the employer an Interim Payment Certificate which shall state the amount which the Engineer fairly determines to be due, with supporting particulars.

However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue the Interim Payment Certificate in an amount which would (after retention and other deductions) be less than the minimum amount of Interim Payment Certificates (if

any) stated in the Contract Data. In this event, the Engineer shall give notice to the Contractor accordingly.

An Interim Payment Certificate shall not be withheld for any other reason, although:

- (a) if anything supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or
- (b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Engineer, the value of this work or obligation may be withheld until the work or obligation has been performed.

The Engineer may in any Payment Certificate make any correction or modification that should properly be made to any previous Payment Certificate. A Payment Certificate shall not be deemed to indicate the Engineer's acceptance, approval, consent or satisfaction.

37.4 Payment

The Employer shall pay to the Contractor:

- (a) the first installment of the advance payment within 42 days after issuing the Letter of Acceptance or within 21 days after receiving the documents in accordance with New-Clause 4.19/PCC [Performance Security] and Sub-Clause 42.0/PCC [Advance Payment], whichever is later;
- (b) (i) After preliminary scrutiny and certifications by the Engineer, payment of 80% of the certified net payment due (after recoveries and deductions), shall be made by the Employer within 10 days of receiving a statement and supporting documents by the Engineer subject to the condition that last interim payment certificate has been settled after detailed check. In the event of the contractor submitting bills based on false measurements, Project Director should issue a written warning to him to the effect that the facility of 80% payment without detailed check will be withdrawn in future. If the contractor repeats the misconduct this facility should be withdrawn.
- (ii) The amount certified in each Interim Payment Certificate within 56 days after the Engineer receives the Statement and supporting documents. Any discrepancy shall be rectified in the next payment to the Contractor; and
- (c) the amount certified in the Final Payment Certificate within 56 days after the Employer receives this Payment Certificate or, the undisputed amount shown in the Final Statement, within 56 days after the date of notification of the suspension.

Payment of the amount due, unless specified in the Contract Data, shall be made in INR into the bank account, nominated by the Contractor.

However, in case of JV, The Employer shall have the right to release payments solely to the Lead Member and shall not in any manner be responsible or liable for the inter se allocation of payments among members of the Joint Venture.

The said payment shall not alter any obligation of the JV and its individual Partners under the Agreement and their obligations under the agreement shall remain joint and several.

A foreign company (either single entity or JV partner), shall have to submit proof of having opened their project office in India before any payment (including advance payment) is released to such a company. The required proof here shall be a copy of the report containing information as per format prescribed by Reserve Bank of India

submitted to the Director General of Police (DGP) of the state concerned in which project office has been established.

37.5 DELETED

37.6 Delayed Payment

If the Contractor does not receive payment in accordance with Sub-Clause 37.4/PCC [Payment], the Contractor shall be entitled to receive interest compounded monthly on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in Sub-Clause 37.4/PCC [Payment], irrespective (in the case of its sub-paragraph (b)) of the date on which any Interim Payment Certificate is issued.

Unless otherwise stated in the Special Conditions of Contract, the interest amount be calculated at the annual rate of 7% (seven percent).

The Contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy, if the Contractor submits the complied (Fulfilled) documents.

37.7 DELETED

37.8 DELETED

37.9 DELETED

37.10 DELETED

37.11 Statement at Completion

Within 84 days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer six copies of a Statement at completion with supporting documents, in accordance with Sub-Clause 37.7/PCC [Application for Interim Payment Certificates], showing:

- (a) the value of all work done in accordance with the Contract up to the date stated in the Taking- Over Certificate for the Works,
- (b) any further sums which the Contractor considers to be due, and
- (c) an estimate of any other amounts which the Contractor considers will become due to him under the Contract. Estimated amounts shall be shown separately in this Statement at completion.

The Engineer shall then certify in accordance with Sub-Clause 37.3/PCC [Issue of Interim Payment Certificates].

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents showing in detail in a form approved by the Engineer:

37.12 Application for Final Payment Certificate

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents (including Contractor's certificate in terms of Sub-Clause 1.22/SCC showing in detail in a form approved by the Engineer:

- (a) the value of all work done in accordance with the Contract, and
- (b) any further sums which the Contractor considers to be due to him under the Contract or otherwise.

If the Engineer disagrees with or cannot verify any part of the draft final statement, as per procedure prescribed by the Engineer the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

However, if, following discussions between the Engineer and the Contractor and any changes to the draft final statement which are agreed, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer (with a copy to the Contractor) an Interim Payment Certificate for the agreed parts of the draft final statement. Thereafter, if the dispute is finally resolved under Sub-Clause 4.SCC [Obtaining Dispute Board's Decision] or Sub-Clause 4.2/SCC [Amicable Settlement], the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.

37.13 Discharge

When submitting the Final Statement, the Contractor shall submit a discharge which confirms that the total of the Final Statement represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and the outstanding balance of this total, in which event the discharge shall be effective on such date

37.14 Issue of Final Payment Certificate

Within 28 days after receiving the Final Statement and discharge in accordance with Sub-Clause 37.12/PCC [Application for Final Payment Certificate] and Sub-Clause 37.13/PCC [Discharge], the Engineer shall issue, to the Employer, the Final Payment Certificate which shall state:

- (a) the amount which he fairly determines is finally due, and
- (b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance (if any) due from the Employer to the Contractor or from the Contractor to the Employer, as the case may be.

If the Contractor has not applied for a Final Payment Certificate in accordance with Sub-Clause 37.12/PCC [Application for Final Payment Certificate] and Sub-Clause 37.13/PCC [Discharge], the Engineer shall request the Contractor to do so. If the Contractor fails to submit an application within a period of 28 days, the Engineer shall issue the Final Payment Certificate for such amount as he fairly determines to be due.

37.15 Cessation of Employer's Liability

The Employer shall not be liable to the Contractor for any matter or thing under or in connection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an amount expressly for it:

- (a) in the Final Statement and also

(b) (except for matters or things arising after the issue of the Taking-Over Certificate for the Works) in the Statement at completion described in Sub-Clause 37.11/PCC [Statement at Completion].

However, this Sub-Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer

37.16 Currencies of Payment

a) The Contract Price shall be paid in Indian Rupees (INR).

37.17 Tax Deduction at Source: Tax deductions will be made at source as per statutory requirement from every payment made to the Contractor at rates notified from time to time.

- i. **Income tax deduction:** Income Tax/ TDS on GST deduction shall be as per law.
- ii. **Labour Cess & Royalties:** The labour Cess & Royalties will be deducted as per norms of applicable law from each IPCs and remitted to the respective Authorities

37.18 Production of Vouchers

- a. The Contractor shall, whenever required by the Engineer, produce or cause to be produced for examination by the Engineer, any quotation, invoice, cost or other account books, vouchers, receipts, letters, memoranda or any copy of or extract from any such documents and also furnish information and returns, as may be required, relating to the execution of this Contract or relevant for verifying or ascertaining the cost of execution of this Contract or ascertaining the Materials supplied by the Contractor are in accordance with the Specifications laid down in the Contract. The Engineer's decision on the question of relevancy of any documents, information or returns shall be final and binding on the parties
- b. If any part or item of the Work is allowed to be carried out by a Sub-Contractor, assignee or any subsidiary or allied firm, the Engineer shall have power to secure the books of such Sub-Contractor, assignee or any subsidiary or allied firm through the Contractor, and shall have power to examine and inspect the same. The above obligations are without prejudice to the obligations of the Contractor under any statute, rules or orders.

37.19 Withholding and Lien For Sums Claimed

- (i) The Employer shall have lien on and over all materials of every description, tools, tackles, plant, equipment or any amount due and/or that may become due and payable to the Contractor under the Contract, and / or on and over the deposit of Performance Security or other amount or amounts made under the Contract and which may become payable to the Contractor. Employer may exercise a general lien also.
- (ii) And further, unless the Contractor pays and clears immediately on demand any claim of the Employer, the Employer shall at all times be entitled to deduct the amount of the said claim from the amount, securities and / or deposits which may have become or will become payable to the Contractor under the existing contract, or under any other Contract or transaction whatsoever between the Employer and the Contractor even if the matter stands referred to Arbitration. The Contractor shall have no claim for any interest or damage whatsoever in respect of any amounts withheld or treated as withheld under the lien referred to above and duly notified as such to the Contractor

	<p>37.20 Signature on Receipts for Payments</p> <p>Every receipt of payment to Contractor including refund of the Performance Security shall be signed by the person authorized to do so on his behalf. In the event of death of any of the Contractor's partners in case the Contractor is a partnership firm, during the currency of the Contract, it is hereby expressly agreed that every receipt by any one of surviving Contractor's partners, shall, if so signed as aforesaid, be a good and sufficient discharge as aforesaid, provided that nothing in this Clause shall be deemed to prejudice or affect any claim, which the Employer may hereafter have against the legal representatives of any Contractor's partner so dying, for or in respect of breach of any of the conditions of the Contract. Provided also that nothing contained in this clause shall be deemed to prejudice or affect the respective rights and obligations of the Contractor's partners, or of the legal heirs / representatives of any deceased Contractor / partner interest</p> <p>37.21 Post Payment Audit</p> <p>It is an agreed term of the Contract, that the Employer reserves to himself the right to carry out a post payment audit and / or technical examination of the Works, and the Final bill including all supporting vouchers, abstracts, etc., and to make a claim on the Contractor for the refund of any excess amount paid to him, if as a result of such examination, any over-payment to him is discovered to have been made in respect of any work done or alleged to have been done by the Contractor, under the Contract. If any under-payment is discovered, the same shall be paid by the Employer to the Contractor. Such payments or recoveries, however, shall not carry any interest.</p> <p>37.22 Recovery of money due to the Employer</p> <p>All damages (including, without limitation, liquidated damages), costs, charges, expenses, debts, or sums for which the Contractor is liable to the Employer under any provision of the Contract may be deducted by the Employer from amount due to the Contractor under the Contract including, without limitation, and the Employer shall have the power to recover any balance not so deducted from amount due to the Contractor under any other contract between the Employer and the Contractor</p> <p>When the Contractor has assigned to a third party the right to receive amount due, or, to become due, under the Contract to the Contractor or charged such amount in favour of a third party, the Employer's right to deduct damages (including without limitation liquidated damages), costs, charges, expenses, debts or sums for which the Contractor is liable to the Employer from amount due to the Contractor under the Contract shall be limited to the right expressed above.</p>
<p>Clause-38/CC</p>	<p>The clause 38 of CC is substituted with the following para.</p> <p>38.1 Compensation Event:</p> <p>The risks referred to in Sub-Clause 11.4/PCC below, in so far as they directly affect the execution of the works in the Country, are:</p> <ul style="list-style-type: none"> (a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies, (b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within the Country, (c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel,

	<p>(d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity,</p> <p>(e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,</p> <p>(f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract,</p> <p>(g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible.</p>
<p>Clause-40/CC</p>	<p>The following paras are added to the Existing CC Clauses.</p> <p>40.1 CONTRACT PRICE</p> <ol style="list-style-type: none"> 1. The Authority shall make payments to the Contractor for the Works on the basis of the lump sum price accepted by the Authority in consideration of the obligations specified in this Agreement, which shall be subject to adjustments in accordance with the provisions of this Agreement. The Parties further agree that save and except as provided in this Agreement, the Contract Price shall be valid and effective until issue of Completion Certificate. 2. The Contract Price includes all duties, taxes, royalty, and fees that may be levied in accordance with the laws and regulations in force as on the Base Date on the Contractor's equipment, Plant, Materials and supplies acquired for the purpose of this Agreement and on the on the Works undertaken under this Agreement. Nothing in this Agreement shall relieve the Contractor from its responsibility to pay any tax including any tax that may be levied in India on profits made by it in respect of this Agreement. 3. The Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs, unless otherwise provided for in this Agreement. 4. Unless otherwise specified in this Agreement, the Contract Price covers all the Contractor's obligations for the Works under this Agreement and all things necessary for the Construction thereof and for the rectification of any Defects in the Railway Project. 5. All payments under this Agreement shall be made in Indian Rupees. <p>Unless otherwise stated in the Special Conditions of Contract:</p> <ol style="list-style-type: none"> (a) the Contract Price shall be agreed or determined under Clause 34.3/PCC [Payment for Variation] and be subject to adjustments in accordance with the Contract; (b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs except as stated in Sub-Clause 34.7/PCC [Adjustments for Changes in Legislation]; (c) any quantities which may be set out in the Price schedule or other Schedule are estimated quantities and are not to be taken as the actual and final quantities: <ol style="list-style-type: none"> (i) of the Works which the Contractor is required to execute, or (ii) for the purposes of New-Clause 7/PCC [Measurement and Evaluation]; and (d) the Contractor shall submit to the Engineer, within 28 days after the Commencement Date, a proposed breakdown of each lump sum price in the Schedules, if applicable. The Engineer may take account of the breakdown when preparing Payment Certificates, but shall not be bound by it.

	<p>(e) It may be noted that in the event of the Contractor not making the due payments stated in sub-clause (b) above, and the concerned party puts up a claim with the Employer / Engineer, then the Employer / Engineer may make such payments and deduct the same from the sums due to the Contractor.</p> <p>Change in Law</p> <p>Change in Law means the occurrence or coming into force of the following, at any time after the last Date of submission of tender:</p> <p>Any new Central and State Taxes, duties, cess, levies, which is imposed or any existing Central and State Taxes, duties, cess, levies & royalties are withdrawn after the due date of submission of tender and which impacts the performance of the contractor with increased cost or which results in extra financial gains to the contractor due to decreased cost in execution of contract. Such additional or reduced cost shall be certified by the Engineer after examining records provided by the contractor and shall be paid by or credited to the employer.</p> <p>However, change in the rate of any existing Central & State taxes (except GST), duties, cess, levies will not be considered as change in Law. Any risk of change in rate of existing Central and State Taxes (except GST), duties, cess, levies lies with and shall be borne by the Contractor.</p>
<p>Clause 42/CC</p>	<p>The following paras are replaced to the Existing 42/CC Clauses.</p> <p>Advance Payment:</p> <p>42.1 Mobilization Advance</p> <p>The Employer shall make payment, as an Interest bearing advance for mobilization, when the Contractor submits a guarantee in accordance with this Sub-Clause. The total advance payment, the number and timing of instalments (if more than one), and the applicable currencies and proportions, shall be as stated in the Contract Data.</p> <p>Unless and until the Employer receives this guarantee, or if the total advance payment is not stated in the Contract Data, this Sub-Clause shall not apply.</p> <p>The Engineer shall issue an interim payment certificate for the first installment of mobilization advance after receiving an application for advance payment (under sub clause 37.1/PCC [Application for Interim Payment Certificates]) and after the Employer receives (i) the Performance Security in accordance with New-Clause 4.19/PCC [Performance Security] and (ii) a guarantee in amounts and currencies equal to the advance payment plus 5%. The next installment shall be released only when the contractor submits statement of having utilized the previous installment of mobilization advance and the Employer is satisfied that the utilization has been done in purposeful manner.</p> <p>The Mobilization Advance shall be interest bearing and secured by BG equivalent to 105% of the advance amount</p> <p>Mobilization advance payment: Comprises of the percentage of Accepted Contract Amount payable in the currencies and proportions in which the Accepted Contract Amount is payable and in installments as mentioned below;</p>

Mobilisation Advance	Installments
As per request of the Contractor subject to a maximum of 5%	Two Equal

Timing of Mobilization Advance Payment: First Installment within 21 (Twenty-one) days from the date of receipt of Bank guarantee acceptable to Employer.

Second Installment shall be released only when the contractor submits statement of having utilized the First Installment of mobilization Advance and the Employer is satisfied that the utilization has been done in purposeful manner. This shall be released within 21 days from the date of receipt of Bank guarantee acceptable to the Employer.

Interest on Advance Payment: At the rate of SBI MCLR+2% interest per annum on reducing balances. **The Interest rate is applicable from the date of submission of IPC / advance request by contractor.**

42.2 Advance against Plant and Machinery

This advance is payable in Indian Rupees/respective currencies as quoted in the Tender and accepted by the Employer against plant, equipment and machinery, provided the same have reached the site, or in the case of new items meant specifically for the works, firm purchase order has been placed and the invoices received. The plant and machinery shall be valued by the Engineer as follows:

(a) New items: 80% of purchase price

(b) Items valued at less than Rs. 1,000,000 (Rs. One million) per unit: Not to be considered

The total advance for Plant and Machinery shall be limited to 5% of the Contract Price and will carry an interest rate of SBI MCLR +2% interest per annum on reducing balances. The Interest rate is applicable from the date of submission of IPC / advance request by contractor It will be paid against submission of Bank Guarantees for 105% of advance value for each stage of advance to be given by each member of the consortium/JV in proportion to their participation as per format given in section 10: Formats, from an Indian Schedule bank (excluding Cooperative Banks) or from a schedule Foreign Bank as defined in Section 21 of RBI Act 1934 read with Second Schedule. All bank Guarantees should be payable in Bangalore at the designated branch. **The Plant and Machinery Advance** shall be interest bearing and secured by BG equivalent to 105% of the advance amount.

The Contractor should give an Undertaking that “No advance/loan has been taken against the subject plant & machinery from any other individual/financial institution/ mobilization etc.” If a wrong/false undertaking is given, all the BGs can be forfeited and the contract is liable for termination under clause 49 of CC/PCC.

The Advance against Plant and Machinery will be paid within 30 days after receipt of the Contractor’s written request by the Employer which is recommended by the Engineer and submission of Bank Guarantees for procurement of plant and machinery.

Wherever Bank Guarantee or any other instrument is to be extended or fresh BG to be obtained, the cost towards getting extension of BG or fresh BG and other incidental charges will be on Contractor’s account

The Contractor;

- i. Shall submit the invoice and RC book (wherever applicable) in original, at the time of obtaining advance amount.
- ii. Shall furnish all four Bank Guarantees one time as per Condition of Contract.
- iii. Shall execute an Indemnity bond in favour of an Employer as against Third Party claim.
- iv. Shall not seek the possession of machinery brought to the site till the Advance obtained from Employer is fully settled.

The contractor should ensure that in the case of "Machinery and Equipment Advance" insurance and hypothecation in favour of the Employer should be done. The contractor should submit the proof of document related to Insurance and Hypothecation to the Engineer who will certify that the insurance and hypothecation to the Employer has been done in proper manner.

Employer shall be the sole custodian of the entire plant and machinery whenever the advance amount is given to the contractor and the same shall remain in the custody of Employer, till the Advance obtained from Employer, is fully settled.

The machinery and equipment brought to the site shall be exclusively intended for the execution of the work of Employer and shall not be removed without the consent of the Engineer.

The Contractor shall indemnify and hold harmless, the Employer against all actions, suits, proceedings, claims, damages, losses, expenses, demands pertaining to Advance amount towards plant and machinery.

The Contractor shall not remove any Equipment or Machinery from the site without the prior permission of the Engineer.

The contractor;

- a) Shall not mortgage/create charge/hypothecate/encumber, in any way the machineries and equipment brought to site from the amounts advanced by Employer and shall give an undertaking in writing to that effect in favour of Employer.
- b) Shall not sell or alienate any part/portion of machinery and equipment without the consent of Employer.
- c) In the event of any such sale/alienation of any portion or part of machinery, Employer shall hold First Charge and the proceeds of such sale or alienation shall be appropriated

towards the loan/ credit/ advance in respect of plant and machinery brought to the site by contractor.

d) All Materials and Plants shall, upon their incorporation into Works, be free from any and all Encumbrances without the Authority being required to make any payment to any person on account of any costs, compensation, expenses and charges for such Materials, Plants and Works.

42.3 Guarantees

Advances as mentioned in sub-clauses 42.1/PCC above, shall be payable against acceptable Bank Guarantees from banks as specified in New-clause 4.19/PCC. The guarantees shall be in the form as given in Section 10 (Contract Forms) or in another form approved by the Employer. The Contractor shall ensure that the guarantees are valid and enforceable until the advance amount paid as has been repaid, but its amount may be progressively reduced by the amount repaid by the Contractor as indicated in the Payment Certificates. If the terms of the guarantee specify its expiry date, and the advance payment has not been repaid by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the guarantee until the advance payment has been repaid.

42.4 Recovery of Advances

Unless stated otherwise in the Contract Data, the advance payment shall be repaid through percentage deductions from the interim payments determined by the Engineer in accordance with Sub-Clause 37.3/PCC [Issue of Interim Payment Certificates], as follows:

- (a) deductions shall commence in the next interim Payment Certificate following that in which the total of all certified interim payments (excluding the advance payment) exceeds 15 percent of the Accepted Contract Amount Less Provisional Sums or passage of six months from the date of release of first advance payment, whichever is earlier; and
- (b) deductions shall be made for accrued interest on the advance up to the month and advance at the rate stated in the Contract Data of the amount of each Interim Payment Certificate (excluding the advance payment and deductions and repayments of retention) in the currencies and proportions of the advance payment until such time as the advance payment and accrued interest has been repaid; provided that the advance payment and accrued interest shall be completely repaid prior to the time when 85 percent of the Accepted Contract Amount has been certified for payment. If the amount of interim payment certificate is not sufficient for recovery of accrued interest or in the opinion of the Employer satisfactory progress is not being achieved by the contractor, then the contractor will have to deposit the accrued interest and return the mobilization advance in part or in full as demanded by the Employer, failing which Employer shall have the right to encash the Bank Guarantee(s)

The contractor shall always have the option to start repayment earlier and/or to complete the repayment earlier than the due date.

If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 49.0/PCC [Termination by Employer] or New-Clause 8/PCC [Force Majeure] (as the case may be), the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Employer.

42.5 Repayment rate of Advance payment: 10% (Ten percent) of the amount of each running account bill payment.

	<p>42.6 Advances to be Used only for this Work</p> <p>The advances shall be used by the Contractor strictly for the purpose of the Contract, and for the purpose for which they are paid. Under no circumstances, shall the advances be diverted for other purposes. Any such diversion shall be construed as a breach of the Contract and the Contractor shall be asked to return the advance at once and pay interest at 15% per annum till the advance is recovered back from him. The Contractor shall return the advance and pay the interest in one go without demur.</p> <p>Employer retains the right for any other remedy prescribed for breach of Contract in this regard.</p> <p>The Contractor, if required by the Engineer shall provide the details of Utilisation of Mobilisation advance.</p> <p>42.7 If the Advance Payment has not been fully repaid prior to Termination under Force majeure event or termination Clause, as the case may be, the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Authority. In the event of Termination for Contractor Default, the Advance Payment shall be deemed to carry interest at an annual rate of 3% (three per cent) above the Bank Rate from the date of Advance Payment to the date of recovery by encashment of bank guarantee for the Advance Payment. For the avoidance of doubt, the aforesaid interest shall be payable on each instalment of the Advance Payment, regardless of whether the instalment or any part thereof has been repaid to the Authority prior to Termination.</p>
<p>Clause 46/CC</p>	<p>The clause 46 of CC replaced with the following paras.</p> <p>Employer Taking Over</p> <p>46.1 Taking Over of the Works and Sections</p> <p>The Employer shall take over the Site and the Works within after issuing a certificate of Completion. Except as stated in Sub-Clause 30.5/PCC [Failure to Pass Tests on Completion], the Works shall be taken over by the Employer/Railway when (i) the Works have been completed in accordance with the Contract, including the matters described in Sub-Clause 26.4/PCC [Time for Completion] and except as allowed in sub-paragraph (a) below, and (ii) a Taking-Over Certificate for the Works has been issued, or is deemed to have been issued in accordance with this Sub-Clause.</p> <p>The Contractor may apply by notice to the Engineer for a Taking-Over Certificate not earlier than 14 days before the Works will, in the Contractor's opinion, be complete and ready for taking over. If the Works are divided into Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section.</p> <p>In case the works are to be taken over in accordance with sub-clause 30.6/PCC, the completed works shall be taken over by the Zonal Railway with the procedure specified by the Engineer.</p> <p>The Engineer shall, within 28 days after receiving the Contractor's application:</p> <p>(a) issue the Taking-Over Certificate to the Contractor, stating the date on which the Works or Section were completed in accordance with the Contract, except for any minor outstanding work and defects which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or</p>

(b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then complete this work before issuing a further notice under this Sub-Clause.

If the Engineer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 28 days, and if the Works or Section (as the case may be) are substantially in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.

46.2 Taking Over of Parts of the Works

The Engineer may, at the sole discretion of the Employer, issue a Taking-Over Certificate for any part of the Permanent Works.

The Employer shall not use any part of the Works (other than as a temporary measure which is either specified in the Contract or agreed by both Parties) unless and until the Engineer has issued a Taking-Over Certificate for this part. However, if the Employer does use any part of the Works before the Taking-Over Certificate is issued:

- (a) the part which is used shall be deemed to have been taken over as from the date on which it is used,
- (b) the Contractor shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the Employer, and
- (c) if requested by the Contractor, the Engineer shall issue a Taking-Over Certificate for this part.

After the Engineer has issued a Taking-Over Certificate for a part of the Works, the Contractor shall be given the earliest opportunity to take such steps as may be necessary to carry out any outstanding Tests on Completion. The Contractor shall carry out these Tests on Completion as soon as practicable before the expiry date of the relevant Defects Notification Period.

If the Contractor incurs Cost as a result of the Employer taking over and/or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and (ii) be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to payment of any such Cost, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with New—Clause 3.5/PCC [Determinations] to agree or determine this Cost and profit.

If a Taking-Over Certificate has been issued for a part of the Works (other than a Section), the delay damages thereafter for completion of the remainder of the Works shall be reduced. Similarly, the delay damages for the remainder of the Section (if any) in which this part is included shall also be reduced. For any period of delay after the date stated in this Taking-Over Certificate, the proportional reduction in these delay damages shall be calculated as the proportion which the value of the part so certified bears to the value of the Works or Section (as the case may be) as a whole. The Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine these proportions. The provisions of this paragraph shall only apply to the daily rate of delay damages under Sub-Clause 26.8/PCC [Delay Damages], and shall not affect the maximum amount of these damages

46.3 Interference with Tests on Completion

If the Contractor is prevented, for more than 14 days, from carrying out the Tests on Completion by a cause for which the Employer/Engineer/other Contractors of the Employer,

	<p>are responsible, the Employer shall be deemed to have taken over the Works or Section (as the case may be) on the date when the Tests on Completion would otherwise have been completed.</p> <p>The Engineer shall then issue a Taking-Over Certificate accordingly, and the Contractor shall carry out the Tests on Completion as soon as practicable, before the expiry date of the Defects Notification Period. The Engineer shall require the Tests on Completion to be carried out by giving 14 days' notice and in accordance with the relevant provisions of the Contract.</p> <p>If the Contractor suffers delay and/or incurs Cost as a result of this delay in carrying out the Tests on Completion, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to:</p> <ul style="list-style-type: none"> (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and (b) payment of any such Cost, which shall be included in the Contract Price. <p>After receiving this notice, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine these matters.</p> <p>46.4 Surfaces Requiring Reinstatement</p> <p>Except as otherwise stated in a Taking-Over Certificate, a certificate for a Section or part of the Works shall not be deemed to certify completion of any ground or other surfaces requiring reinstatement.</p>
<p>Clause-49/CC</p>	<p>The following paras are added to the existing CC Clauses.</p> <p>TERMINATION BY EMPLOYER</p> <p>49.6 Notice to Correct/Notice of Termination</p> <p>If the Contractor fails to carry out any obligation under the Contract as mentioned below, but not limited to the obligations mentioned herein below, the Engineer/ Employer may serve the contractor with a 14 days' notice in writing calling upon the Contractor to make good the failure and to remedy it. If the Contractor;</p> <ul style="list-style-type: none"> (a) fails to comply with New-Clause 4.19/PCC [Performance Security], (b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract, (c) without reasonable excuse fails to: <ul style="list-style-type: none"> (i) proceed with the Works in accordance with Clause 26/CC/PCC [Commencement, Delays and Suspension], or (ii) comply with a notice issued under New-Clause 5.5 [Rejection] or New-Clause 5.6/PCC [Remedial Work], within 28 days after receiving it, or (iii) adhere to the agreed programme of work / activity on the critical path, by a margin of 10% of the stipulated period, or (iv) take steps to deploy competent and adequate number of personnel, and equipment to achieve progress as per agreed programme or (v) adhere to the instructions of Engineers/Employer persistently or

	<p>(vi) comply any provision of the contract or</p> <p>(vii) provide the Engineer/Employer or their representative proper facilities for inspecting the works or any part thereof as required, under New-Clause 5.3/PCC (Inspection) and New-clause 5.4/PCC (Testing).</p> <p>(d) subcontracts the whole or major part of the Works or assigns the Contract without prior written consent of the Employer.,</p> <p>If the Contractor does not, within 14 days of receipt of notice under this sub-clause, proceed to make good his default in so far as the same is capable of being made good and carry on the work of complying with such direction as contained in the notice under sub clause 49.6/PCC to the entire satisfaction of the Engineer/Employer, the Employer shall be entitled to take action under sub-clause 49.6/PCC, 49.7/PCC below,</p> <p>In case of Contractor's repeated failure to adhere to the agreed program, and whereas the contractor has been served with a Notice to Correct under Clause 49.6 of PCC, if the Contractor approaches K-RIDE with a revised program with specific monthly physical and financial targets along with the proposal to deploy matching inputs in the form of manpower and other resources to the satisfaction of the Employer, then the Employer may consider whether to proceed with termination of the contract under Clause 49.7/PCC or to continue with the contract. However, the request to continue with the contract shall only be considered if the Contractor supports his earnestness to adhere to the revised program by submitting additional Performance Security in the form of Bank Guarantee(s) of specified number and value as decided by the Employer (total value of which will not exceed 10% of the contract price). The encashment of these additional Bank Guarantee(s) shall be linked with the non-achievement of agreed physical/financial targets agreed upon by the Contractor and the Employer.</p> <p>In case the Contractor's failure is limited to only some of the works, and in response to Notice to Correct under Clause 49.6 of PCC, the contractor approaches the Employer that such works may be offloaded from him and got executed through another agency and additional cost incurred, if any, should be recovered from his dues, the Employer, on being convinced that the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor and that such offloading will help in improving the overall progress of the project, may agree to such offloading without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. However, the Employer will not be under any compulsion to agree to such a request. The Contractor shall be informed of the LOA issued to other agency(ies) for such works.</p> <p>In case the Contractor does not approach the employer for offloading but the Employer is convinced that:</p> <ul style="list-style-type: none"> (i) offloading of some works will help in improving the progress of the project; (ii) termination/part termination of the contract at this stage will not be in the interest of the project; (iii) the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the Contractor; <p>The Employer may issue 7 days' notice to the Contractor stating the resources required to be deployed against each work. If the Contractor fails to deploy the required resources as indicated in the notice, the employer shall offload such works and proceed with getting the</p>
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works executed through other agency(ies). The Contractor shall be informed of the LOA issued to other agency(ies) for such works.

Offloading under the sub clause 49.6/PCC shall be without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. The Contractor would have no future claim on this account and the extra expenditure so incurred, if any, by the Employer in getting the offloaded work done, shall be recovered from subsequent payment certificates or any other dues of the Contractor

49.7 Termination by Employer

The Employer shall be entitled to terminate the Contract as a whole or any part or parts (as may be specified in the Notice of Termination under any of the above Sub-Clause issue) if the Contractor:

- (a) fails to comply with the directions contained in the notice under Sub-Clause 49.6/PCC [Notice to Correct/ Notice of Termination],
- (b) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against it by Court or Statutory Authority him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events, or
- (c) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:
 - (i) for doing or forbearing to do any action in relation to the Contract, or
 - (ii) for showing or forbearing to show favour or disfavour to any person in relation to the Contract,
 or if any of the Contractor's Personnel, agents or Subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this sub-paragraph I. However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination.
- (d) a resolution for winding up of the Contractor is passed, or any petition for winding up of the Contractor is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Contractor is ordered to be wound up by a court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Contractor are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Contractor under this Agreement; and provided that:
 - (i) the amalgamated or reconstructed entity has the capability and experience necessary for the performance of its obligations under this Agreement; and
 - (ii) the amalgamated or reconstructed entity has the financial standing to perform its obligations under this Agreement and has a credit worthiness at least as good as that of the Contractor as at the Appointed Date;
- (e) failure to complete the Punch List items within the periods stipulated.

- (f) the Contractor fails to rectify any Defect, the non-rectification of which shall have a Material Adverse Effect on the Project, within the time specified in this Agreement or as directed by the Authority's Engineer;
- (g) the Contractor creates any Encumbrance in breach of this Agreement;
- (h) the Contractor has failed to fulfil any obligation, for which failure Termination has been specified in this Agreement;
- (i) the Contractor commits a default in complying with any other provision of this Agreement if such a default causes a Material Adverse Effect on the Project or on the Authority.

In any of these events or circumstances, the Employer may, by Notice Terminate the contract with immediate effect.

The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer, under the Contract or otherwise.

The Contractor shall remove all his plants and machinery from the site then leave the Site and deliver any required Goods, all Contractors' Documents, and other design documents made by or for him, to the Engineer within 7 days from the issue of Notice of Termination, failing which Delay Damages as prescribed for delay in completion of works shall be imposed as per provision of clause 26.8/PCC However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice of Termination (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works.

After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods, Contractor's Documents and other design documents made by or on behalf of the Contractor for completing the work.

49.8 Valuation at Date of Termination

As soon as practicable after a notice of termination under Sub-Clause 49.7/PCC [Termination by Employer] has taken effect, the Engineer shall proceed in accordance with Sub-Clause 3.5/PCC [Determinations] to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract. For this purpose, the contractor shall be notified the date for witnessing of measurements and handing over of the materials for which contractor has already been paid. In case the contractor fails to attend or send a representative even after such notice, the Engineer shall export proceed with measurements of the works executed and taking over of plants and materials etc. for which payment has already been made to the contractor, which shall be treated as final.

49.9 Payment after Termination

After a notice of termination under Sub-Clause 49.7/PCC [Termination by Employer] has taken effect, the Employer may:

- (a) proceed in accordance with New-Clause 2.4/PCC [Employer's Claims],
- (b) encash the Performance Guarantee and forfeit the Performance Security:
 - i. In full including additional Performance Guarantee amount if any taken in terms of ITT and not due for release on the date of issue of termination letter, in case of termination of the contract as a whole; or

ii. in part/parts proportionate to the contract price of the bill/schedule to which the terminated part of work belongs i.e.

$$P = (A \times B) \div C \text{ where,}$$

P = Proportionate Bank Guarantee Amount

A = Contract Price of the particular bill/schedule to which the terminated part of work belongs

B = Performance Guarantee amount in terms of CC New- clause 4.19/PCC

C = Total Contract Price

Plus, additional Performance Guarantee amount if any taken in terms of ITT and not due for release on the date of issue of termination letter against that particular bill/Schedule to which the terminated part of the work belongs in case of termination in part/parts.

- (c) release any payment due to the contractor for works executed prior to termination and evaluation under clause 49.8/PCC (valuation at date of termination, however, if by this time the Contractor has failed to make a payment due to the Employer, the same will be deducted from the payment due and any balance remaining shall then be paid to the Contractor.)

49.10 Employer's Entitlement to Termination for Convenience

The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this Sub-Clause in order to execute the Works himself or to arrange for the Works to be executed by another contractor or to avoid a termination of the Contract by the Contractor.

After this termination, the Contractor shall proceed in accordance with the relevant clause and shall be paid in accordance with New-Clause 8/PCC [Payment and Release in case of Optional Termination].

49.11.1. Requirements after Termination

Upon Termination of this Agreement in accordance with the provisions of this clause 49, the Contractor shall comply with and conform to the following:

- (a) deliver to the Authority all Plant and Materials which shall have become the property of the Authority under this clause 49;
- (b) deliver all relevant records, reports, Intellectual Property and other licenses pertaining to the Works, other design documents and in case of Termination occurring after the Provisional Certificate has been issued, the "as built" Drawings for the Works;
- (c) transfer and/or deliver all Applicable Permits to the Authority to the extent permissible under Applicable Laws; and
- (d) vacate the Site within seven days.

49.11.2 Other rights and obligations of the Parties

Upon Termination for any reason whatsoever

- (a) property and ownership in all Materials, Plant and Works and the Railway Project shall, as between the Contractor and the Authority, vest in the Authority in whole, free from any and all Encumbrances; provided that the foregoing shall be without prejudice to Clause 49.11.3;
- (b) risk of loss or damage to any Materials, Plant or Works and the care and custody thereof shall pass from the Contractor to the Authority; and
- (c) the Authority shall be entitled to restrain the Contractor and any person claiming through or under the Agreement from entering upon the Site or any part of the Project except for taking possession of materials, stores, implements, construction plants and equipment of the Contractor, which have not been vested in the Authority in accordance with the provisions of this Agreement.

49.11.3 Payment on Termination

After termination under Sub-Clause-49.7/PCC the Employer shall return the Performance Security, and shall pay the Contractor an amount calculated and certified in accordance with the following conditions:

- A. The value of approved materials actually brought to the site and reasonably required to execute the works during next three months, as per approved programme, and
- B. Value of work completed up to date by the Contractor at rates specified in the Contract, after taking into account any deductions, retentions, and setoff.
- C. In addition, a sum not exceeding 2% (two percent) of the value of the work remaining incomplete on the date of Termination notice taking effect.

The payment as above are full compensation for termination under this clause and the Contractor has no claim for damages or other entitlements whether under the contract or otherwise.

In case of termination/ foreclosure of the Contract under whatsoever circumstances, any remaining tools, plants, equipment's and surplus materials of the Employer with the Contractor will be returned to the Employer at Employer's depot at the Contractor's cost. In case of the failure of the Contractor to do so, the Employer will be entitled to recover their cost from the Contractor from the amount becoming due to the Contractor or from any other amount due in any other contracts.

The decision of the Engineer of the amount to be recovered will be final decision and full credit at rates initially charged to the Contractor shall be allowed for such materials. Similarly, the Employer shall be entitled to recover the cost of the unreturned material, plants, equipment and tools from the Contractor, where such material have been supplied free of cost and plants, equipment and tools, free of cost or on lease basis to the Contractor as stipulated in the Contract.

49.12 Survival

Termination of this Contract

- a. shall not relieve the Contractor or the Employer of any obligations already incurred hereunder which expressly or by implication survives Termination hereof and
- b. except as otherwise provided in any provision of this Contract expressly limiting the liability of either party, shall not relieve either party of any obligations or liabilities for loss or damage to the other Party arising out of or caused by acts or omissions of such Party prior to the effectiveness of such Termination or arising out of such Termination

	<p>49.13 Corrupt or Fraudulent Practices</p> <p>If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive or coercive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days' notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 49 CC/PCC shall apply as if such expulsion had been made under Sub-Clause 49.7/PCC.</p> <p>For the purposes of this Sub-Clause:</p> <p>(a) "corrupt practice" means the offering, giving, receiving of soliciting of anything of "value to influence the action of a public official in the procurement process or in the Contract execution.</p> <p>(b) "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of the Contract to the detriment of the Employer, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition</p> <p>(c) "collusive practice" means a scheme or arrangement between two or more bidders, with or without the knowledge of the Employer, designed to establish bid prices at artificial, non-competitive levels.</p> <p>(d) "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the procurement process or affect the execution of a contract.</p>
<p>Clause 1/SCC</p>	<p>The following New-paras are added to the Existing SCC Clauses.</p> <p>1.1 Engagement of Staff and Labour</p> <p>Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, housing, feeding and transport.</p> <p>The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labor with appropriate qualifications and experience from sources within the Country.</p> <p>1.2 Rates of Wages and Conditions of Labour</p> <p>The Contractor shall pay rates of wages, and observe conditions of labour, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.</p> <p>If the Employer is obliged to provide amenities or arrange payment of wages to contract labour employed by the contractor either directly or through sub-contractor under the contract on account of failures on the part the contractor to provide the amenities and / or arrange payment of wages to the contract labour as required of him under the provision of the applicable acts / rules made there under, the Engineer/Employer shall be at liberty without prejudice to the rights of Engineer/Employer under Section 20(2) and 21(4) of the Contract Labour (Regulation and Abolition) Act 1970 to recover the whole or part of the expenditure so incurred on the wages so paid by the Engineer/Employer/Railway from the security deposit and/or from any sum or sums due to the Contractor whether under this contract or any other contract.</p>

The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, allowances, and any benefits as are subject to taxes under the Laws of the Country for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there-under, regulation or notifications including amendment. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/ regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the contractor including his amount of performance security. The Employer/Engineer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

The Contractor shall duly comply with the provisions of the Apprentices Act 1961 (III of 1961), the rules made there under and the orders that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so he shall be subject to all liabilities provide by the said Act and said Rules.

The Contractor and his Sub Contractors shall comply with all applicable Labour Laws, and should not employ Child Labour for construction and maintenance activities. The Contractor shall provide appropriate facilities for children in Construction Camp sites.

The Contractors shall not differentiate wages between men and women for work of equal value

1.3 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst persons in the service of the Employer or the Engineer

1.4 Labour Laws

The Contractor shall comply with all the relevant Labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration, and emigration, and shall allow them all their legal rights. The Contractor and his sub-contractors shall be responsible to ensure at his own cost, compliance to all laws, bye-laws, rules and regulations for the time being in force pertaining to the employment of local or imported labour and shall take all necessary precautions to ensure and preserve the health and safety of all staff employed directly or through sub-contractors or petty contractors on the works which shall include all the acts listed in Appendix – 1 but not limited to the same.

The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.

During continuance of the Contract, the Contractor and his Sub-Contractors shall abide at all times by all existing labor enactments and rules made thereunder, regulations, notifications and bye laws of the State or Central government or local authority and any other labor laws (including rules), regulations, bye laws that may be passed or notification that may be issued under any labor law in future either by the State or the Central Government or the

local authority. Salient features of some of the major labor laws that are applicable to construction industry are given in Appendix 1 to these Conditions of Contract

1.5 Working Hours

No work shall be carried out on the Site on locally recognized days of rest, or outside the normal working hours stated in the Contract Data, unless:

- (a) otherwise stated in the Contract,
- (b) the Engineer gives consent, or
- (c) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer.
- (d) The Contractor, generally will have to carry out work during night hours also and in shifts unless specifically provided otherwise in the Contract. No increase in rates or extra payments shall be admissible for night work. Wherever night working is carried out by Contractor, temporary lighting arrangements as per approved layout shall be provided, installed, maintained for the duration of the contract and removed after completion of work. Flashing lights to warn the traffic on roads shall be used at all times on all obstructions. No extra payment will be made for the provision of temporary lighting, flashing lights and for maintenance. It is to be noted that the works are being undertaken in an urban area.
- (e) Should there be complaints received by members of the public regarding excessive noise or vibration, etc. especially at night, and if such complaints are valid, then the contractor shall take remedial measures to prevent such nuisance. No extra payment will be made to the contractor for the provision of such measures.
- (f) Working hours during the Defect liability period will be curtailed when certain system become operational

1.6 Facilities for Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.

The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

1.7 Health and Safety

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and a standing arrangement for ambulance service are available at a phone call at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same. The Contractor shall appoint an accident prevention officer at the Site, responsible

for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence.

HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals

Epidemics

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same.

Records of Safety and Health

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

Submission of Returns

The contractor shall be responsible for timely submission of all returns and statements to the concerned authorities in full compliance of all rules, bye-laws and regulations for the time being in force.

The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labor as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor.

The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 25.3 an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this program shall not exceed the Provisional Sum dedicated for this purpose.

1.8 Contractor's Superintendence

Throughout the execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work.

Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications (defined in Sub-Clause 3/CC [Law and Language]) and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.

The Contractor shall employ the key personnel named in the Schedule of Personnel as referred to in the Contract Data to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

The Contractor shall not employ any retired government Gazetted officer, who has either not completed one year after the date of retirement, or has not obtained permission to employment with the Contractor

1.9 Contractor's Personnel

The Contractor's Personnel shall be appropriately qualified, skilled and experienced in their respective trades or occupations. The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative if applicable, who:

- (a) persists in any misconduct or lack of care,
- (b) carries out duties incompetently or negligently,
- (c) fails to conform with any provisions of the Contract, or
- (d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment.

If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons, the Contractor shall ensure that the person leaves the Site within seven (7) days and has no further connection with the work in the Contract. The replacement person shall be appointed within fourteen (14) days of the notification by the Engineer.

A reasonable proportion of the Contractor's Superintending Staff shall have a working knowledge of the English language or the Contractor shall have available on site at all times a sufficient number of competent interpreters to ensure the proper transmission of instructions and information. If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person

1.10 Records of Contractor's Personnel and Equipment

The Contractor shall submit, to the Engineer, details showing the number of each class of Contractor's Personnel and of each type of Contractor's Equipment on the Site. Details shall be submitted each calendar month, in a form approved by the Engineer, until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works

1.11 Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site

1.12 Foreign Personnel

The Contractor may bring in to the country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, without any financial liability, if requested by the Contractor, use his best endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.

The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial. Contractor shall also be responsible for any legal liabilities during their stay.

1.13 Supply of Foodstuffs

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract

1.14 Supply of Water

The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel

1.15 Measures against Insect and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide

The Contractor shall provide his staff and labour with suitable prophylactics for the prevention of malaria, and take steps to prevent the formation of stagnant pools of water. He shall comply with all the regulations of the local health authorities in these respects and shall in particular arrange to spray thoroughly with approved insecticides all buildings erected on the site such treatment shall be carried out at least once a year or as instructed by the Engineer. The Contractor shall warn his staff and labour of the dangers of diseases like Malaria, Filaria and other contagious diseases etc. and also regarding, Scorpions, Snakes, Wild animals etc. and preventive actions required to be taken by the labour and staff.

1.16 Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter or disposal thereto by Contractor's Personnel.

1.17 Arms and Ammunition

	<p>The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.</p> <p>1.18 Festivals and Religious Customs</p> <p>The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs</p> <p>1.19 Funeral Arrangements</p> <p>The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of his local employees who may die while engaged upon the Works.</p> <p>1.20 Prohibition of Forced or Compulsory Labour</p> <p>The contractor shall not employ "forced or compulsory labour" in any form. "Forced or compulsory labour" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.</p> <p>1.21 Prohibition of Harmful Child Labour</p> <p>The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.</p> <p>1.22 Employment Records of Workers</p> <p>The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and shall be available for inspection by the Engineer during normal working hours. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 1.10/SCC of PCC [Records of Contractor's Personnel and Equipment].</p>
<p>Clause Price adjustment/ Contract data</p>	<p><u>REPLACE THE SUB-CLAUSE OF PRICE ADJUSTMENT IN CONTRACT DATA WITH THE FOLLOWING:</u></p> <p>PRICE VARIATION CLAUSE (PVC) Adjustment for changes in cost for the work of elevated viaduct, minor bridges and earth work etc., of suburban corridor.</p> <p>Contract price shall be adjusted for increase or decrease in rates and prices of labour, materials, fuels and lubricants in accordance with the following principles and procedures and as per formula given here under.</p> <p>The amounts payable to the Contractor shall be adjusted for rises or falls in the cost of labour, Goods and other inputs to the Works, by the addition or deduction of the amounts determined by the formulae prescribed in this Sub-Clause. To the extent that full compensation for any rise or fall in Costs is not covered by the provisions of this or other Clauses, the Accepted Contract Amount shall be deemed to have included amounts to cover the contingency of other rises and falls in costs.</p>

(A) Adjustment Formula

The adjustment to be applied to the amount otherwise payable to the Contractor, as valued in accordance with the appropriate Schedule and certified in Payment Certificates, shall be determined from formulae in which the Contract Price is payable. No adjustment is to be applied to work valued on the basis of Cost or current prices. The formulae shall be of the following:

Following expressions and meanings are assigned to the work done during each month.

R=Total value of work done during the month shall include the value of materials on which secured advance has been granted, if any during the month less the value of materials in respect of which the secured advance has been recovered, if any, during the month. This excludes the cost of work on items for which rates were fixed under Variations Clause 34.3/PCC for which the escalation will be regulated as mutually agreed at the time of fixation of rate. It will also exclude the value of work done during the month which was programmed to be done prior to this month as per work schedule in the agreement.

Following expressions and meanings are assigned to the work done during each month.

V=VL +VF+VM+VP+VS+VC Where

V = Total adjustment on account of all components.

VL = Adjustment on account of labour component.

VF = Adjustment on account of High speed diesel component.

VM = Adjustment on account of other materials component.

VP = Adjustment on account of Plant, machinery and spares.

VS = Adjustment on account of steel component.

VC = Adjustment on account of cement component.

Adjustment for labour Component:

Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with following formula. (Base: 2001=100).

VL= 0.85 X R X PL x [(Li – Lo)/Lo] Where

VL= Increase or decrease in the cost of work during the month under consideration due to change in rates for local labour

Lo =. The average consumer price index for industrial workers for Bangalore Centre as applicable for the month preceding the date of opening of the tenders as published by Labour Bureau, Ministry of Labour, GOI.

Li = The average consumer price index for industrial workers for Bangalore Centre during the 'month under consideration' as published by Labour Bureau, Ministry of Labour, GOI.

PL (cost co-efficient of labour to the total cost) = 0.23

Adjustment for High Speed Diesel component:

Price adjustment for increase or decrease in the cost of High Speed Diesel component shall be paid in accordance with following formula (Base: 2011-12=100).

VF = 0.85 X R X PF x [(Fi –Fo)/Fo] where

VF = Increase or decrease in the cost of work during the month under consideration due to change in rates for High-Speed Diesel components.

Fo = The official retail price of HSD at IOC/HPCL/BPL or other consumer pump at the location of the nearest POL consumer pump on the day 30 Days prior to the date of opening of tenders.

Fi = The official retail price of HSD at IOC/HPCL/BPL or other consumer pump at the location of the nearest POL consumer pump for the 15th day of the month under consideration.

PF (cost co-efficient of fuel and lubricants to the total cost) = 0.10

Adjustment on account of other materials component:

Price adjustment for increase or decrease in the cost of other materials component shall be paid in accordance with following formula (Base: 2011-12=100).

VM = 0.85 X R X PM x [(Mi –Mo)/Mo] where

VM = Increase or decrease in the cost of work during the month under consideration due to change in rates for other material components.

Mo = The all India whole sale price index for all commodities as applicable for the month preceding the date of opening of Tenders as published by Office of the Economic Adviser.

Mi = The all India whole sale price index for all commodities for the 'month under consideration' as published by Office of the Economic Adviser.

PM= (cost co-efficient of other materials to the total cost) =0.12

Adjustment on account of Plant, machinery and spares:

Price adjustment for increase or decrease in the cost of plant, machinery and spares component shall be paid in accordance with following formula (Base: 2011-12=100).

VP = 0.85 X R X PP x [(Pi – Po)/Po] where

VP = Increase or decrease in the cost of work during the month under consideration due to change in rates for plant, machinery and spares components.

Po = the all India wholesale price index for manufacture of machinery for mining, quarrying and construction as applicable for the month preceding the date of opening of Bids as published by Office of the Economic Adviser.

Pi = the all India wholesale price index for manufacture of machinery for mining, quarrying and construction for the 'month under consideration' as published by Office of the Economic Adviser.

PP (cost co-efficient of Plant, machinery and spares to the total cost) =0.14

Adjustment on account of steel component:

Price adjustment for increase or decrease in the cost of Steel shall be paid in accordance with following formula. (Base: 2011-12=100)

VS = 0.85 X R X PS x [(Si – So)/So] where

VS= Increase or decrease in the cost of work during the month under consideration due to change in rates for Structural Steel / TMT rebars / MS Steel / Pre-stressing strands.

So = The all India wholesale price index for **Mild Steel – Long products** as applicable for the month preceding the date of opening of Bids as published by Office of the Economic Adviser.

Si = The all India wholesale price index for **Mild Steel – Long products** for the 'month under consideration' as published by Office of the Economic Adviser.

PS (cost co-efficient of steel to the total cost) =0.27

Adjustment on account of cement component:

Price adjustment for increase or decrease in the cost of cement shall be paid in accordance with following formula. (Base: 2011-12=100)

VC = 0.85 X R X PC x [(Ci – Co)/Co] where

VC= Increase or decrease in the cost of work during the month under consideration due to change in rates for cement component.

Co = The all India wholesale price index for **Ordinary Portland Cement** as applicable for the month preceding the date of opening of Tender as published by Office of the Economic Adviser.

Ci = The all India wholesale price index for **Ordinary Portland Cement** for the 'month under consideration' as published by Office of the Economic Adviser.

PC (cost co-efficient of Cement to the total cost) = 0.14

Period of Work under consideration will mean as under:

- i. In the case of first Bill the period from the month of signing of agreement to the month of measurement of the first bill.
- ii. In the case of second and subsequent interim payment certificate and Final bills, the Period from the month of measurement for previous bill to the month of measurement of that bill.
- iii. As per provisions of contract (Clause 37.3/PCC) interim payments certificates are to be submitted by the contractor on monthly basis for the works/supply of items pertaining to a particular month. However, in case a bill is submitted for a period pertaining to more than a calendar month the average indices for those months and

previous month(s) shall be used for calculation purpose.

Responsibility of arranging the RBI indices /Economic advisor indices/Labour Bulletins desired by the Employer or the Engineer shall rest with the Contractor.

(B) Procedure in case of Delay in Availability of Final RBI Indices/ Economic advisor indices

Where the final Price Indices are not available in the Economic advisor, while making payment towards interim payment certificate, payment towards Price Variation will be made on provisional basis based on the indices available, to be adjusted in subsequent bills as and when the final Indices figures become available.

(C) Adjustment on Account of Price Variation

Adjustment on account of Price Variations may be positive (in which case extra amount shall be paid to the Contractor), or negative (in which case the amount of Price Variation shall be recovered from the Contractor). Adjustment on account of Price Variation shall be calculated separately, for each period, between two successive dates of measurements for bills and paid along with each bill as claimed by the contractor.

After verifying the bill, the Engineer shall certify the adjustment amount and advise the same to the Employer along with the interim payment certificate. Should any extra amount be due to Contractor, the Employer shall pay the same. Any amount due from Contractor on account of negative adjustment shall be recovered from his pending or other bills at the earliest.

The above adjustment on account of Price Variation payment shall be made to the contractor in accordance with the proportion stipulated in Schedule of Payment Currencies by using exchange rate on the last day of the period to which a particular interim payment certificate is related as per the website of Reserve Bank of India (RBI). In case the exchange rate on the above date, is not available in this web site, it will be as per the web site of Financial Benchmark India Private Limited (FBIL) as recommended by RBI.

In case the exchange rate of particular currency is not available on the above date in both these websites then the exchange rate as per the website of the Central Bank of that country to which this currency belongs will be adopted. In case the exchange rate of that currency is not directly available in INR on that website then the currency will be first converted to USD as per the exchange rate between that foreign currency and US Dollar on that web site and then converted from USD to INR as per RBI or FBIL exchange rate between US Dollar and INR, as prevailing on the said date.

(D) Limit of Price Adjustment

Provided that, in determining all such price adjustment in accordance with the aforesaid Sub-Clauses:

- a. No account will be taken of any amount by which any cost incurred by the Contractor has been increased by default or negligence of the Contractor.-p
- b. If the Contractor fails to complete the work within time for completion prescribed under Clause 26.4 the adjustment of prices thereafter until the completion of the works shall be made using either the indices or prices, whichever is more favourable to the Employer, provided that if an extension of time is granted pursuant to Sub-

	<p>Clause 26.5/PCC, the above position shall apply to the adjustments made after expiry of such extension of time.</p> <p>(E) Price Variation during extended period of completion</p> <p>The price adjustment as worked out above i.e., either increase or decrease will be applicable up to the stipulated Completion Date of the Works, including the extended period of completion where such extension has been granted under Sub-Clause 26.5/PCC and where such an extension has been granted, the price adjustment will be due as follows:</p> <p>a. In a. In case the indices increase above the indices applicable to a bill made on the last date of original completion period or the extended period under Sub-Clause 26.5/PCC, the price adjustment for the period of extension granted in accordance with Sub-Clause 26.5/PCC will be limited to the amount payable as per the indices applicable to a statement made on the last date of the original completion period or the extended period as the case may be.</p> <p>b. In case the indices fall below the indices applicable to a statement made on the last date of the original or extended period of completion, then the lower indices will be adopted for Price Adjustment for the period of extension</p>
<p>New Clause-1.1</p>	<p>Assignment</p> <p>Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party:</p> <p>i. may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party, and</p> <p>ii. may, as security in favour of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.</p>
<p>New Clause -1.2</p>	<p>Care and Supply of Documents</p> <p>The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, two copies of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor.</p> <p>Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.</p> <p>The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.</p> <p>If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.</p>

New Clause-1.3	<p>Delayed Drawings or Instructions</p> <p>The Contractor shall give notice to the Engineer whenever the Works are likely to be delayed or disrupted if any necessary drawing or instruction is not issued to the Contractor within a particular time, which shall be reasonable. The notice shall include details of the necessary drawing or instruction, details of why and by when it should be issued, and details of the nature and amount of the delay or disruption likely to be suffered if it is late. If the Contractor suffers delay and/or incurs Cost as a result of a failure of the Engineer to issue the notified drawing or instruction within a time which is reasonable and is specified in the notice with supporting details, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Clause 4.1/SCC of contract conditions [Contractor's Claims] to:</p> <ul style="list-style-type: none"> (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and (b) payment of any such Cost, which shall be included in the Contract Price. <p>After receiving this further notice, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine these matters.</p> <p>However, if and to the extent that the Engineer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit.</p>
New Clause-1.4	<p>Employer's Use of Contractor's Documents</p> <p>As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.</p> <p>The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:</p> <ul style="list-style-type: none"> (a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works, (b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and (c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor. <p>The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this Sub-Clause.</p>
New Clause-1.5	<p>Contractor's Use of Employer's Documents</p> <p>As between the Parties, the Employer shall retain the copyright and other intellectual property rights in the Specification, the Drawings and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be</p>

	copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.
New Clause-1.6	<p>Confidential Details</p> <p>The Contractor shall disclose all such confidential and other information as the Engineer may reasonably require in order to verify the Contractor's compliance with the Contract.</p> <p>The Contractor shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out the Contractor's obligations under the Contract or to comply with applicable Laws. The Contractor shall not publish or disclose any particulars of the Works without the previous agreement of the Employer. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.</p>
New Clause-1.7	<p>Compliance with Laws</p> <p>The Contractor shall, in performing the Contract, comply with applicable Laws. Unless otherwise stated in the Special Conditions of Contract:</p> <p>(a) the Employer shall have obtained (or shall obtain) the planning, zoning or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or being) obtained by the Employer; and the Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so; and</p> <p>(b) the Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.</p>
New Clause-1.8	<p>Joint Venture — Joint and Several Liability</p> <p>If the Contractor constitutes (under applicable Laws) a Joint Venture of two or more persons/firms:</p> <p>(a) these persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;</p> <p>(b) these persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and</p> <p>(c) the Contractor shall not alter its composition or legal status without the prior consent of the Employer.</p> <p>(d) In the event of default by any partner of Joint Venture, on or after achieving 25% of the financial progress (excluding advance if any) the lead partner or remaining partner(s), in case the defaulting partner is the lead partner, shall notify the Employer within twenty eight (28) days of the occurrence and within Fifty six (56) days of the said notification, the lead partner or remaining partner(s), who are not the defaulting partner, shall assign the works of the defaulting partner, to equally competent party with prior consent of the Employer. For this purpose the term "equally competent party" shall mean as under:</p> <p>"The new JV partner replacing the defaulting partner should meet the EQC requirement of package/combination of packages which was met by the defaulting partner on the basis of which the original tender was awarded."</p>

	<p>The replacement of any defaulting partner, with the new partner shall be subject to the condition that the new partner has to submit additional performance security equal to 10% of balance cost of work of the JV partner being replaced. The performance security submitted by the defaulting partner shall also continue with K-RIDE till satisfactory completion of the work.</p> <p>(e) Notwithstanding the consent of the Employer for change in composition or legal status of the Joint Venture the partners shall continue to be jointly and severally liable to the Employer.</p> <p>(f) The Joint Venture shall enter into a Joint Venture Agreement incorporating the provisions of sub-paras (a) to I based upon the form annexed to the Conditions of Contract. The JV agreement shall indicate precisely the specific role of all members of the JV in respect of planning, design, construction equipment, key personnel, work execution, and financing of the project. The authority to sign the JV Agreement shall be evidenced by approved legal instruments.</p> <p>Notwithstanding the contents of the sub-clauses above, if the performance of any JV partner is not found satisfactory by the Employer, in respect of the responsibilities assigned to him as per JV agreement which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV as the case may be from participating in any K-RIDE tender from the date of issue of notice of default.</p>
New Clause-1.9	<p>Inspections by the Employer</p> <p>The Contractor shall permit the Employer and/or persons appointed by the Employer to inspect the Site and/or the Contractor's records relating to the performance of the Contract.</p>
New Clause-1.10	<p>Bidder's Credentials:</p> <p>The bidder shall submit an affidavit on a stamp paper to the effect that all the documents submitted by her along with her bid are true. This shall be mandatory all bids. The bid shall be summarily rejected if the bidder fails to submit this undertaking along with the bid.</p> <p>After opening the financial bid, the tender committee shall verify the credentials of the bidder who is declared as the lowest bidder (L1) for their authenticity. In case the credentials of L1 are not found to be in order, The bid shall be treated as technically unresponsive and thus invalid. The process shall be repeated for the next higher bidder till the valid L1 is established. If any document (or copy thereof) submitted by a bidder is found to be false/forged:</p> <p>a) The bidder/each partner/member of the bidding firm shall be liable to legal actions apart from punitive actions, as decided by competent authority of K-RIDE. In such an eventuality. The bid shall also be summarily rejected.</p> <p>b) If the contract has already been awarded, or Letter of Acceptance (LoA) has been issued and in the event of any failure to comply with the above, the contract shall be terminated, irrespective of the stage of progress in execution of the work. In such an eventuality, Security Deposit (SD), performance Guarantee (PG) and partial/full payments otherwise due to the contractor, in respect of the partial/full work executed by the contractor, shall be forfeited by the K-RIDE.</p>

	c) Other punitive actions, like banning the bidder and partners/members of the bidding firm for future dealings with K-RIDE/Government of India/ Government of Karnataka may also be taken.
	2. THE EMPLOYER
New clause 2.0	<p>Obligations of the Employer</p> <ol style="list-style-type: none"> 1. The Employer shall, at its own cost and expense, undertake, comply with and perform all its obligations set out in this Agreement or arising hereunder. 2. The Employer shall be responsible for the correctness of the Scope of the Project, Project Facilities, Specifications and Standards and the criteria for Testing of the completed Works. 3. The Employer shall, upon receiving the Performance Security, provide to the Contractor: <ol style="list-style-type: none"> (a) the Right of Way in accordance with the provisions progressively. (b) all environmental and forest clearances as required and approval of the general arrangement drawings (the "GAD") from road authorities to enable the Contractor to construct road over-bridges and under-bridges at level crossings on the Railway Project in accordance with the Specifications and Standards, and subject to the terms and conditions specified in such approval. 4. In the event that <ol style="list-style-type: none"> (i) the Employer does not procure fulfilment of any or all of the obligations set forth in para 3 above within the period specified in respect thereof, and (ii) the delay has not occurred as a result of breach of this Agreement by the Contractor or due to Force Majeure, the Employer shall extend Time Extension in accordance with the provisions. 5. The Employer agrees to provide support to the Contractor and undertakes to observe, comply with and perform, subject to and in accordance with the provisions of this Agreement and Applicable Laws, the following: <ol style="list-style-type: none"> a) upon written request from the Contractor, and subject to the Contractor complying with Applicable Laws, provide reasonable support to the Contractor in procuring Applicable Permits required from any Government Instrumentality for implementation of the Project; b) upon written request from the Contractor, provide reasonable assistance to the Contractor in obtaining access to all necessary infrastructure facilities and utilities, including water and electricity. c) procure that no barriers that would have a material adverse effect on Works are erected or placed on or about the Railway Project by any Government Instrumentality or persons claiming through or under it, except for reasons of Emergency, national security or law and order;

	<p>d) not do or omit to do any act, deed or thing which may in any manner be violative of any of the provisions of this Agreement;</p> <p>e) support, cooperate with and facilitate the Contractor in the implementation of the Project in accordance with the provisions of this Agreement; and</p> <p>6. Environmental and Forest Clearances</p> <p>The Employer will obtain the required environmental and forest for construction of project before issue of LOA. In the event of any delay, the Contractor shall be entitled to Time Extension for the period of such delay in accordance with the provisions.</p> <p>7. Provision of Power Blocks and Traffic Blocks</p> <p>The Employer shall provide Power Block or Traffic Block or both to enable the Contractor to undertake the construction of overhead equipment, or such other work as may be determined by the Employer's Engineer.</p> <p>The Contractor shall, in consultation with the Employer's Engineer, submit a weekly programme of Blocks.</p> <p>The minimum period for which a Power Block or Traffic Block shall be provided to the Contractor shall not be less than two hours, period being counted from the time the track is placed at the disposal of the Contractor and until it is cleared by the Contractor. Provided, however, that a Power Block or Traffic Block, as the case may be, of shorter duration may be provided with mutual consent of the Parties.</p> <p>The Contractor shall organize its work so as to complete all Construction Works within such period.</p> <p>In the event of any change in the schedule of Power Block or Traffic Block or both, as the case may be, the Employer shall inform the Contractor.</p> <p>The Contractor shall be entitled to undertake the Construction Works within the traffic block /power block period, provided, In the event the block period utilized by the Contractor exceeds the period specified, the Contractor shall pay to the Authority hourly charges at the rate specified.</p>
New Clause-2.1	<p>Permits, Licenses or Approvals</p> <p>The Employer shall (where he is in a position to do so) provide reasonable assistance to the Contractor at the request of the Contractor:</p> <p>(a) by obtaining copies of the Laws of the Country which are relevant to the Contract but are not readily available, and</p> <p>(b) for the Contractor's applications for any permits, licences or approvals required by the Laws of the Country:</p> <p>(i) which the Contractor is required to obtain under New-Clause 1.7/PCC [Compliance with Laws],</p> <p>(ii) for the delivery of Goods, including clearance through customs, and</p> <p>(iii) for the export of Contractor's Equipment when it is removed from the Site.</p>

New Clause -2.2	<p>Employer's Personnel</p> <p>The Employer shall be responsible for ensuring that the Employer's Personnel and the Employer's other contractors on the Site:</p> <p>(a) co-operate with the Contractor's efforts under New-Clause 4.24/PCC [Co-operation], and</p> <p>(b) take actions similar to those which the Contractor is required to take under sub-paragraphs (a), (b) and (c) of New-Clause 4.26/PCC [Safety Procedures] and under New-Clause 4.36/PCC [Protection of the Environment].</p>
New Clause-2.3	<p>Employer's Financial Arrangements</p> <p>The Employer has sourced the funds to finance the project</p> <p>Assignment by the Employer</p> <p>The Employer shall be fully entitled without the consent of the Contractor, to assign the benefit of the Contract or any part thereof and any interest therein or there under to any third party.</p>
New Clause-2.4	<p>Employer's Claims</p> <p>If the Employer considers himself to be entitled to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Notification Period, the Employer or the Engineer shall give notice and particulars to the Contractor. However, notice is not required for payments due under New-Clause 4.37/PCC [Electricity, Water and Gas], under New-Clause 4.38/PCC [Employer's Equipment and Free-Issue Material], or for other services requested by the Contractor.</p> <p>The notice shall be given as soon as practicable after the Employer became aware, or should have become aware, of the event or circumstances giving rise to the claim. A notice relating to any extension of the Defects Notification Period shall be given before the expiry of such period.</p> <p>The particulars shall specify the Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers himself to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defects Notification Period in accordance with New-Clause 6.12/[PCC Extension of Defects Notification Period].</p> <p>This amount may be included as a deduction in the Contract Price and Payment Certificates. The Employer shall only be entitled to set off against or make any deduction from an amount certified in a Payment Certificate, or to otherwise claim against the Contractor, in accordance with this Sub-Clause.</p>
	<p>3.THE ENGINEER</p>
New Clause-3.1	<p>"Engineer" means the person nominated by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under New-Clause 3.4 [Replacement of the Engineer]. The person nominated to act as an engineer may be an employee of Rail Infrastructure Development Company (Karnataka) Ltd (K-RIDE) or an employee of a Project Management Consultancy firm engaged by K-RIDE for project management as per the discretion of the Employer.</p>

	<p>Engineer's Duties and Authority</p> <p>The Employer shall appoint the Engineer who shall carry out the duties assigned to him in the Contract. The Engineer's staff shall include suitably qualified engineers and other professionals who are competent to carry out these duties.</p> <p>The Engineer shall have no authority to amend the Contract.</p> <p>The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract.</p> <p>However, the Engineer shall obtain the specific approval of the Employer before taking action under the following Sub-Clauses of these Conditions:</p> <ul style="list-style-type: none"> a) New-Clause 4.30/PCC [Unforeseeable Physical Conditions] Agreeing or determining an extension of time and/or additional cost. b) Sub-Clause 26.5/PCC [Extension of Time for Completion] Agreeing or determining extension of time. c) New-Clause 6.9/PCC [Performance Certificate] Issue of Performance Certificate. d) Sub-Clause 34. Except, <ul style="list-style-type: none"> (i) in an emergency situation as determined by the Engineer and as amplified in sub-paras (h) and (i) below, or (ii) DELETED e) Sub-Clause 34.2 – Procedure for change of scope: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 34.1. f) Sub-Clause 37.16 -Payment in applicable Currencies: Specifying the amount payable in each of the applicable currencies for a Variation. g) Clause 4.1/SCC: Contractor Claims for extension of time and/or additional payment. h) Providing Power block or Traffic block to the contractor. i) DELETED <p>Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 34/PCC and shall notify the Contractor accordingly, with a copy to the Employer.</p> <ul style="list-style-type: none"> j) In case the emergency mentioned in above Sub-paras occurs on account of failure of Contractor, by way of not adhering to the approved scheme of work or not taking adequate safety precautions or by any other reason attributable to the contractor, then no additional amounts shall be paid to the Contractor for attending to such emergencies and the Contractor shall be liable for Employer's claims. k) Clause 7/PCC regarding deployment of Sub-Contractors.

<p>New Clause-3.2</p>	<p>Delegation by the Engineer</p> <p>The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. These assistants may include a resident engineer, and/or independent inspectors appointed to inspect and/or test items of Plant and/or Materials. The assignment, delegation or revocation shall be in writing and shall not take effect until copies have been received by both Parties.</p> <p>However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with New-Clause 3.5/PCC [Determinations].</p> <p>Assistants shall be suitably qualified persons, who are competent to carry out these duties and exercise this authority, and who are fluent in the language for communications defined in Sub-Clause 3/CC [Law and Language].</p> <p>Each assistant, to whom duties have been assigned or authority has been delegated, shall only be authorised to issue instructions to the Contractor to the extent defined by the delegation. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by an assistant, in accordance with the delegation, shall have the same effect as though the act had been an act of the Engineer. However:</p> <ul style="list-style-type: none"> (a) any failure to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Engineer to reject the work, Plant or Materials; (b) if the Contractor questions any determination or instruction of an assistant, the Contractor may refer the matter to the Engineer, who shall promptly confirm, reverse or vary the determination or instruction.
<p>New Clause-3.3</p>	<p>Instructions of the Engineer</p> <p>The Engineer may issue to the Contractor (at any time) instructions and additional or modified Drawings which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this Clause. If an instruction constitutes a Variation, Clause 34/PCC [Variations and Adjustments] shall apply.</p> <p>The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. Whenever practicable, their instructions shall be given in writing. If the Engineer or a delegated assistant,</p> <ul style="list-style-type: none"> (a) gives an oral instruction and (b) receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction, and (c) does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation, (d) then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be).
<p>New Clause-3.4</p>	<p>Replacement of the Engineer</p> <p>Notwithstanding New-Clause 3.1/PCC, if the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of replacement, give notice to the Contractor of the name, address and relevant experience of the replacement Engineer.</p>

New Clause-3.5	<p>Determinations</p> <p>Whenever these Conditions provide that the Engineer shall proceed in accordance with this New-Clause 3.5/PCC to agree or determine any matter, the Engineer shall consult with each Party in an endeavour to reach agreement. If agreement is not achieved, the Engineer shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.</p> <p>The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars. Each Party shall give effect to each agreement or determination unless and until revised under Clause 4/SCC [Claims, Disputes and Arbitration].</p>
New Clause-3.6	<p>Remuneration of the Authority's Engineer</p> <p>The remuneration, cost and expenses of the Authority's Engineer shall be borne by the Authority</p>
New Clause-3.7	<p>Interim Arrangement</p> <p>In the event that the Authority has not appointed an Authority's Engineer, or the Authority's Engineer so appointed has relinquished its functions, the Authority may, in the interim, designate and authorise any person to discharge the functions of the Authority's Engineer in accordance with the provisions of this Agreement, save and except that such person shall not exercise any functions relating to review, comment, approval or inspection as specified in this Agreement for and in respect of the Authority's Engineer, and such functions shall be discharged as and when an Authority's Engineer is appointed in accordance with the provisions of this Agreement. Provided, however, that nothing contained in this Clause shall in any manner restrict the rights of the Authority to enforce compliance of the provisions of this Agreement.</p>
	<p>4.THE CONTRACTOR</p>
New Clause-4.1	<p>Contractor's General Obligations</p> <p>4.1.1 Subject to and on the terms and conditions of this Agreement, the Contractor shall undertake the survey, investigation, design, engineering, procurement, and construction of the Railway Project and observe, fulfil, comply with and perform all its obligations set out in this Agreement or arising hereunder.</p> <p>4.1.2 The Contractor shall comply with all Applicable Laws and Applicable Permits (including renewals as required) in the performance of its obligations under this Agreement.</p> <p>4.1.3 Save and except as otherwise provided in this Agreement or Applicable Laws, as the case may be, the Contractor shall, in discharge of all its obligations under this Agreement, conform with and adhere to Good Industry Practice at all times.</p> <p>4.1.4 The Contractor shall remedy any and all loss or damage to the Railway Project, occurring on or after the Appointed Date and until the date of Provisional Certificate, with respect to the Works completed prior to the issuance of the Provisional Certificate and/or Completion Certificate, with respect to the Works referred to in the Punch List, at its own cost, save and except to the extent that any such loss or damage shall have arisen from any default of the Authority or on account of a Force Majeure Event in which case the provisions of New Clause 8/PCC/ Force majeure shall apply.</p> <p>4.1.5 The Contractor shall remedy any and all loss or damage to the Railway Project during the Defects Liability Period at its own cost, to the extent that such loss or damage shall have arisen out of the reasons specified.</p> <p>4.1.6 The Contractor shall, at its own cost and expense, in addition to and not in derogation of its obligations elsewhere set out in this Agreement:</p>

- (a) make, or cause to be made, necessary applications to the relevant Government Instrumentalities with such particulars and details as may be required for obtaining Applicable Permits and obtain and keep in force and effect such Applicable Permits in conformity with Applicable Laws;
- (b) procure, as required, the appropriate proprietary rights, licences, agreements and permissions for Materials, methods, processes, know-how and systems used or incorporated into the Railway Project;
- (c) make reasonable efforts to maintain harmony and good industrial relations among the personnel employed by it or its Sub-contractors in connection with the performance of its obligations under this Agreement;
- (d) ensure and procure that its Sub-contractors comply with all Applicable Permits and Applicable Laws in the performance by them of any of the Contractor's obligations under this Agreement;
- (e) always act in a manner consistent with the provisions of this Agreement and not cause or fail to do any act, deed or thing, whether intentionally or otherwise, which may in any manner be violative of any of the provisions of this Agreement;
- (f) support, cooperate with and facilitate the Authority in the implementation and operation of the Project in accordance with the provisions of this Agreement;
- (g) ensure that the Contractor and its Sub-contractors comply with the safety and welfare measures for labour in accordance with Applicable Laws and Good Industry Practice;
- (h) keep, on the Site, a copy of Agreement, publications named in Agreement, the Drawings, Documents relating to the Project, Change of Scope Orders and other communications sent under Agreement, and provide access to all these documents at all reasonable times to the Authority's Engineer and its 207obilizati personnel;
- (i) cooperate with other contractors employed by the Authority and with personnel of any other public authority; and
- (j) not interfere unnecessarily or improperly with the convenience of the public, or the access to and use and occupation of all the existing facilities within the Right of Way, irrespective of whether they are public or in the possession of the Authority or of others.
- (k) to provide reasoned comments on any information relating to the contractor's activities under or pursuant to the agreement, which the Authority may publish.
- (l) The Contractor shall undertake all necessary superintendence to plan, arrange, direct, manage, inspect and test the Works

4.1.7 Electricity, water and other services

The Contractor shall be responsible for procuring of all power, water and other services that it may require for the Railway Project.

4.1.8 Unforeseeable difficulties

Except as otherwise specified in the Agreement:

- (a) the Contractor accepts complete responsibility for having foreseen all difficulties and costs of successfully completing the Works;

- (b) the Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs; and
- (c) the Scheduled Completion Date shall not be adjusted to take account of any unforeseen difficulties or costs.

For the purposes of this Clause, unforeseeable difficulties include physical conditions like man-made or natural physical conditions including sub-surface and hydrological conditions which the Contractor encounters at the Site during execution of the Works.

4.1.9 Safety at work site

The Contractor and its sub-contractors shall follow the safety instructions and take all safety measures for workmen and vehicles plying in the work area in accordance with Applicable Laws, Good Industry Practice and the provisions of this Agreement.

The Contractor shall design (to the extent specified in the Contract), execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works.

The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.

All equipment, and material, to be incorporated in or required for the Works shall be procured from approved sources as stipulated in the Contract.

- i. All plants / equipment to be deployed on the work shall carry designated authority certificate. Where not specified, it shall have third party safety certificate for the safe working of the equipment and shall be renewed after every 3 months. This certificate shall be produced to the Engineer as and when required.
- ii. All the construction plant shall be provided with the experienced operators having valid license issued by the competent authority.
- iii. Any material or equipment not meeting the approval of the Engineer shall be removed from the site immediately.
- iv. All Contractor's Equipment and Temporary Works provided by the Contractor shall, when brought on to the site, be deemed to be exclusively intended for execution of the Works and not be removed without the consent in writing of the Engineer. Such consent shall not be unreasonably withheld or delayed.

The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor (i) shall be responsible for all Contractors' Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract, and (ii) shall not otherwise be responsible for the design or specification of the Permanent Works.

The Contractor shall throughout the execution of the Works including the carrying out of any testing, commissioning or remedying of any defect:

- i. provides and maintain all lights, guards, fences and warning signs and watchmen when and where necessary or required by the Engineer or by laws or by any relevant

	<p>authority for the protection of the Works and for the safety and convenience of the public and all persons on or in the vicinity of the Site; and</p> <p>ii. Contractor is required to take note of all the necessary provisions in Employer's Safety, Health and Environment Manual (SHE Manual) and the Contractor's price shall be inclusive of all the necessary costs to meet the prescribed safety standards as specified in the Special Conditions of Contract. In the case, the Contractor fails in the above; the Employer may provide the necessary arrangements and recover the costs from the Contractor</p>
New Clause-4.2	<p>Tools, Plants and Equipment Supplied by the Employer</p> <p>i. Except for any specific item mentioned in the Special Conditions of Contract or in Employer's Requirements, the Contractor shall provide all tools, plants and Equipment for the Works. In respect of such exceptional tools, plants or Equipment committed to be provided by the Employer under terms and conditions specified in the Special Conditions of Contract, the Contractor shall take all reasonable care and shall be responsible for all damages or loss caused by him, his representatives, sub-contractors or his workmen or others while they are in his charge.</p> <p>ii. No tools, plant and equipment shall be supplied by the Employer. Unless specifically incorporated in special conditions, the Contractor has to arrange all tools, plant, equipment required for the work.</p> <p>iii. On completion of the Works, the Contractor shall hand over the unused balance of the tools, plants and Equipment supplied by the Employer to the Employer back in good order and repair, fair wear and tear expected, and shall be responsible for any failure to account for the same or any damage done thereto.</p> <p>iv. The decision of the Engineer as to the amount recoverable from the Contractor on this account shall be final and binding.</p>
New Clause-4.3	<p>Employer's Materials</p> <p>Except for items mentioned in the Special Conditions of Contract, the Contractor shall provide all materials for the Works. Material if any, to be provided by Employer will be done only in a phased manner as per pre-approved program, against a Bank Guarantee for the value of the Material and at terms and conditions for issue, upkeep, usage, return and recovery of such Materials as specified in Special Conditions of Contract.</p>
New Clause-4.4	<p>Sheds, Stores, Yards</p> <p>It shall be the responsibility of the Contractor to provide at his own expense the required sheds, store houses, and yards for both Permanent and Temporary Works and provide free access to the Engineer and the Engineer's Representative who will have right of inspection including that of instructing the Contractor to remove a particular material from the stores and not to use the same on the Works.</p>
New Clause-4.5	<p>Temporary Works</p> <p>The Contractor's proposals for erection of all ancillary and temporary works shall be in conformity with the proposals submitted along with the Tender and modifications thereto as approved by Engineer.</p> <p>The Contractor shall submit drawings, supporting design calculations of Temporary works, where called for by the Engineer and other relevant details of all such works to the Engineer for approval at least one month before he desires to commence such works. Approval by the Engineer of any such proposal shall not relieve the Contractor of his responsibility for sufficiency of such works.</p> <p>All temporary works necessary for the proper execution of the Works shall be provided and maintained by the Contractor at his cost (unless otherwise provided in tender document) and</p>

	subject to the consent of the Engineer shall be removed by Contractor at his own expense when they are no longer required and in such manner as the Engineer shall direct. In case the Contractor fails to remove the temporary works on completion the Engineer is authorized to get the same removed and recover the cost thereof from the Contractor.
New Clause-4.6	<p>Access for Engineer</p> <p>The Contractor shall allow at all times the Engineer or the Engineer's assistant or any other person authorised by the Engineer access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured, fabricated and/or assembled for the Works. The Contractor shall ensure that sub contracts if any shall contain provisions entitling the Engineer or any person authorised by him to have such access.</p>
New Clause-4.7	<p>Access Road and Way Leave</p> <ol style="list-style-type: none"> I. Providing access roads/ way leaves to the site will be Contractor's responsibility. II. The Contractor shall pay the statutory vehicle license and permit fees for use of public roads. The Contractor's heavy construction or tracked equipment shall not travel on any public road or bridge, unless the Contractor has made arrangements with the authority concerned and has obtained the approval of the Engineer to such arrangements. III. The Contractor shall repair any damage to the road or bear the cost thereof due to movement of contractor's plants and equipment, vehicles etc. to the specifications and satisfaction of road authorities as well as of Engineer. IV. The Contractor shall plan transportation of construction materials to work site in accordance with traffic regulations enforced by local traffic authorities from time to time and in such a way that congestion on the roads and road accidents are avoided. The Contractor should study this aspect thoroughly before quoting for the work.
New Clause-4.8	<p>Contractor to keep Site Clear</p> <ol style="list-style-type: none"> i. During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction, and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required. ii. On completion of the works, the Contractor shall clear away and remove from site all Constructional Plant, surplus material and Temporary Works. He should leave the whole of the site and Works in a clean, tidy and workman like condition to the satisfaction of the Engineer. iii. On completion of Work the Contractor shall also clear away the labour camps, hutments and other related installations and restore the land to its original condition to the satisfaction of the Engineer within 45 days of the physical completion of Work. The cost on account of delay in return of land and reinstatement of original condition within the stipulated time as determined by Engineer will be recovered from the Contractor's dues. iv. All garbage shall be removed from site daily or as they accumulate. All surface and sub-soil drains shall be maintained in a clean, sound and satisfactory state of performance. No extra payment shall be made on this account. v. No final payment in settlement of the accounts for Works shall be made till, in addition to any other condition necessary for such final payment, site clearance and clearances of labour camps etc. shall have been effected by him. Such clearance may be made by the Engineer through any other agency at the expense of the Contractor in the event of the Contractor's failure to comply with this provision within 7 days after receiving notice to that effect from the Engineer. All expenses on such removal / clearance shall be debit able to the Contractor as loans due from the Contractor to the Employer, and the Employer shall

	<p>be competent to recover the same from Contractor's on-account or final bills, or from Performance Security amount or from any other amount payable to the Contractor in any other Contract.</p>
<p>New Clause-4.9</p>	<p>Security of the Site</p> <ol style="list-style-type: none"> I. The Contractor shall take all measures necessary to ensure security, including exercising control over all persons and vehicles which are employed or engaged on the Site or in connection with the Works or the other works comprising the Project and with the security arrangements applicable to any other site within the Project. II. The Contractor shall arrange the issue of passes for the admission of all persons and vehicles to the Site or to any part thereof and may refuse admission to or remove from the Site any person or vehicle failing to show an appropriate pass on demand to any duly authorized person. III. If required by the Engineer, the Contractor shall submit a list identifying all persons to whom passes have been issued together with two photographs of each person and all entities to which a pass has been issued in respect of any vehicle and shall satisfy the Engineer of the bonafides of any such person or entity. IV. The Contractor shall not, without the written permission of the Engineer or otherwise in accordance with the Contract, allow access to the Site to any person unless the presence on Site of such person is necessary in connection with the execution of the Works or with the discharge of the duties of any relevant authority. V. The Contractor shall be wholly responsible for security of site and Works. The Contractor shall follow relevant Safety and Security instructions issued by the concerned Authorities from time to time and shall work in close coordination with the concerned Authorities.
<p>New Clause-4.10</p>	<p>Contractor's Operations on Site</p> <ol style="list-style-type: none"> I. The Contractor shall confine his operations to the Site, and to any additional area which may be provided to the Contractor and agreed by the Engineer as working areas. The Contractor shall take all necessary precautions to keep his personnel and equipment within the Site and such additional areas, and to keep and prohibit them from encroaching on adjacent land. II. The Contractor, after obtaining any necessary consent from any relevant authority, shall submit to the Engineer proposals showing the layout of pedestrian routes, lighting, signs, and guarding any road opening or traffic diversion which may be required in connection with the execution of the Works and which the Contractor intends to construct. Any consent given by the Engineer to such proposals shall not relieve the Contractor of any obligation under the Contract or absolve the Contractor from any liability for or arising from such proposals or the implementation thereof. III. All lights provided by the Contractor shall be so placed or screened as not to interfere with signs, signals or lights. The Contractor shall not in any way obscure or affect signs, signals or lights, in use by any relevant authority. In the event that the Contractor does so, the Contractor shall pay all costs associated with the re-fitting, re-instating or provision of alternatives for any sign, signal or light, obscured or affected.

	<p>IV. For the purposes of this Clause only, "Site" shall include off-Site places of manufacture or storage and the Contractor's Work Areas and shall include, areas provided to the Contractor by others.</p>
New Clause-4.11	<p>Publicity</p> <p>The Contractor shall not publish or otherwise circulate alone or in conjunction with any other person, any articles, photographs or other materials relating to the Contract, the Site, the Works, the Project or any part thereof, nor impart to the press, or any radio or television network any information relating thereto, nor allow any representative of the media access to the Site, Contractor's Works Areas, or off-Site place of manufacture, or storage except with the permission, in writing, of the Employer. The Contractor shall ensure that his sub-contractors of any tier shall be bound by a like obligation and shall, if so required by the Employer, enforce the same at his own expense. The provisions of this Sub-Clause shall not exempt the Contractor from complying with any statutory provision in regard to the taking and publication of photographs.</p>
New Clause-4.12	<p>Disclosure of Relationship</p> <p>If the Contractor or any partner of the Contractor or Director of the Contractor's company is closely related to any of the Officers of the Employer or the Engineer, or alternatively, if any close relative of an officer of the Employer or the Engineer has financial interest / stake in the Contractor's firm, the same shall be disclosed by the Contractor at the time of filing his tender. Any failure to disclose the interest involved, shall entitle the Employer to rescind the Contract, without payment of any compensation to the Contractor. The Contractor shall note that he is prohibited from developing such interest during the Contract period.</p>
New Clause-4.13	<p>Use Of Explosives</p> <p>Explosives if required on the Work shall be used by Contractor only with prior Approval of the Engineer and in the manner and to the extent permitted by him. The explosives shall be handled, stored in a special magazine to be provided at the cost of the Contractor and used under the strict supervision of persons licensed for this purpose under the requisite statutory rules and regulations. The Contractor shall take all precautions in transporting and using the explosives and avoid damage to nearby structures and utilities. The Contractor shall be responsible for taking all the precautions in the usage of the explosives at Contractor's cost, sole risk and responsibility. The Contractor shall hold the Employer harmless and indemnify for the above.</p>
New Clause-4.14	<p>In pursuance with this policy, the Employer</p> <p>a. Will reject the Tender for the Work or rescind the Contract, if the Employer determines that the Tenderer/Contractor has engaged in corrupt or fraudulent practices.</p> <p>b. Will declare a Tenderer/Contractor ineligible, either indefinitely or for a minimum period of 2 years from the date of identification of such prohibited conduct, to be awarded a Contract/s if the Employer at any time determines that the Contractor has engaged in corrupt or fraudulent practices in competing for, or in executing the Contract.</p>
New Clause-4.15	<p>Compensation to Contractor on rescission of Contract under this clause</p> <p>In the event of rescission of Contract, the Contractor shall not be entitled to any compensation whatsoever, except for the work done up to the date of rescission.</p>
New Clause-4.16	<p>Quality Assurance</p> <p>Unless otherwise stated in Special Conditions of Contract and/or Employer's Requirement, the Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. Such system shall be in accordance with the details stated in the</p>

	<p>Contract. Compliance with the quality assurance system shall not relieve the Contractor of his duties, obligations or responsibilities.</p> <p>Details of all procedure and compliance documents shall be submitted to the Engineer for his consent before each execution stage is commenced</p>
New Clause-4.17	<p>Work by Persons Other than Contactor</p> <ol style="list-style-type: none"> I. If the Contractor shall fail to carry out any work required under the Contract or refuse to comply with any instruction or order given by the Engineer in accordance with the Contract within a reasonable time, the Engineer may give the Contractor 14 days' notice in writing to carry out such work or comply with such instruction. II. If the Contractor fails to comply with such notice, the Employer shall be entitled to carry out such work or instruction by his own workmen or by other contractors in whatever manner the Engineer decides, be it single Tender or limited Tender or open Tender or on entrustment basis without any right of appeal by the contractor. III. However, in case of emergencies/urgencies/affecting safety the period of 14 days' notice shall be 24hours notice in writing. The Classification of work as emergencies/urgencies/affecting safety is the prerogative of Engineer and his decision is final and binding on the contractor. Without prejudice to any other right or remedy, all additional expenditure properly incurred by the Employer in having such work or instruction carried out shall be recoverable by the Employer from the Contractor. IV. If by reason of any accident or failure or other event occurring to, in, or in connection with the Works any remedial or other work shall, in the opinion of the Engineer, be urgently necessary and the Contractor is unable or unwilling at once to do such remedial or other work, the Engineer may authorize the carrying out of such remedial or other work by a person other than the Contractor. V. If the remedial or other work so authorized by the Engineer is work, which, in the Engineer's opinion, the Contractor was liable to do under the Contract; all expenses properly incurred in carrying out the same shall be recoverable by the Employer from the Contractor. Provided that the Engineer shall, as soon after the occurrence of any such emergency as may be reasonably practicable, notify the Contractor thereof in writing.
New Clause-4.18	<p>Confidentiality of Information</p> <ol style="list-style-type: none"> I. The Contractor shall not use or divulge, except for the purpose of the Contract or with the written permission of the Employer, any information relating to the Works or the Project provided in the Contract or otherwise provided by the Employer, or the Engineer. The Contractor shall ensure that his sub-contractors of any tier shall be bound by a like confidentiality undertaking. II. The Employer, Engineer and any third party to whom an assignment has been made in accordance with New-clause 2.3/PCC may use any information provided by the Contractor in accordance with the Contract. The Employer shall use reasonable endeavours to ensure that the Engineer and any third party referred to in aforesaid New-clause 2.3/PCC shall not; divulge such information except for any purpose connected with the Contract. <p>On completion of the works, the contractor shall arrange to furnish to the Employer two (2) bound sets of all "As Built" drawings for every component of the Works at his own cost, all such copies being on Polyester film of quality to be approved by the Engineer or his Representative. The Taking – over Certificate of the Works, as per the provisions of</p>

	<p>Clause 46.1/PCC herein, shall not be issued by the Engineer in the event of the Contractor's failure to furnish the aforesaid "As Built" drawings for the entire works.</p> <p>If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Special Conditions of Contract:</p> <ul style="list-style-type: none"> (a) the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract; (b) these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications defined in Sub-Clause 3/CC [Law and Language], and shall include additional information required by the Engineer to add to the Drawings for co-ordination of each Party's designs; (c) the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and (d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair this part of the Works. Such part shall not be considered to be completed for the purposes of taking-over under Sub-Clause 46.1/PCC [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer.
<p>New Clause-4.19</p>	<p>Performance Security</p> <p>The Contractor shall obtain (at his cost) a Performance Security and an additional Performance Security, if any in terms of ITB 35.5, for proper performance of the contract, for the amount, currencies and validity period for Performance Security stated in the Contract Data. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.</p> <p>The Contractor shall deliver the Performance Security and additional Performance Security, if any, to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer. The Performance Security/additional Performance Security shall be issued by an entity and from within a country (or other jurisdiction) approved by the Employer and shall be in the form as given in Section 10 (Formats) or in another form specifically approved by the Employer.</p> <p>The procedure for obtaining Performance Guarantee is outlined below:</p> <p>The successful bidder shall have to submit a Performance Guarantee (PG) within 28 (Twenty-eight) days from the date of issue of Letter of Acceptance (LOA). Extension of time for submission of PG beyond 28 (Twenty-eight) days and upto 60 days from the date of issue of LOA may be given by the Authority who is competent to sign the contract agreement. However, a penal interest of 12% per annum shall be charged for the delay beyond 28(Twenty-eight) days, i.e. from 29th day after the date of issue of LOA. Further, if the 60th day happens to be a declared</p>

holiday in the concerned office of the Railway, submission of PG can be accepted on the next working day.

In all other cases, if the Contractor fails to submit the requisite PG even after 60 days from the date of issue of LOA, the contract is liable to be terminated. In case contract is terminated railway shall be entitled to forfeit Earnest Money Deposit and other dues payable against that contract. In case a tenderer has not submitted Earnest Money Deposit on the strength of their registration as a Startup recognized by Department for promotion of industry and internal trade (DPIIT) under Ministry of Commerce and Industry, DPIIT shall be informed to this effect. The failed Contractor shall be debarred from participating in re-tender for that work.

The Performance Security/additional Performance Security shall be, at the Contractor's option, in any of the following forms:

- (i) An unconditional Bank Guarantee in the prescribed format
- (ii) A Pay Order / Demand Draft drawn on a Scheduled / Nationalized Bank in India in favour of "Rail Infrastructure Development Company (Karnataka) Ltd" payable at Bangalore.
- (iii) FDR in favour of "Rail Infrastructure Development Company (Karnataka) Ltd." (free from any encumbrance).
- (iv) A online bank transfer to K-RIDE account.

The Bank Guarantee shall be from a bank having minimum net-worth of over INR 500 million from the specified banks as under:

- (i) a Schedule Bank in India, or
- (ii) a Foreign Bank having their operations in India, or
- (iii) a Foreign Bank which does not have operations in India is required to provide a counter-guarantee by State Bank of India,

The Scheduled Bank is suing the Bank Guarantee must be on "Structured Financial Messaging System (SFMS)" platform. A separate advice of the BG shall be invariable be sent by the issuing bank to the Employer's Bank through SFMS and only after this the BG shall become operative and acceptable to the Employer.

The Issuing Bank shall send the SFMS to:

Beneficiary: Rail Infrastructure Development Company (Karnataka) Ltd. (K-RIDE)Bank

Name: Canara Bank

Branch: Prime Corporate Branch

Account No. 0430201012110

IFSC Code: CNRB0002636

In case the contractor is a JV,"the Performance Security/additional Performance Security, if any in terms of ITB 35.5, shall be submitted by each JV Partner separately on behalf of the JV in favour of K-RIDE in proportion of their respective percentage share specified in the JV Agreement. The additional Performance Security shall be submitted by the partner(s) responsible for execution of schedule(s) (as per JV agreement) against which additional Performance Security is required to be submitted in terms of ITB 35.5.

However, Submission of Performance Guarantee Security by individual partners on behalf of the JV shall in no way dilute their Joint & Several responsibility. The Employer shall be entitled to

recover the amount of Bank Guarantees individually and / or from all the Partners jointly at its discretion.”

The Contractor shall ensure that the Performance Security/additional Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied defects, if any. If the contractor does not complete the work for any reasons whatsoever, the terms of the Performance Security/ additional Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 28 days prior to the expiry date, the Contractor shall be bound to extend the validity of the Performance Security/additional Performance Security until the Works have been completed and any defects have been remedied.

Failure of the successful Tenderer to furnish the required Performance Security shall be a ground for the annulment of the award of Contract and execution of the Tender Securing Declaration.

Release of performance security

- (i) The whole or such portion of the Performance Security amount shall be liable to be forfeited by the Employer at the discretion of the Employer, in the event of any breach of Contract on the part of the Contractor.
- (ii) After completion of the entire Work, the Performance Security shall be released to the Contractor, on issue of last Taking Over Certificate if more than one Certificate exist, by the Engineer, the release of Performance Security shall not relieve the Contractor from his obligations and liabilities, to make good that may be detected during the Defects Liability Period.

The Guarantees shall be unconditional and irrevocable. The Employer shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate or passing of the Final Payment Certificate whichever is later. However, on completion of specified section(s) and successful passage of defect liability period for such section(s) along with execution of any leftover works at the time of completion of such section(s), the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data subject to the condition that Engineer certifies that no recoveries are pending in the contract. In case Engineer points out amount to be recovered then the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data minus the amount to be recovered.

The Employer shall return additional Performance Security submitted in terms of ITB 35.5 as per the following;

- (a) If the Contractor submits an application stating that all the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed in all respect, then the Employer, on being satisfied with the claim of the Contractor, shall return the full additional Performance Security against the particular schedule(s). Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the Contractor.
- (b) If the Contractor submits an application stating that majority of the works (physical progress being not less than 90%) against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed and execution of balance works is held up for reasons not attributable to the Contractor, then the Employer, on being satisfied with the claim of the Contractor, shall return 75% of the amount of additional Performance Security against the particular schedule(s). The balance

amount of additional Performance Security shall however be returned only after completion of the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5, in all respects to the satisfaction of the Employer. Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the Contractor.

Without limitation to the provisions of the rest of this Sub-Clause, whenever the Engineer determines an addition or a reduction to the Contract Price as a result of a change in cost and/or legislation or as a result of a Variation amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor shall at the Engineer's request promptly submit Performance Guarantee @ 10% of the increased amount over the original contract price in a specific currency. On the other hand if the value of contract price decreases by more than 25% of the original contract price payable in a specific currency, Performance Guarantee @ 10% of the decrease in contract price from the original contract price in a specific currency shall be returned to the contractor, on his request.

Wherever the contract is terminated under Clause 49.7/PCC, the Performance Guarantee shall be encashed by the Employer:

- i) in full including additional Performance Guarantee amount, if any, taken in terms of clause 25.5 and 29 of ITT and not due for release on the date of issue of termination letter in terms of this clause, in case of termination of the contract as a whole; or
- ii) at the discretion of the Employer it may be encashed in part/parts proportionate to the Contract price of the bill/schedule to which the terminated part of work belongs
i.e $P=(A \times B) \div C$ where

P=Proportionate Bank Guarantee Amount.

A= Contract price of the particular bill/schedule to which the terminated part of work belongs.

B=Performance Guarantee amount in terms of CC New-clause 4.19/PCC

C=Total Contract price.

Plus additional performance Guarantee amount, if any, taken in terms of sub clause 25.5 and 29 of ITT and not due for release on the date of issue of termination letter in terms of this clause against this particular bill/schedule to which the terminated part of the work belongs, in case of termination in part/parts.

The balance work should be got done separately, and independently by K-RIDE without risk and cost of the original contractor. The original contractor shall be debarred from participating in the tender for executing the balance work. If the failed contractor is a JV or a partnership firm, then every member/partner of such a firm would be debarred from participating in the tender for the balance work either in his/her individual capacity or as a partner of any other JV/partnership firm.

In case the Contractor fails to perform the Contract or any JV partner fails to perform its obligations under the JV agreement, which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV, as the case may be, from participating in any K-RIDE tender from the date of issue of notice of default. The relevant performance security including additional performance security, if any, in terms of sub clauses 25.5 and

	<p>29 of ITT submitted by the Contractor or submitted on behalf of JV partner to the extent not due for release at the time of contemplation of such action shall be encashed and forfeited either fully or in proportion of the percentage share of that partner in the JV agreement, as the case may be.</p>
New Clause-4.20	<p>Security Deposit: The Security Deposit shall be 5% of the contract value. Security Deposit may be deposited by the Contractor before release of first on account bill in cash or Term Deposit Receipt issued from Scheduled Bank, or may be recovered at the rate defined in this section PCC, the bill amount till the full Security Deposit is recovered. Provided also that in case of defaulting Contractor, the Employer may retain any amount due for payment to the Contractor on the pending “on account bills” so that the amounts so retained (including amount guaranteed through Performance Security) may not exceed 10% of the total value of the contract. The security deposit may be recovered at the rate 6% of bill amount till the security deposit is recovered.</p> <p>Further, in case of contracts having value equal to or more than ₹ 50 crore (Rs Fifty crore) the Security Deposit may be deposited as Bank Guarantee Bond also, issued by a scheduled bank after execution of contract documents, but before payment of 1st on account bill. Provided further that the validity of Bank Guarantee Bond shall be extended from time to time, depending upon extension of contract granted in terms Clause No 26 of PCC.</p> <p>Further, in case Security Deposit has been submitted as Term Deposit Receipt/Bank Guarantee Bond in full amount, the Bid security by Contractor with his tender will be returned by K-RIDE.</p> <p>Note: After the work is physically completed as certified by competent authority, Security Deposit recovered from the running bills of a Contractor can be returned to him, if he so desires, in lieu of Term Deposit Receipt/irrevocable Bank Guarantee for equivalent amount from Scheduled Bank, to be submitted by him.</p> <p>4.2.b(i) Refund of Security Deposit: Security Deposit mentioned in clause above shall be returned to the Contractor along with or after, the following:</p> <ul style="list-style-type: none"> (a) Final Payment of the Contract and (b) Execution of Final Supplementary Agreement or Certification by Engineer that K-RIDE has No Claim on Contractor and (c) Maintenance Certificate issued, on expiry of the maintenance period. <p>4.2.b(ii) Forfeiture of Security Deposit: Whenever the contract is rescinded as a whole under clause 49 of CC/PCC, the Security Deposit already with K-RIDE under the contract shall be forfeited. However, in case the contract is rescinded in part or parts under clause 49 of CC/PCC, the Security Deposit shall not be forfeited.</p> <p>4.2.(c) No interest shall be payable upon the Bid Security and Security Deposit or amounts payable to the Contractor under the Contract, but Government Securities deposited in terms of New-Clause 4.19/PCC of this clause will be payable with interest accrued thereon.</p>
New Clause -4.21	<p>Contractor Representative:</p> <p>The Contractor shall depute his Representative to attend all the review meetings notified by the Engineer.</p>

Facilities for and Co-ordination with Others

The Contractor shall not impede and shall afford all necessary facilities, access and/or services to the Employer, Engineer, Designated Contractors, utility undertakings, other relevant authorities and other contractors (whether employed by the Employer or not) who are carrying out on, or in the vicinity of, the Site, works not included in the Contract but forming part of the Project:

- A. The Contractor shall take all reasonable steps to ensure that the Works are co-ordinated and integrated with the Design, manufacture, installation execution and testing of such other works and shall in particular (but without limitation):
 - (i) comply with any direction which the Engineer may give for the integration of the Design with the design of any other part of the Project;
 - (ii) consult, liaise and co-operate with those responsible for carrying out such other works, including where necessary, in the preparation of the respective designs, the preparation of co-ordinated programmes, method statements, co-ordination drawings and specifications together with arrangements of service priorities and zoning;
- B. The Contractor shall undertake Design co-ordination with other contractors who are carrying out works forming part of the Project as described in the Employer's Requirements. At the end of each such co-ordination period, the Contractor and the other contractor with whose works the interface period refers shall jointly state in writing that their design co-ordination activities are complete and that their respective designs are integrated and can be finalised without interference with each other's designs or the designs with which their designs have already been integrated.

A copy of this joint written statement shall be provided to the Engineer within 7 days of the end of the said design co-ordination period. Unless and until copies of all relevant and necessary design co-ordination statements have been submitted to the Engineer, the Engineer shall be entitled to suspend any review or further review of the Contractor's or the other contractor's design submissions. Such suspension shall not be grounds for the Contractor to claim nor shall be entitled to receive an extension of time or additional payments.
- C. The Contractor shall share within the Site, staging, storage and unloading areas for the use of Designated Contractors, if any, who are undertaking civil work, fare collection system, supply, testing and commissioning of Rolling Stock, escalators, lifts, signalling and telecommunications and traction power installation works, etc. Separate locations shall be provided for each such contractor. The exact size and location of these staging, storage and unloading areas, and the commencement date shall be co-ordinated and agreed during the design interface period with each Designated Contractor.
- D. Any other contract which depends for its execution on the Contract or upon which the Contract is dependent for its own execution shall be identified by the Engineer as a "Designated Contract". The Contractor shall provide attendance on Designated Contractors in accordance with the Employer's Requirements and as instructed by the Engineer. The identity of the contractor for a Designated Contract may not be known before the execution of the Contract but this shall not be a ground for the Contractor to object to the subsequent appointment of a Designated Contractor
- E. The Contractor shall in accordance with the requirements of the Engineer co-ordinate his own Works with that of Designated Contractors through Co-ordinated Installation Programme (CIP) stated in the Employer's Requirements, or as the Engineer may require,

	<p>and shall afford the Designated Contractors all reasonable opportunities for carrying out their works.</p> <p>F. The Contractor shall afford all reasonable opportunities, for carrying out their work, to other contractors employed by the Employer and their workmen respectively and the workmen of the Employer who may be engaged on or near the Site of any work, ancillary to the Works, but, not included in the Contract and shall not cause them inconvenience.</p> <p>G. If the Contractor shall suffer delay by reason of failure by any Designated Contractor to meet the specified installation interfacing and co-ordination, completion dates, which delay shall be caused otherwise than by fault of the Contractor, or, if compliance with sub-clause (f) herein shall involve the Contractor in delay beyond that which could be reasonably foreseen by an experienced contractor at the time of tender, then the Engineer shall take such delay into account in determining any extension of time to which the Contractor is entitled under the Contract.</p> <p>H. It shall be the responsibility of the Contractor to ensure that the full extent of the Works under the Contract and the works to be carried out by Designated Contractors within the Works or, in, on, under, through and over the Site are co-ordinated and integrated in their design, manufacture, installation and construction. Such responsibility shall neither be mitigated nor in any other way affected by virtue of similar responsibilities being placed on other contractors.</p> <p>The Contractor shall be deemed to have made adequate allowance in the Contract Price and in the Works Programme in respect of these obligations.</p> <p>If any act or omission of the Contractor whether directly or indirectly results in the delay in the execution of the works of a Designated Contractor, the Contractor, in addition to his liability in respect of liquidated damages if they become due, shall pay to the Employer, or the Engineer may deduct from Interim Payment Certificates such amount as the Engineer shall have certified in respect of additional payments or costs to the Designated Contractor in respect of such delay.</p>
New Clause-4.22	DELETED
New Clause-4.23	DELETED
New Clause-4.24	<p>Co-operation</p> <p>The Contractor shall, as specified in the Contract or as instructed by the Engineer, allow appropriate opportunities for carrying out work to:</p> <ul style="list-style-type: none"> (a) the Employer's Personnel, (b) any other contractors employed by the Employer, and (c) the personnel of any legally constituted public authorities, <p>who may be employed in the execution on or near the Site of any work not included in the Contract.</p> <p>Any such instruction shall constitute a Variation if and to the extent that it causes the Contractor to incur Unforeseeable Cost. Services for these personnel and other contractors may include the use of Contractor's Equipment, Temporary Works or access arrangements which are the responsibility of the Contractor.</p> <p>If, under the Contract, the Employer is required to give to the Contractor possession of any foundation, structure, plant or means of access in accordance with Contractor's Documents, the Contractor shall submit such documents to the Engineer in the time and manner stated in the Specification.</p>

<p>New Clause-4.25</p>	<p>Setting Out</p> <p>The Contractor shall set out the Works in relation to original points, lines and levels of reference specified in the Contract or notified by the Engineer. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the works, notifying the Engineer within 28 days of the date of commencement</p> <p>In the event of such discrepancy arising during the course of the work, for which Employer's documents are handed over after the date of commencement, the contractor shall seek clarifications within 14 days of receipt of such documents</p> <p>The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable efforts to verify their accuracy before they are used.</p> <p>Contractor shall promptly notify the Employer and the Engineer of any error, omission, fault, or any other defect in the design, drawing or specifications for the works, which he discovers when reviewing the Contract Documents, and in the process of execution of the Works. The Contractor shall be responsible to ensure correlation in various drawings and Price schedule, before commencement and execution of work. In case of any discrepancy the Contractor shall bring it to notice of the Engineer for clarification within 28 days of the issue of Letter of Acceptance. In the event of such discrepancy arising during the course of the work, for which drawings are given after the date of issue of Letter of Acceptance, the Contractor shall seek clarifications within 14 days of receipt of such drawings.</p> <p>Notwithstanding with any other provision, the Contractor shall have to pay penalty for damage to Railway cable in terms of clause C 15 of the JPO as given in para 1.2 of Chapter 1. (Safety and Security) of Section 8 and shall also indemnify the Employer against any losses, damages to property or life in terms of para 1.11 and 1.12 of the chapter 1. (Safety and Security) of Section 8.</p>
<p>New Clause-4.26</p>	<p>Safety Procedures</p> <p>The Contractor shall follow the provisions laid down in Chapter 1. (Safety and Security) of Section 8 and shall:</p> <ul style="list-style-type: none"> (a) comply with all applicable safety regulations, (b) take care for the safety of all persons entitled to be on the Site, (c) use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons, (d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 46/PCC [Employer's Taking Over], and (e) provide any Temporary Works (including roadways, footways, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land. <p>Additional Safety Precautions</p> <ul style="list-style-type: none"> (1) The Contractor shall comply with all the precautions as required for the safety of the workmen by the I.L.O Convention No.62 as far as they are applicable to the Contract. The Contractor shall provide all necessary safety appliances; such as safety goggles, helmets, masks, etc. to the workmen and the staff. (2) Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except for such short period work as

can be done safely from ladders. When a ladder is used, an extra labourer shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable foot-holds and hand-holds shall be provided on the ladder, which shall be given an inclination not steeper than 1/4 to 1 (1/4 horizontal in 1 vertical).

- (3) Scaffolding or staging more than 3.25 metres above the ground or floor, swung or suspended from an overhead support or erected with stationary support, shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as maybe necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying in from the support or structure.
- (4) Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of any platform or gangway or stairway is more than 3.25 metres above ground level or floor level, it shall have closely spaced boards, have adequate width and be suitably provided with guard rails as described in (3) above.
- (5) Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of one metre.
- (6) Safe means of access and egress shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length. The width between side rails in a rung ladder shall in no case be less than 30 cm for ladders up to and including 3 metres in length. For longer ladders the width shall be increased at least 6 mm for each additional 30 cm of length. Spacing of steps shall be uniform and shall not exceed 30 cm.
- (7) Adequate precautions shall be taken to prevent danger from electrical equipment. Adequate safety measures shall be taken when any work is undertaken near any live highly charged electric wire. Necessary shutdown may be arranged, where and whenever essential. All rules in force in this connection shall be fully complied with. The Contractor shall ensure all precautions to prevent any accidents due to electrocution or otherwise.
- (8) No materials on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect the public from accidents and shall be bound to bear the expenses of defending every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.
- (9) Excavation and Trenching : All trenches, 1.5 metres or more in depth, shall at all times be supplied with at least one ladder for each 20 metres in length or fraction thereof, Ladders shall be extended from the bottom of the trench to at least 1 metre above the surface of the ground. The sides of a trench, which is 1.5 metres or more in depth shall be stepped back to provide a suitable slope, or be securely held by timber bracing so as to avoid the danger of side collapse. Excavated material shall not be

placed within 1.5 metres of the edge of any trench or half the depth of the trench, whichever is more. Excavation shall be made from the top to the bottom. Under no circumstances shall undermining or undercutting be done.

(10) Demolition : Before any demolition work is commenced and also during the process of the work :

- (a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- (b) No electric cable or apparatus, which is liable to be a source of danger other than a cable or apparatus used by operators, shall remain electrically charged:
- (c) All practical steps shall be taken to prevent danger to persons employed by the Employer, from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

(11) All necessary personal safety equipment as considered adequate by the Engineer shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use; and the Contractor shall take adequate steps to ensure proper use of such equipment by those concerned.

- (a) Workers employed on mixing asphaltic materials, cement, lime mortars, concrete etc. shall be provided with protective footwear and protective goggles.
- (b) Those engaged in handling any material, which is injurious to the eyes, shall be provided with protective goggles.
- (c) Those engaged in welding works shall be provided with welder's protective eye-shield.
- (d) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
- (e) When workers are employed in sewers and manhole, which are in use, the contractor shall ensure that manhole covers are open and manholes are ventilated at least for an hour before workers are allowed to go into them. Manholes so open shall be cordoned off with suitable railing and provide warning signals or boards to prevent accidents to the public.
- (f) The Contractor shall not employ men below the age of 18 years and women, on the work of painting with products containing lead in any form. Whenever men above the age of 18 years are employed on the work of lead painting, the following precautions shall be taken
- (g) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.
- (h) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

	<p>(i) Overalls shall be supplied by the Contractor to workmen and adequate facilities shall be provided to enable workers to wash during and at the close of any day's work.</p> <p>(12) When work is performed near any place where there is risk of drowning all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt first aid treatment of all injuries likely to be sustained during the course of the work.</p> <p>(13) Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:</p> <p>a) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order, be regularly inspected and properly maintained.</p> <p>b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from defects</p> <p>c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 shall be in charge of any hoisting machine including scaffold equipment. Only trained men over the age of 21 shall be permitted to give signals to such plant and appliance operators.</p> <p>d) For every hoisting machine and every chain hook, shackle, swivel and pulley block used in hoisting, lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine or a variable safe working load, each safe working load and conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to in the paragraph above shall be loaded beyond safe working load except for the purpose of testing.</p> <p>e) In case of the Employer's machine, safe working load shall be notified by the Engineer or his Representative. As regards Contractor's machines, the Contractor shall notify safe working load of each machine to the Engineer or his Representative, whenever he brings it to the site of work and get it verified by him.</p> <p>(14) Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce the risk of accident during descent of load to the minimum. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already utilized, insulating mats, working apparel such as gloves, sleeves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductor of electricity.</p> <p>(15) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or</p>
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	<p>removed while it is in use. Adequate washing facilities shall be provided at or near places of work.</p> <p>(16) These safety provisions shall be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work location. Persons responsible for ensuring compliance with the Safety Code shall be named therein by the Contractor.</p> <p>(17) To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the contractor shall be open to inspection by the Engineer or his Representative.</p> <p>(18) Notwithstanding anything contained in conditions (1) to (17) above, the Contractor shall at its own costs, remain liable to comply with the provisions of all acts, rules, regulations, and bylaws for the time being in force in India and applicable in this matter.</p> <p>(19) For work carried out in the vicinity of any wharf or quay, the Contractor shall abide by all the provisions of the Dock Workers (Safety, Health and Welfare) Scheme, 1961.</p> <p>(20) The Contractor shall at his own expense provide protective safety Equipment like gloves and footwear for all labour engaged on concrete mixing work and all other types of working involving the use of tar, cement, etc. to the satisfaction of the Engineer or his Representative, and on his failure to do so, the employer shall be entitled to provide the same and recover the cost from the Contractor.</p> <p>The Contractor shall be responsible for observance, by the sub-contractors, of the foregoing provisions.</p> <p>(21) All construction labour at all-time shall use personal protective equipment like, safety shoes, helmets and reflective jackets in all activities at site. This shall be ensured without fail on each work site. Failing to comply with this, provision shall attract penalty of Rs. 500/- per occasion per staff.</p> <p>Notwithstanding with any other provision, the Contractor shall have to pay penalty for damage to Railway cable in terms of clause C 15 of the JPO as given in para 1.2 of Chapter 1. (Safety and Security) of Section 8 and shall also indemnify the Employer against any losses, damages to property or life in terms of para 1.11 and 1.12 of the chapter 1. (Safety and Security) of Section 8).</p>
New Clause-4.27	<p>Quality Assurance</p> <p>The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Engineer shall be entitled to audit any aspect of the system.</p> <p>Details of all procedures and compliance documents shall be submitted to the Engineer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.</p> <p>Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.</p>

	<p>Quality Control</p> <p>Within 28 days of the issue of the Letter of acceptance, the Contractor shall submit to the Engineer, for his consent, his proposed Site Quality Plan based on the Outline Quality Plan and the Employer's Requirements. The quality manual should address the quality system as required by ISO 9001-1991. Any supplement to the Site Quality Plan shall be submitted at least 14 days before commencement of the relevant work.</p> <p>Upon the Engineer notifying his consent to the Site Quality Plan, or any supplement thereto, the Contractor shall, adhere to the principles and procedures contained in such document, except where the Engineer gives his consent to any amended or varied version thereof. The Contractor shall cause any sub-contractors to adhere to this Plan.</p> <p>The Contractor shall appoint a suitably qualified and experienced person, not otherwise engaged in the performance of the Contract, to act as manager of the quality assurance system and shall provide such other personnel and resources as required to ensure effective operation of the quality assurance system. The said manager shall carry out audits of the application of the quality assurance system, and ensure effective quality control and delivery of quality assurance.</p> <p>The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer to carry out surveillance visits both on and off the Site to verify that the quality assurance system is being properly and fully implemented. No extra payment shall be made in this regard and the cost of the Work under this element shall be deemed to be included in the Contract Price.</p> <p>Quality control records and Documents</p> <p>The Contractor shall hand over to the Authority's Engineer a copy of all its quality control records and documents before the Completion Certificate is issued.</p> <p>Video recording</p> <p>During the Construction Period, the Contractor shall provide to the Authority for every calendar month, a video recording, which will be compiled into a 3 (three) hour digital video disc or any substitute thereof, covering the status and progress of Works in that month. The video recording shall be provided to the Authority no later than 15 (fifteen) days after the close of each month after the Appointed Date.</p>
<p>New Clause-4.28</p>	<p>Site Data</p> <p>The Employer shall have made available to the Contractor for his information, prior to the Base Date, all relevant data in the Employer's possession on sub-surface and hydrological conditions at the Site, including environmental aspects. The Employer shall similarly make available to the Contractor all such data which come into the Employer's possession after the Base Date. The Contractor shall be responsible for interpreting all such data.</p> <p>To the extent which was practicable (taking account of cost and time), the Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Bid or Works. To the same extent, the Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Bid as to all relevant matters, including (without limitation):</p> <ul style="list-style-type: none"> (a) the form and nature of the Site, including sub-surface conditions, (b) the hydrological and climatic conditions,

	<p>(c) the extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects,</p> <p>(d) the Laws, procedures and labour practices of the Country, and</p> <p>(e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.</p> <p>(f) Data made available by the Employer in accordance with the preceding paragraph shall be deemed to include data listed elsewhere in the contract as open for inspection at the address stipulated in the Contract.</p>
<p>New Clause-4.29</p>	<p>Sufficiency of the Accepted Contract Amount</p> <p>The Contractor shall be deemed to:</p> <ol style="list-style-type: none"> a) have satisfied himself as to the correctness and sufficiency of the Accepted Contract Amount, and b) have based the Accepted Contract Amount on the data, interpretations, necessary information, inspections, examinations and satisfaction as to all relevant matters referred to in New-Clause 4.28/PCC [Site Data]. <p>Unless otherwise stated in the Contract, the Accepted Contract Amount covers all the Contractor's obligations under the Contract (including those under Provisional Sums, if any) and all things necessary for the proper execution and completion of the Works and the remedying of any defects.</p>
<p>New Clause-4.30</p>	<p>Unforeseeable Physical Conditions</p> <p>In this Sub-Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions.</p> <p>If the Contractor encounters adverse physical conditions which he considers to have been Unforeseeable, the Contractor shall give notice to the Engineer as soon as practicable.</p> <p>This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Engineer may give. If an instruction constitutes a Variation, Clause 34/PCC [Variations and Adjustments] shall apply.</p> <p>If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to:</p> <ol style="list-style-type: none"> (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and (b) Payment of any such Cost, which shall be included in the Contract Price. <p>After receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.</p>

	<p>However, before additional Cost is finally agreed or determined under sub-paragraph (ii), the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favourable than could reasonably have been foreseen when the Contractor submitted the Bid. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under sub-paragraph (b) and all these reductions, for all the physical conditions encountered in similar parts of the Works, shall not result in a net reduction in the Contract Price.</p> <p>The Engineer may take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Bid, which may be made available by the Contractor, but shall not be bound by any such evidence.</p>
<p>New Clause-4.31</p>	<p>1. Rights of Way and Facilities</p> <p>The Contractor shall bear all costs and charges for special and/or temporary rights-of-way which he may require, including those for access to the Site. The Contractor shall also obtain, at his risk and cost, any additional facilities outside the Site which he may require for the purposes of the Works.</p> <p>In case any operation connected with traffic necessitates diversion, obstruction or closure of any road, railway or any other right of way, the approval of the Engineer and the concerned authorities shall be obtained well in advance by the Contractor.</p> <p>Provided that if it is found necessary for the Contractor to move one or more loads of heavy constructional plants and equipment, materials or Pre-constructed units or parts of units of work over roads, highways, bridges on which such oversized and overweight items that are not normally to be moved, the contractor shall obtain prior permission from the concerned authorities.</p> <p>Payments for complying with the requirements, if any, for protection or strengthening of the roads, highways or bridges shall be made by the contractor and such expenses shall be deemed to be included in his quoted contract price.</p> <p>2. Protection of Site from encroachments</p> <p>The Contractor shall maintain a round-the-clock vigil over the Site and shall ensure and procure that no encroachment thereon takes place. During the Construction Period, the Contractor shall protect the Site from any and all occupations, encroachments or Encumbrances, and shall not place or create nor permit any Sub-contractor or other person claiming through or under the Agreement to place or create any Encumbrance or security interest over all or any part of the Site or the Project Assets, or on any rights of the Contractor therein or under this Agreement, save and except as otherwise expressly set forth in this Agreement. In the event of any encroachment or occupation on any part of the Site, the Contractor shall report such encroachment or occupation forthwith to the Authority and undertake its removal at its own cost and expenses.</p> <p>3. Temporary Right of Way</p> <p>The Contractor shall bear all costs and charges for any temporary right of way required by it in connection with access to the Site. The Contractor shall obtain at its cost such facilities on or outside the Site as may be required by it for the purposes of the Railway Project and the performance of its obligations under this Agreement.</p>

	<p>4. Access to the Authority and the Authority’s Engineer</p> <p>4.1 The Right of Way given to the Contractor hereunder shall always be subject to the right of access of the Authority and the Authority’s Engineer and their employees and agents for inspection, viewing and exercise of their rights and performance of their obligations under this Agreement.</p> <p>4.2 The Contractor shall ensure, subject to all relevant safety procedures, that the Authority has unrestricted access to the Site during any Emergency.</p> <p>5. Geological and archaeological finds</p> <p>It is expressly agreed that mining, geological or archaeological rights do not form part of this Agreement with the Contractor for the Works, and the Contractor hereby acknowledges that it shall not have any mining rights or interest in the underlying minerals, fossils, antiquities, structures or other remnants or things either of particular geological or archaeological interest and that such rights, interest and property on or under the Site shall vest in and belong to the Authority or the concerned Government Instrumentality. The Contractor shall take all reasonable precautions to prevent its workmen or any other person from removing or damaging such interest or property and shall inform the Authority forthwith of the discovery thereof and comply with such instructions as the Authority or the concerned Government Instrumentality may reasonably give for the removal of such property.</p>
<p>New Clause-4.32</p>	<p>Avoidance of Interference</p> <p>The Contractor shall not interfere unnecessarily or improperly with:</p> <ul style="list-style-type: none"> a) the convenience of the public, or b) the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others or c) Passenger amenities at stations and station platforms. <p>The Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.</p>
<p>New Clause-4.33</p>	<p>Access Route</p> <p>The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site. The Contractor shall use reasonable efforts to prevent any road or bridge from being damaged by the Contractor’s traffic or by the Contractor’s Personnel. These efforts shall include the proper use of appropriate vehicles and routes.</p> <p>Except as otherwise stated in these Conditions:</p> <ul style="list-style-type: none"> (a) the Contractor shall (as between the Parties) be responsible for any maintenance which may be required for his use of access routes; (b) the Contractor shall provide all necessary signs or directions along access routes, and shall obtain any permission which may be required from the relevant authorities for his use of routes, signs and directions; (c) the Employer shall not be responsible for any claims which may arise from the use or otherwise of any access route; (d) the Employer does not guarantee the suitability or availability of particular access routes; and

	(e) Costs due to non-suitability or non-availability, for the use required by the Contractor, of access routes shall be borne by the Contractor.
New Clause-4.34	<p>Transport of Goods</p> <p>Unless otherwise stated in the Special Conditions of Contract:</p> <p>(a) the Contractor shall give the Engineer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site;</p> <p>(b) the Contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing and protecting all Goods and other things required for the Works; and</p> <p>(c) the Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from the transport of Goods, and shall negotiate and pay all claims arising from their transport.</p>
New Clause-4.35	<p>Contractor's Equipment</p> <p>The Contractor shall be responsible for all Contractors' Equipment. When brought on to the Site, Contractor's Equipment shall be deemed to be exclusively intended for the execution of the Works. The Contractor shall not remove from the Site any major items of Contractor's Equipment without the consent of the Engineer. However, consent shall not be required for vehicles transporting Goods or Contractor's Personnel off Site</p> <p>In the event of Contractor imports any equipment the following shall apply”</p> <p>A. Custom Clearance: The Employer will assist the contractor, when required by furnishing letters of recommendation for obtaining expeditious clearance through customs of constructional plants, material and other things required for the works and then for re-export, if any. The following publications, may be referred to by the contractor for guidance about custom regulations etc :</p> <ol style="list-style-type: none"> i. Import & export policy, together with amendments, if any, published by Govt. of India, Ministry of Commerce.. ii. Hand Book of Procedures, together with amendments, if any, Volume 1 and 2 published by Ministry of Commerce. iii. Customs Tariff, together with amendments, if any published by Central Customs. <p>The Contractor shall be responsible to follow the latest rules and regulations without any liability of the Employer.</p> <p>B. Re-export of Contractors equipment: The contractor shall obtain all the relevant information regarding procedure for the import and subsequent re-export of his equipment and materials from the Chief Controller of Imports and Exports, Bangalore, and shall inform himself and keep himself informed on the details of custom charges and draw-back regulations as applicable to the items of Constructional plant. The contractor shall provide the necessary guarantee/bonds where these are required by the customs notwithstanding that import licenses may be granted in the name of Employer.</p> <p>C. Notwithstanding the provisions mentioned above, Contractor's Equipment, including essential spare parts therefore, imported by the Contractor for the sole purpose of executing the Contract shall be temporarily exempt from the payment of import duties and taxes upon initial importation, provided the Contractor shall post with the customs authorities at the port of entry an approved export bond or bank guarantee, valid until the Time for Completion plus six months, in an amount equal to the full import duties and taxes which would be payable on the assessed imported value of such Contractor's Equipment and spare parts,</p>

	<p>and callable in the event the Contractor's Equipment is not exported from the Country on completion of the Contract. A copy of the bond or bank guarantee endorsed by the custom authorities shall be provided by the Contractor to the Employer upon the importation of individual items of Contractor's Equipment and spare parts. Upon export of individual items of Contractor's Equipment or spare parts, or upon the completion of the Contract, Contractor shall prepare for approval by the customs authority the authorities, an assessment of the residual value of the Contractor's Equipment and spare parts to be exported based on the depreciation scale(s) and other criteria used by the customs authorities for such purposes under the provisions of the applicable Laws. Import duties and taxes shall be due and payable to the customs authorities by the Contractor on (a) the difference between the initial imported value and the residual value of the contractor's equipment and spare parts to be exported and (b) on the initial imported value that contractor's equipment and spare parts remaining in the Country after completion of the Contract. Upon payment of such dues within 28 days of being invoiced, the bond or bank guarantee shall be reduced or released accordingly; otherwise the security shall be called in the full amount remaining in the Country.</p> <p>D. Conditions of hire of the contractor's equipment: A certified copy of the agreement in respect of any item of Equipment held by contractor under any agreement for hire or hire purchase thereof, shall be supplied to the Engineer/Employer."</p>
New Clause-4.36	<p>Protection of the Environment</p> <p>The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.</p> <p>The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.</p>
New Clause-4.37	<p>Electricity, Water and Gas</p> <p>The Contractor shall, except as stated below, be responsible for the provision of all power, water and other services he may require.</p> <p>The Contractor shall be entitled to use for the purposes of the Works such supplies of electricity, water, gas and other services as may be available on the Site and of which details and prices are given in the Specification. The Contractor shall, at his risk and cost, provide any apparatus necessary for his use of these services and for measuring the quantities consumed.</p> <p>The quantities consumed and the amounts due (at these prices) for such services shall be agreed or determined by the Engineer in accordance with New-Clause 2.4/PCC [Employer's Claims] and New-Clause 3.5/PCC [Determinations]. The Contractor shall pay these amounts to the Employer.</p>
New Clause-4.38	<p>Employer's, Equipment and Free-Issue Material</p> <p>The Employer shall make the Employer's Equipment (if any) available for the use of the Contractor in the execution of the Works in accordance with the details, arrangements and prices stated in the Specification. Unless otherwise stated in the Specification:</p> <p>(a) the Employer shall be responsible for the Employer's Equipment, except that</p> <p>(b) the Contractor shall be responsible for each item of Employer's Equipment whilst any of the Contractor's Personnel is operating it, driving it, directing it or in possession or control of it.</p>

	<p>The appropriate quantities and the amounts due (at such stated prices) for the use of Employer's Equipment shall be agreed or determined by the Engineer in accordance with New-Clause 2.4/PCC [Employer's Claims] and New-Clause 3.5/PCC [Determinations]. The Contractor shall pay these amounts to the Employer.</p> <p>The Employer shall supply, free of charge, the "free-issue materials" (if any) in accordance with the details stated in the Contract data.</p> <p>The Employer shall, at his risk and cost, provide these materials at the time and place specified in the Contract. The Contractor shall then visually inspect them, and shall promptly give notice to the Engineer of any shortage, defect or default in these materials. Unless otherwise agreed by both Parties, the Employer shall immediately rectify the notified shortage, defect or default.</p> <p>In case materials are handed over, in accordance with the procedure prescribed by the Engineer, after proper measurement and accounted for, the contractor shall be solely liable for any shortage, damage, defect or default in such material, and shall indemnify the Employer until the final account of materials is made by the Contractor on completion of the work.</p>
New Clause-4.39	<p>Progress Reports</p> <p>Unless otherwise stated in the Special Conditions of Contract, monthly progress reports shall be prepared by the Contractor and submitted to the Engineer in six copies. The first report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates.</p> <p>Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.</p> <p>Each report shall include:</p> <p>Charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in Clause 7/PCC (Nominated Subcontractors)),</p> <p>photographs showing the status of manufacture and of progress on the Site; for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:</p> <ul style="list-style-type: none"> (i) commencement of manufacture, (ii) Contractor's inspections, (iii) tests, and (iv) shipment and arrival at the Site; <p>the details described in Sub-Clause 1.10/SCC of PCC [Records of Contractor's Personnel and Equipment];</p> <ul style="list-style-type: none"> a) copies of quality assurance documents, test results and certificates of Materials; b) list of notices given under New-Clause 2.4/PCC [Employer's Claims] and notices given under Sub-Clause 4.1/SCC [Contractor's Claims]; c) safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and

	<p>d) Comparisons of actual and planned progress of all activities, with details of any events or circumstances which may jeopardise the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.</p>
New Clause-4.40	<p>Security of the Site</p> <p>Unless otherwise stated in the Special Conditions of Contract:</p> <p>(a) the Contractor shall be responsible for keeping unauthorised persons off the Site, and</p> <p>(b) authorised persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorised personnel of the Employer's other contractors on the Site.</p>
New Clause-4.41	<p>Contractor's Operations on Site</p> <p>The Contractor shall confine his operations to the Site, and to any additional areas which may be obtained by the Contractor and agreed by the Engineer as working areas. The Contractor shall take all necessary precautions to keep Contractor's Equipment and Contractor's Personnel within the Site and these additional areas, and to keep them off adjacent land.</p> <p>During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction, and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish and Temporary Works which are no longer required.</p> <p>Upon the issue of a Taking-Over Certificate, the Contractor shall clear away and remove, from that part of the Site and Works to which the Taking-Over Certificate refers, all Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works. The Contractor shall leave that part of the Site and the Works in a clean and safe condition.</p> <p>However, the Contractor may retain on Site, during the Defects Notification Period, such Goods as are required for the Contractor to fulfill obligations under the Contract.</p>
New Clause-4.42	<p>Design – General Obligations:</p> <p>Drawings for Permanent works:</p> <p>Preliminary Drawings (Tentative) showing general dimensions & details elaborating the scope of work (not based on detailed design) will be supplied along with the Tender documents. The design and Drawings of permanent works are in the scope of contractor.</p> <p>Design, Drawings and Specifications:</p> <p>The Contractor shall Design temporary works such as false work, form work, staging scheme, LG etc. required to perform their work and shall get the same and related working drawings approved by the Engineer. The Contractor would supply 6 sets of these drawings to the Engineer for the latter's use.</p> <p>Shop Drawings</p> <p>Based on "Good for Construction" drawings issued by Engineer the Contractor shall prepare shop / fabrication drawings to scale as directed indicating the required details. The shop drawings shall be prepared before execution of work, after taking actual site dimensions and all existing and proposed services / structures etc. The shop / fabrication drawings shall be checked by independent consultant prior to submission to the Engineer for approval.</p> <p>Shop drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, breakdown for packing and shipment, the external connections, fixing arrangements required, the dimensions required for installation and interconnections with other</p>

	<p>equipment and materials, clearances and spaces required between various portions and any other information specifically called for.</p> <p>Approval of Engineer of any such proposal / drawings shall not relieve the contractor of his responsibility of sufficiency of such works. It shall be the responsibility of the Contractor to promptly bring to the notice of the Engineer any error or discrepancy in the Contract documents and obtains his orders thereon. Only stated dimensions are to be taken and not those obtained from scaling drawings. In case any feature of the work is not fully described and set forth in the Drawings and Specifications, the Contractor shall forthwith apply to the Engineer for further instructions, Drawings or Specifications.</p>
New Clause-4.43	<p>Fossils</p> <p>All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.</p> <p>The Contractor shall, upon discovery of any such finding, promptly give notice to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to:</p> <p>(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and</p> <p>(b) payment of any such Cost, which shall be included in the Contract Price.</p> <p>After receiving this further notice, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine these matters.</p>
	5. PLANT, MATERIALS AND WORKMANSHIP.
New Clause-5.1	<p>Manner of Execution</p> <p>The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works:</p> <p>(a) in the manner (if any) specified in the Contract,</p> <p>(b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and</p> <p>(c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.</p>
New Clause-5.2	<p>Samples</p> <p>The Contractor shall submit the following samples of Materials, and relevant information, to the Engineer for consent prior to using the Materials in or for the Works:</p> <p>(a) manufacturer's standard samples of Materials and samples specified in the Contract, all at the Contractor's cost, and</p> <p>(b) additional samples instructed by the Engineer as a Variation.</p> <p>Each sample shall be labelled as to origin and intended use in the Works.</p>
New Clause-5.3	<p>Inspection</p> <p>The Employer's Personnel shall at all reasonable times:</p>

	<p>(a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and</p> <p>(b) during production, manufacture and construction (at the Site and elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials.</p> <p>The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.</p> <p>The Contractor shall give notice to the Engineer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport. The Engineer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.</p> <p>Inspection and technical audit by the Authority</p> <p>The Authority or any representative authorised by the Authority in this behalf may inspect and review the progress and quality of the construction of Works and issue appropriate directions to the Authority's Engineer and the Contractor for taking remedial action in the event the Works are not in accordance with the provisions of this Agreement.</p> <p>External technical audit</p> <p>At any time during construction, the Authority may appoint an external technical auditor to conduct an audit of the quality of the Works. The findings of the audit, to the extent accepted by the Authority, shall be notified to the Contractor and the Authority's Engineer for taking remedial action in accordance with this Agreement. The Contractor shall provide all assistance as may be required by the auditor in the conduct of its audit hereunder. Notwithstanding anything contained in this Clause, the external technical audit shall not affect any obligations of the Contractor or the Authority's Engineer under this Agreement.</p> <p>Inspection of construction records</p> <p>The Authority shall have the right to inspect the records of the Contractor relating to the Works.</p>
New Clause-5.4	<p>Tests :</p> <p>I. For determining that the Works conform to the Specifications and Standards, the Authority's Engineer shall require the Contractor to carry out or cause to be carried out tests, at such time and frequency and in such manner as specified in this Agreement, and in accordance with Good Industry Practice for quality assurance. The Contractor shall, with due diligence, carry out all the tests in accordance with the Agreement and furnish the results thereof to the Authority's Engineer. Of the total tests for each category or type to be undertaken by the Contractor under the provisions of this Agreement and Good Industry Practice, the Authority's Engineer or his authorized representative may witness or participate in such tests conducted or cause to be conducted by the Contractor. Documentation of test records to be maintained by Contractor and Authority Engineer or his authorized representative shall scrutinize 100% Testing records of all tests conducted as per existing guidelines of Indian Railways and Indian Road Congress.</p> <p>In the event that results of any tests conducted under in the above Clause establish any Defects or deficiencies in the Works, the Contractor shall carry out remedial measures and</p>

furnish a report to the Authority's Engineer in this behalf. The Authority's Engineer shall require the Contractor to carry out or cause to be carried out tests to determine that such remedial measures have brought the Works into compliance with the Specifications and Standards, and the procedure shall be repeated until such Works conform to the Specifications and Standards. For the avoidance of doubt, the cost of such tests and the remedial measures in pursuance thereof shall be solely borne by the Contractor.

II. Examination of work before covering up

In respect of the work which the Authority's Engineer is entitled to examine, inspect, measure or test before it is covered up or put out of view or any part of the work is placed thereon, the Contractor shall give notice to the Authority's Engineer whenever any such work is ready and before it is covered up. The Authority's Engineer shall then either carry out the examination, inspection or testing without unreasonable delay, or promptly give notice to the Contractor that the Authority's Engineer does not require to do so. Provided, however, that if any work is of a continuous nature where it is not possible or prudent to keep it uncovered or incomplete, the Contractor shall notify the schedule of carrying out such work to give sufficient opportunity, not being less than 3 (three) business days' notice, to the Authority's Engineer to conduct its inspection, measurement or test while the work is continuing. Provided further that in the event the Contractor receives no response from the Authority's Engineer within a period of 3 (three) business days from the date on which the Contractor's notice hereunder is delivered to the Authority's Engineer, the Contractor shall be entitled to assume that the Authority's Engineer would not undertake the said inspection.

This Sub-Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any).

The Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently. The Contractor shall agree, with the Engineer, the time and place for the specified testing of any Plant, Materials and other parts of the Works.

The Engineer may, under Clause 34/PCC [Variations and Adjustments], vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract.

The Engineer shall give the Contractor not less than 24 hours' notice of the Engineer's intention to attend the tests. If the Engineer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Engineer, and the tests shall then be deemed to have been made in the Engineer's presence.

If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 4.1/SCC [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 26.5/PCC [Extension of Time for Completion], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

	<p>After receiving this notice, the Engineer shall proceed in accordance with New—Clause 3.5/PCC [Determinations] to agree or determine these matters.</p> <p>The Contractor shall promptly forward to the Engineer duly certified reports of the tests. When the specified tests have been passed, the Engineer shall endorse the Contractor’s test certificate, or issue a certificate to him, to that effect. If the Engineer has not attended the tests, he shall be deemed to have accepted the readings as accurate.</p>
<p>New Clause-5.5</p>	<p>Rejection</p> <p>If, as a result of an examination, inspection, measurement or testing, any Plant, Materials or workmanship is found to be defective or otherwise not in accordance with the Contract, the Engineer may reject the Plant, Materials or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.</p> <p>If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to New-Clause 2.4/PCC [Employer’s Claims] pay these costs to the Employer.</p> <p>The Contractor shall not be entitled to any extension of time on account of rectifying any Defect or retesting as specified in this Clause.</p> <p>No examination, inspection, measurement or testing of any Plant, Material, design or workmanship by the Authority’s Engineer or its failure to convey its observations or to examine, inspect, measure or test shall relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Authority be liable for the same in any manner</p>
<p>New Clause-5.6</p>	<p>Remedial Work</p> <p>Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to:</p> <ul style="list-style-type: none"> (a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract, (b) remove and re-execute any other work which is not in accordance with the Contract, and (c) Execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise. <p>The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified under sub-paragraph I.</p> <p>If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to New-Clause 2.4/PCC [Employer’s Claims] pay to the Employer all costs arising from this failure.</p>
<p>New Clause-5.7</p>	<p>Ownership of Plant and Materials</p> <p>Each item of Plant and Materials shall, to the extent consistent with the Laws of the Country, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances:</p> <ul style="list-style-type: none"> (i) when it is delivered to the Site; (ii) when the Contractor is entitled to payment of the value of the Plant and Materials under Sub-Clause 26.11/PCC [Payment for Plant and Materials in Event of Suspension].

	<p>Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:</p> <ul style="list-style-type: none"> a) natural Materials obtained from outside the Site, and b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.
	6. Defect Liability
New Clause-6.1	<p>DEFECTS LIABILITY</p> <p>6.1 Defects Liability Period</p> <p>6.1.1 The Contractor shall be responsible for all the Defects and deficiencies, except usual wear and tear in the Railway Project or any part thereof, till the expiry of a period of 1 (one) year commencing from the completion date.</p>
New Clause 6.2	<p>6.2 Remedy and rectification of Defects and deficiencies</p> <p>6.2.1 Without prejudice to the provisions of Clause 6.2.2, the Contractor shall repair or rectify all Defects and deficiencies observed by the Authority's Engineer during the Defects Liability Period within a period of 15 (fifteen) days from the date of notice issued by the Authority's Engineer in this behalf, or within such reasonable period as may be determined by the Authority's Engineer at the request of the Contractor, in accordance with Good Industry Practice.</p> <p>6.2.2 During a period of 2 (two) months from the date of issuance of Completion Certificate, the Contractor shall retain sufficient staff and spares at Project for procuring prompt replacement, installation or re-installation of any defective parts.</p>
New Clause 6.3	<p>6.3 Cost of remedying Defects</p> <p>For the avoidance of doubt, any repair or rectification undertaken in accordance with the provisions of Clause 6.2, including any additional tests, shall be carried out by the Contractor at its own risk and cost, to the extent that such rectification or repair is attributable to:</p> <ul style="list-style-type: none"> (a) the design of the Project; (b) Works, Plant, Materials or workmanship not being in accordance with this Agreement and the Specifications and Standards; (c) improper maintenance during construction of the Railway Project by the Contractor; or (d) failure by the Contractor to comply with any other obligation under this Agreement.
New Clause 6.4	<p>6.4 Contractor's failure to rectify Defects</p> <p>In the event that the Contractor fails to repair or rectify such Defect or deficiency within the period specified in Clause 6.2, the Authority shall be entitled to get the same repaired, rectified or remedied at the Contractor's cost so as to make the Railway Project conform to the Specifications and Standards and the provisions of this Agreement. All costs consequent thereon shall, after due consultation with the Authority and the Contractor, be determined by the Authority's Engineer. The cost so determined, and an amount equal to 20% (twenty per cent) of such cost as Damages, shall be recoverable</p>

	by the Authority from the Contractor and may be deducted by the Authority from any monies due to the Contractor.
New Clause-6.5	<p>Removal of Defective Work</p> <p>If the defect or damage cannot be remedied expeditiously on the Site and the Employer gives consent, the Contractor may remove from the Site for the purposes of repair such items of Plant as are defective or damaged. This consent may require the Contractor to increase the amount of the Performance Security by the full replacement cost of these items, or to provide other appropriate security.</p>
New Clause-6.6	<p>Further Tests</p> <p>If the work of remedying of any defect or damage may affect the performance of the Works, the Engineer may require the repetition of any of the tests described in the Contract. The requirement shall be made by notice within 28 days after the defect or damage is remedied.</p> <p>These tests shall be carried out in accordance with the terms applicable to the previous tests, except that they shall be carried out at the risk and cost of the Party liable, under New-Clause 6.3/PCC [Cost of Remedying Defects], for the cost of the remedial work.</p>
New Clause-6.7	<p>Right of Access</p> <p>Until the Performance Certificate has been issued, the Contractor shall have such right of access to the Works as is reasonably required in order to comply with this Clause, except as may be inconsistent with the Employer's reasonable security restrictions.</p>
New Clause-6.8	<p>Contractor to search cause</p> <p>6.8.1 The Authority's Engineer may instruct the Contractor to examine the cause of any Defect in the Works or part thereof before the expiry of the Defects Liability Period.</p> <p>6.8.2 In the event any Defect identified under Clause 6.8.1 is attributable to the Contractor, the Contractor shall rectify such Defect within the period specified by the Authority's Engineer, and shall bear the cost of the examination and rectification of such Defect.</p> <p>6.8.3 In the event such Defect is not attributable to the Contractor, the Authority's Engineer shall, after due consultation with the Authority and the Contractor, determine the costs incurred by the Contractor on such examination and notify the same to the Contractor, with a copy to the Authority, and the Contractor shall be entitled to payment of such costs by the Authority.</p>
New Clause-6.9	<p>Performance Certificate</p> <p>Performance of the Contractor's obligations shall not be considered to have been completed until the Employer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract.</p> <p>The Employer shall issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects.</p> <p>Only the Performance Certificate shall be deemed to constitute acceptance of the Works.</p>
New Clause-6.10	<p>Unfulfilled Obligations</p> <p>After the Performance Certificate has been issued, each Party shall remain liable for the fulfilment of any obligation which remains unperformed at that time. For the purposes of</p>

	<p>determining the nature and extent of unperformed obligations, the Contract shall be deemed to remain in force.</p> <p>Emergency defect rectification</p> <p>If any defect or damage is one requiring immediate attention from safety, environmental or operational viewpoint, the Engineer has the authority to proceed with rectification in any manner suitable and deduct such sums from the Contract Price</p>
New Clause-6.11	<p>Clearance of Site</p> <p>Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site.</p> <p>If all these items have not been removed within 28 days after the Employer receives a copy of the Performance Certificate, the Employer may sell or otherwise dispose of any remaining items. The Employer shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site.</p> <p>Any balance of the moneys from the sale shall be paid to the Contractor. If these moneys are less than the Employer's costs, the Contractor shall pay the outstanding balance to the Employer.</p>
New Clause-6.12	<p>Extension of Defects Liability Period</p> <p>6.12.1 The Defects Liability Period shall be deemed to be extended till the identified Defects under Clause 6.2 have been remedied.</p> <p>6.12.2 Any Materials or Works with Defects identified under Clause 6.2 and replaced or repaired during the Defects Liability Period or the extended Defects Liability Period, as the case may be, would be further warranted for a period of twelve (12) months from the date of completion of such repair or replacement.</p> <p>6.12.3 The Contractor shall upon termination or expiry of this Agreement or upon expiry of the Defects Liability Period, assign any outstanding benefit in respect of any subcontract or any warranty, to the Authority or to such other person as the Authority may direct.</p>
	7.MEASURMENT AND EVALUATION
New Clause 7.1	<p>Works to be Measured</p> <p>The Works shall be measured, and valued for payment, in accordance with this Clause.</p> <p>Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:</p> <p>(a) promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and</p> <p>(b) supply any particulars requested by the Engineer.</p> <p>If the Contractor fails to attend or send a representative, the measurement made by (or on behalf of) the Engineer shall be accepted as accurate.</p> <p>Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured from records, these shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend, the records shall be accepted as accurate.</p>

	<p>If the Contractor examines and disagrees the records, and/or does not sign them as agreed, then the Contractor shall give notice to the Engineer of the respects in which the records are asserted to be inaccurate. After receiving this notice, the Engineer shall review the records and either confirm or vary them. If the Contractor does not so give notice to the Engineer within 14 days after being requested to examine the records, they shall be accepted as accurate.</p>
New Clause 7.2	<p>Method of Measurement</p> <p>Except as otherwise stated in the Contract and notwithstanding local practice:</p> <p>(a) measurement shall be made of the net actual quantity of each item of the Permanent Works, and</p> <p>(b) the method of measurement shall be in accordance with the Price schedule or other applicable Schedules.</p>
New Clause 7.3	<p>Omissions</p> <p>Whenever the omission of any work form's part (or all) of a Variation, the value of which has not been agreed, if:</p> <p>a) the Contractor will incur (or has incurred) cost which, if the work had not been omitted, would have been deemed to be covered by a sum forming part of the Accepted Contract Amount;</p> <p>b) the omission of the work will result (or has resulted) in this sum not forming part of the Contract Price; and</p> <p>c) this cost is not deemed to be included in the evaluation of any substituted work;</p> <p>then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with New-Clause 3.5/PCC [Determinations] to agree or determine this cost, which shall be included in the Contract Price.</p>
New Clause 8	<p>FORCE MAJEURE</p> <p>If at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract shall be prevented or delayed by reason of any war, hostility, acts of public enemy, civil commotion, sabotage, serious loss or damage by fire, explosions, epidemics, pandemics, strikes, lockouts or acts of God (hereinafter referred to 'events') provided, notice of the happening of any such event is given by either party to the other within 14 days from the date of occurrence thereof, neither party shall by reason of such event, be entitled to terminate this contract nor shall either party have any claim for damages against the other in respect of such non-performance or delay in performance, and works under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist, and decision of the Engineer as to whether the works have been so resumed or not shall be final and conclusive, provided further that if the performance in whole or in part of any obligation under this contract is prevented or delayed by reason of any such event for a continuous period exceeding 84 days, either party may at its option terminate the contract by giving notice to the other party.</p>

	<p>Payment and Release in case of Optional Termination</p> <p>Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include:</p> <ol style="list-style-type: none"> a) The amounts payable for any work carried out for which a price is stated in the contract; b) The Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the contractor is liable to accept delivery; this Plant and materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, the Contractor shall place the same at the Employer's disposal; c) Other Costs or liabilities supported by necessary documentary evidence which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works as per mutually agreed programme. d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost).
New Clause-9	Defect liability period: 365 Days
New Clause-10	<p>Integrated testing and system commissioning</p> <p>Integrated Testing: Tests on Completion shall also include Integrated Testing. The Contractor shall, following satisfactory completion of tests on his works, equipment, sub-systems or system, perform, at the direction of the Engineer, programme of tests to verify and confirm the compatibility and complete performance of his works, equipment, sub-systems or system with the works, equipment, sub-systems or system provided by others.</p> <p>Compilation of Test Results: The results of the Integrated Testing and Commissioning shall be compiled and evaluated by the Engineer and the Contractor</p> <p>Retesting: If the Works, or a part thereof, or a Section, fail to pass the Integrated Testing and Commissioning, the Engineer may order such failed tests to be repeated with the same terms and conditions. If such failure and retesting result from a default of the Contractor and cause the Employer to incur costs, the same shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any amount due, or to become due, to the Contractor.</p> <p>Failure to Pass Test: If the Works, or a part thereof, or a Section, fail to pass Integrated Testing and Commissioning and the Contractor in consequence proposes to make any adjustment or modification to the Works or a part thereof, or a section, the Engineer may, with the approval of the Employer, instruct the Contractor to carry out such adjustment or modification, at his own cost and to satisfy the requirements of Integrated Testing and Commissioning within such time as the Employer / Engineer may deem to be reasonable.</p> <p>Statutory Requirements: The Contractor shall carry out all statutory tests and trials, under the supervision of the Engineer, necessary for obtaining sanction of the competent authority for opening the system for public carriage of passengers as mentioned in the Special Conditions of Contract.</p>

New clause-11	<p>Conflict of Interest:</p> <p>The remuneration of the Tenderer shall constitute the Tenderer's sole remuneration in connection with this Contract or the Services and, the Tenderers shall not accept for their own benefit any trade commission, discount or similar payment in connection with activities pursuant to this Contract or to the Services or in the discharge of their obligations hereunder, and the Tenderers shall use their best efforts to ensure that any Personnel either of them, similarly shall not receive any such additional remuneration Neither the Tenderer nor the Personnel of either of them shall engage, either directly or indirectly, in any of the following activities:</p> <p>(a) during the term of this Contract, any business or professional activities in India which would conflict with the activities assigned to them under this Contract</p> <p>The tenderer shall not be one of the following:</p> <p>(i) A firm which has been engaged by the Employer to provide consulting services for the preparation related to procurement for or implementation of this project.</p> <p>(ii) Any association/affiliation (inclusive of parent firms) of a firm or an organization mentioned in para (i) above.</p> <p>(iii) A Tenderer who lends, or temporarily seconds its personnel to firms or organizations which were engaged in consulting services for the preparation related to procurement for or implementation of the project, if the personnel would be involved in any capacity on the same project.</p> <p>Jurisdiction of Court in case of dispute or differences arising on account of this tender: Any suit or application, arising out of any dispute or differences on account of this tender shall be filed in a competent court at Bangalore, Karnataka only and no other court or any other district of the country shall have any jurisdiction in the matter.</p>
New Clause-12	<p>Special/Acceleration Advance</p> <p>Employer at his sole discretion, may provide Interest bearing Special/Acceleration Advance based on the recommendation of the Engineer to expedite works or to bring forward the completion date(s) and on account of immediate additional mobilization to complete balance works as targeted. The maximum cumulative Special/Acceleration Advance shall be 10% of the Accepted contract amount, which shall be released in stages as and when deemed appropriate as decided by the Engineer/Employer. The advance released at a time shall not exceed 2.5% of the Accepted contract amount. The Special Acceleration Advance shall be interest bearing and secured by BG equivalent to 105% of the advance amount.</p> <p>Interest on Advance Payment: At the rate of SBI MCLR+2% interest per annum on reducing balances. The Interest rate is applicable from the date of submission of IPC/ advance request by contractor.</p>
New Clause-13	Deleted
New Clause-14	Ruling Language- English
New Clause-15	Language for communications- English
New Clause-16	Time for access to Site

	Starting from the Date of Commencement, the section will be progressively handed over in 180 days.
New clause-17	<p>Employers' Bank details for Letter of Credit</p> <p>(a) Nodal Branch Canara Bank, MG Road, Bangalore 560001 IFSC Code – CNRB0002636 A/c No - 0430201012110</p> <p>(b) Issuance/ reimbursing branch for LC Shall be indicated later.</p>
New clause-18	<p>18.1 Representations and warranties of the Contractor</p> <p>The Contractor represents and warrants to the Authority that:</p> <ol style="list-style-type: none"> a) it is duly organised and validly existing under the laws of India, and has full power and authority to execute and perform its obligations under this Agreement and to carry out the transactions contemplated hereby; b) it has taken all necessary corporate and other actions under Applicable Laws to authorise the execution and delivery of this Agreement and to validly exercise its rights and perform its obligations under this Agreement; c) this Agreement constitutes its legal, valid and binding obligation, enforceable against it in accordance with the terms hereof, and its obligations under this Agreement will be legally valid, binding and enforceable obligations against it in accordance with the terms hereof; d) it is subject to the laws of India, and hereby expressly and irrevocably waives any immunity in any jurisdiction in respect of this Agreement or matters arising thereunder including any obligation, liability or responsibility hereunder; e) the information furnished in the Bid and as updated on or before the date of this Agreement is true and accurate in all respects as on the date of this Agreement; f) the execution, delivery and performance of this Agreement will not conflict with, result in the breach of, constitute a default under, or accelerate performance required by any of the terms of its memorandum and articles of association or any Applicable Laws or any covenant, contract, agreement, arrangement, understanding, decree or order to which it is a party or by which it or any of its properties or assets is bound or affected; g) there are no actions, suits, proceedings, or investigations pending or, to its knowledge, threatened against it at law or in equity before any court or before any other judicial, quasi-judicial or other authority, the outcome of which may result in the breach of this Agreement or which individually or in the aggregate may result in any material impairment of its ability to perform any of its obligations under this Agreement; h) it has no knowledge of any violation or default with respect to any order, writ, injunction or decree of any court or any legally binding order of any Government Instrumentality

which may result in any material adverse effect on its ability to perform its obligations under this Agreement and no fact or circumstance exists which may give rise to such proceedings that would adversely affect the performance of its obligations under this Agreement;

- (i) it has complied with Applicable Laws in all material respects and has not been subject to any fines, penalties, injunctive relief or any other civil or criminal liabilities which in the aggregate have or may have a material adverse effect on its ability to perform its obligations under this Agreement;
- (j) no representation or warranty by it contained herein or in any other document furnished by it to the Authority or to any Government Instrumentality in relation to Applicable Permits contains or will contain any untrue or misleading statement of material fact or omits or will omit to state a material fact necessary to make such representation or warranty not misleading;
- (k) no sums, in cash or kind, have been paid or will be paid, by it or on its behalf, to any person by way of fees, commission or otherwise for securing the contract or entering into this Agreement or for influencing or attempting to influence any officer or employee of the Authority in connection therewith;
- (l) all information provided by the {selected bidder/ members of the Consortium/Joint Venture} in response to the tender or otherwise, is to the best of its knowledge and belief, true and accurate in all material respects; and
- (m) nothing contained in this Agreement shall create any contractual relationship or obligation between the Authority and any Sub-contractors, designers, consultants or agents of the Contractor.

18.2 Representations and warranties of the Employer.

The Employer represents and warrants to the Contractor that:

- a) it has full power and authority to execute, deliver and perform its obligations under this Agreement and to carry out the transactions contemplated herein and that it has taken all actions necessary to execute this Agreement, exercise its rights and perform its obligations, under this Agreement;
- b) it has taken all necessary actions to authorise the execution, delivery and performance of this Agreement;
- c) it has the financial standing and capacity to perform its obligations under this Agreement;
- d) this Agreement constitutes a legal, valid and binding obligation enforceable against it in accordance with the terms hereof;
- e) it has no knowledge of any violation or default with respect to any order, writ, injunction or any decree of any court or any legally binding order of any Government Instrumentality which may result in any material adverse effect on the Authority's ability to perform its obligations under this Agreement;
- (f) it has complied with Applicable Laws in all material respects;
- (g) it has good and valid right to the Site.

	<p>18.3 Disclosure</p> <p>In the event that any occurrence or circumstance comes to the attention of either Party that renders any of its aforesaid representations or warranties untrue or incorrect, such Party shall immediately notify the other Party of the same. Such notification shall not have the effect of remedying any breach of the representation or warranty that has been found to be untrue or incorrect nor shall it adversely affect or waive any obligation of either Party under this Agreement.</p>
<p>New clause-19</p>	<p>Disclaimer</p> <p>19.1 The Contractor acknowledges that prior to the execution of this Agreement, the Contractor has, after a complete and careful examination, made an independent evaluation of the Tender, Scope of the Project, Specifications and Standards, Site, local conditions, physical qualities of ground, subsoil and geology, traffic volumes, suitability and availability of access routes to the Site and all information provided by the Authority or obtained, procured or gathered otherwise, and has determined to its satisfaction the accuracy or otherwise thereof and the nature and extent of difficulties, risks and hazards as are likely to arise or may be faced by it in the course of performance of its obligations hereunder. Save as provided in New Clause 2.0/PCC and New Clause 18.2/PCC, the Authority makes no representation whatsoever, express, implicit or otherwise, regarding the accuracy, adequacy, correctness, reliability and/or completeness of any assessment, assumptions, statement or information provided by it and the Contractor confirms that it shall have no claim whatsoever against the Authority in this regard.</p> <p>19.2 The Contractor acknowledges and hereby accepts to have satisfied itself as to the correctness and sufficiency of the Contract Price.</p> <p>19.3 The Contractor acknowledges and hereby accepts the risk of inadequacy, mistake or error in or relating to any of the matters set forth in Clause 19.1/PCC above and hereby acknowledges and agrees that the Authority shall not be liable for the same in any manner whatsoever to the Contractor, or any person claiming through or under any of them, and shall not lead to any adjustment of Contract Price or Scheduled Completion Date.</p> <p>19.4 The Parties agree that any mistake or error in or relating to any of the matters set forth in Clause 19.1/PCC above shall not vitiate this Agreement, or render it voidable.</p> <p>19.5 In the event that either Party becomes aware of any mistake or error relating to any of the matters set forth in Clause 19.1/PCC above, that Party shall immediately notify the other Party, specifying the mistake or error.</p> <p>19.6 Except as otherwise provided in this Agreement, all risks relating to the Project shall be borne by the Contractor; and the Authority shall not be liable in any manner for such risks or the consequences thereof.</p>
<p>New Clause-20</p>	<p>COMPLETION CERTIFICATE</p> <p>20.1 Tests on completion</p> <p>20.1.1 No later than 30 (thirty) days prior to the likely completion of the Railway Project, the Contractor shall prepare and submit to the Authority's Engineer the documents required for seeking approval of the Commissioner of Railway Safety in accordance with the provisions of the Railways Opening for Public Carriage of Passenger Rules, the Indian Railway Permanent Way Manual or the Indian Railways Manual of A.C. Traction, as the case may be, and notify the Authority's Engineer of its intent to subject the Railway Project</p>

to Tests. After ensuring and procuring that the documents required to be submitted to the Commissioner for Railway Safety meet the requirements of Applicable Laws, the Authority's Engineer shall, in consultation with the Contractor, determine the date and time of each of the Tests, and inform the Authority who may designate its representative to witness the Tests. The Contractor shall provide such assistance as the Authority's Engineer may reasonably require for conducting the Tests.

20.1.2 All Tests shall be conducted in accordance with as per relevant Schedule at the cost and expense of the Contractor; provided, however, that the trial running on railway track shall be undertaken at the cost and expense of the Authority. The Authority's Engineer shall observe, monitor and review the results of the Tests to determine compliance of the Railway Project with Specifications and Standards and if it is reasonably anticipated or determined by the Authority's Engineer during the course of any Test that the performance of the Railway Project or Section or any part thereof, does not meet the Specifications and Standards, it shall have the right to suspend or delay such Test and require the Contractor to remedy and rectify any Defect or deficiency. Upon completion of each Test, the Authority's Engineer shall provide to the Contractor and the Authority copies of all Test data including detailed Test results. For the avoidance of doubt, the Parties expressly agree that the Authority's Engineer may require the Contractor to carry out or cause to be carried out additional Tests, in accordance with Good Industry Practice, for determining the compliance of the Railway Project thereof with the Specifications and Standards.

20.2 Provisional Certificate

20.2.1 Upon completion of Tests, the Authority's Engineer shall satisfy itself that the Tests have been successful and the Railway Project is fit for opening to traffic. Upon such determination, the Authority's Engineer shall issue to the Contractor and the Authority a certificate substantially in the form set forth in relevant Schedule (the "Provisional Certificate"). The Authority's Engineer may issue a Provisional Certificate even if certain works forming part of the Railway Project are not yet completed and in such an event, the Provisional Certificate shall have appended thereto a list of outstanding items signed jointly by the Authority's Engineer and the Contractor (the "Punch List"). For the avoidance of doubt and by way of illustration, the Punch List may include [fencing, tree plantation, rest areas].

20.2.2 Upon issuance of the Provisional Certificate, the Authority's Engineer shall forward to the Authority (i) copies of all Test data including Test results, and (ii) the documents submitted by the Contractor for seeking approval of the Commissioner of Railway Safety in accordance with the provisions of the Railways Opening for Public Carriage of Passenger Rules, the Indian Railway Permanent Way Manual/ or the Indian Railways Manual of A.C. Traction, as the case may be, for obtaining authorisation from the Commissioner for Railway Safety.

20.2.3 The Contractor shall assist the Authority during inspection and tests to be conducted by the Commissioner of Railway Safety for determining compliance of the Railway Project with Applicable Laws and the provisions of this Agreement.

20.2.4 The Parties hereto expressly agree that the Authority's Engineer may, upon request of the Authority to this effect, issue a Provisional Certificate for part of the Railway Project and the provisions of above Clauses shall apply mutatis mutandis to such Provisional Certificate. The issuance of the provisional certificate will not absolve the contractor of its obligations to complete the remaining part of Railway Project.

	<p>20.2.5 The risk of loss or damage to any Materials, Plant or Works in the Railway Project or part thereof, as the case may be, and the care and custody thereof shall pass from the Contractor to the Authority upon issuance of Provisional Certificate for the Railway Project or part thereof.</p> <p>20.3 Completion of Punch List items</p> <p>All items in the Punch List shall be completed by the Contractor within 90 (ninety) days of the date of issuance of the Provisional Certificate and for any delay thereafter, other than for reasons solely attributable to the Authority or due to Force Majeure, the Authority shall be entitled to recover Damages from the Contractor to be calculated and paid for each day of delay until all items are completed, at the lower of (a) 0.1% (zero point one per cent) of the Performance Security, and (b) 0.2% (zero point two per cent) of the cost of completing such items as estimated by the Authority's Engineer. Subject to payment of such Damages, the Contractor shall be entitled to a further period not exceeding 120 (one hundred and twenty) days for completion of the Punch List items. For the avoidance of doubt, it is agreed that if completion of any item in the Punch List is delayed for reasons attributable to the Authority or due to Force Majeure, the completion date thereof shall be determined by the Authority's Engineer in accordance with Good Industry Practice, and such completion date shall be deemed to be the date of issue of the Provisional Certificate for the purposes of Damages, if any, payable for such item under this Clause.</p> <p>20.4 Completion Certificate</p> <p>20.4.1 Upon completion of all items in the Punch List and issuance of authorisation by the Commissioner of Railway Safety, the Authority's Engineer shall issue forthwith to the Contractor and the Authority a completion certificate substantially in the form (the "Completion Certificate") separately for and in respect of each Provisional Certificate issued.</p> <p>20.4.2 Upon receiving the Completion Certificate, the Contractor shall remove its equipment, materials, debris and temporary works from the Site within a period of 15 (fifteen) days thereof, failing which the Authority may remove or cause to be removed, such equipment, materials, debris and temporary works and recover from the Contractor an amount equal to 120% (one hundred and twenty per cent) of the actual cost of removal incurred by the Authority.</p> <p>20.5 Rescheduling of Tests</p> <p>If the Authority's Engineer certifies to the Authority and the Contractor that it is unable to issue the Completion Certificate or Provisional Certificate, as the case may be, because of events or circumstances on account of which the Tests could not be held or had to be suspended, the Contractor shall be entitled to re-schedule the Tests and hold the same as soon as reasonably practicable.</p>
<p>New Clause -21</p>	<p>TRAFFIC REGULATION</p> <p>21.1 Traffic regulation by the Contractor</p> <p>21.1.1 The Contractor shall take all the required measures and make arrangements for the safety of any persons and vehicles on or about the Site during the construction of the Railway Project or a Section thereof in accordance with Good Industry Practice, and Applicable Laws. It shall provide, erect and maintain all such barricades, signs, markings, flags, and lights as may be required by Good Industry Practice for the safety</p>

	<p>of the traffic using any public roads or access along or across the Section under construction.</p> <p>21.1.2 All works shall be carried out in a manner creating least interference to traffic passing along or across the Railway Project or a Section thereof. The Contractor shall ensure that proper passage is provided for the traffic. Where it is not possible or safe to allow traffic on the existing road or passage, a temporary diversion of proper specifications shall be constructed by the Contractor at its own cost. The Contractor shall take prior approval of the Authority's Engineer for any proposed arrangement for traffic regulation during Construction, which approval shall not be unreasonably withheld.</p> <p>21.1.3 In the event any construction work is required to be executed in close proximity of an existing operating system of Railways, the Contractor shall make arrangements for the safety of such system in accordance with the provisions of the 'Compendium of Instructions on Safety at work Sites' issued by the Authority and Good Industry Practice.</p>
<p>New Clause -22</p>	<p>LIABILITY AND INDEMNITY</p> <p>22.1 General indemnity</p> <p>The Contractor will indemnify, defend, save and hold harmless the Authority and its officers, servants, agents, Government Instrumentalities and Government owned and/or controlled entities/enterprises, (the "Authority Indemnified Persons") against any and all suits, proceedings, actions, demands and third party claims for any loss, damage, cost and expense of whatever kind and nature, whether arising out of any breach by the Contractor of any of its obligations under this Agreement or from any negligence under the Agreement, including any errors or deficiencies in the design documents, or tort or on any other ground whatsoever, except to the extent that any such suits, proceedings, actions, demands and claims have arisen due to any negligent act or omission, or breach or default of this Agreement on the part of the Authority Indemnified Persons.</p> <p>22.2 Indemnity by the Contractor</p> <p>22.2.1 Without limiting the generality of Clause 22.1, the Contractor shall fully indemnify, hold harmless and defend the Authority and the Authority Indemnified Persons from and against any and all loss and/or damages arising out of or with respect to:</p> <ul style="list-style-type: none"> (a) failure of the Contractor to comply with Applicable Laws and Applicable Permits; (b) payment of taxes required to be made by the Contractor in respect of the income or other taxes of the Sub-contractors, suppliers and representatives; or (c) non-payment of amounts due as a result of Materials or services furnished to the Contractor or any of its Sub-contractors which are payable by the Contractor or any of its Sub-contractors. <p>22.2.2 Without limiting the generality of the provisions of this LIABILITY AND INDEMNITY, the Contractor shall fully indemnify, hold harmless and defend the Authority Indemnified Persons from and against any and all suits, proceedings, actions, claims, demands, liabilities and damages which the Authority Indemnified Persons may hereafter suffer, or pay by reason of any demands, claims, suits or proceedings arising out of claims of infringement of any domestic or foreign patent rights, copyrights or other Intellectual</p>

Property, proprietary or confidentiality rights with respect to any materials, information, design or process used by the Contractor or by the Sub-contractors in performing the Contractor's obligations or in any way incorporated in or related to the Project. If in any such suit, action, claim or proceedings, a temporary restraint order or preliminary injunction is granted, the Contractor shall make every reasonable effort, by giving a satisfactory bond or otherwise, to secure the revocation or suspension of the injunction or restraint order. If, in any such suit, action, claim or proceedings, the Railway Project, or any part thereof or comprised therein, is held to constitute an infringement and its use is permanently enjoined, the Contractor shall promptly make every reasonable effort to secure for the Authority a licence, at no cost to the Authority, authorising continued use of the infringing work. If the Contractor is unable to secure such licence within a reasonable time, the Contractor shall, at its own expense, and without impairing the Specifications and Standards, either replace the affected work, or part, or process thereof with non-infringing work or part or process, or modify the same so that it becomes non-infringing.

22.3 Notice and contest of claims

In the event that either Party receives a claim or demand from a third party in respect of which it is entitled to the benefit of an indemnity under this Agreement (the "Indemnified Party") it shall notify the other Party (the "Indemnifying Party") within 15 (fifteen) days of receipt of the claim or demand and shall not settle or pay the claim without the prior approval of the Indemnifying Party, which approval shall not be unreasonably withheld or delayed. In the event that the Indemnifying Party wishes to contest or dispute the claim or demand, it may conduct the proceedings in the name of the Indemnified Party, subject to the Indemnified Party being secured against any costs involved, to its reasonable satisfaction.

22.4 Defence of claims

22.4.1 The Indemnified Party shall have the right, but not the obligation, to contest, defend and litigate any claim, action, suit or proceeding by any third party alleged or asserted against such Party in respect of, resulting from, related to or arising out of any matter for which it is entitled to be indemnified hereunder, and reasonable costs and expenses thereof shall be indemnified by the Indemnifying Party. If the Indemnifying Party acknowledges in writing its obligation to indemnify the Indemnified Party in respect of loss to the full extent provided by this Agreement, the Indemnifying Party shall be entitled, at its option, to assume and control the defence of such claim, action, suit or proceeding, liabilities, payments and obligations at its expense and through the counsel of its choice; provided it gives prompt notice of its intention to do so to the Indemnified Party and reimburses the Indemnified Party for the reasonable cost and expenses incurred by the Indemnified Party prior to the assumption by the Indemnifying Party of such defence. The Indemnifying Party shall not be entitled to settle or compromise any claim, demand, action, suit or proceeding without the prior written consent of the Indemnified Party, unless the Indemnifying Party provides such security to the Indemnified Party as shall be reasonably required by the Indemnified Party to secure the loss to be indemnified hereunder to the extent so compromised or settled.

22.4.2 If the Indemnifying Party has exercised its rights under Clause 22.3, the Indemnified Party shall not be entitled to settle or compromise any claim, action, suit or proceeding

	<p>without the prior written consent of the Indemnifying Party (which consent shall not be unreasonably withheld or delayed).</p> <p>22.4.3 If the Indemnifying Party exercises its rights under Clause 22.3, the Indemnified Party shall nevertheless have the right to employ its own counsel, and such counsel may participate in such action, but the fees and expenses of such counsel shall be at the expense of the Indemnified Party, when and as incurred, unless:</p> <ul style="list-style-type: none"> (a) the employment of counsel by such party has been authorised in writing by the Indemnifying Party; or (b) the Indemnified Party shall have reasonably concluded that there may be a conflict of interest between the Indemnifying Party and the Indemnified Party in the conduct of the defence of such action; or (c) the Indemnifying Party shall not, in fact, have employed independent counsel reasonably satisfactory to the Indemnified Party, to assume the defence of such action and shall have been so notified by the Indemnified Party; or (d) the Indemnified Party shall have reasonably concluded and specifically notified the Indemnifying Party either: <ul style="list-style-type: none"> (i) that there may be specific defences available to it which are different from or additional to those available to the Indemnifying Party; or (ii) that such claim, action, suit or proceeding involves or could have a material adverse effect upon it beyond the scope of this Agreement: <p>Provided that if Sub-clauses (b), (c) or (d) of this Clause 22.4.3 shall be applicable, the counsel for the Indemnified Party shall have the right to direct the defence of such claim, demand, action, suit or proceeding on behalf of the Indemnified Party, and the reasonable fees and disbursements of such counsel shall constitute legal or other expenses hereunder.</p> <p>22.5 No consequential claims</p> <p>Notwithstanding anything to the contrary contained in this new clause 22, the indemnities herein provided shall not include any claim or recovery in respect of any cost, expense, loss or damage of an indirect, incidental or consequential nature, including loss of profit, except as expressly provided in this Agreement.</p> <p>22.6 Survival on Termination</p> <p>The provisions of this new clause 22 shall survive Termination.</p>
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APPENDIX 1

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK

(The laws as current on the date of bid opening will apply)

- a) **Employees Compensation Act 1923:** The Act provides for compensation in case of injury by accident arising out of and during the course of employment.
- b) **Payment of Gratuity Act 1972:** Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.
- c) **Employees Provident Fund and Miscellaneous Provisions Act 1952 (since amended):** The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:
 - (i) Pension or family pension on retirement or death, as the case may be.
 - (ii) Deposit linked insurance on the death in harness of the worker.
 - (iii) payment of P.F. accumulation on retirement/death etc.
- d) **Maternity Benefit Act 1951:** The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.
- e) **Contract Labour (Regulation & Abolition) Act 1970:** The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.
- f) **Minimum Wages Act 1948:** The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.
- g) **Payment of Wages Act 1936:** It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
- h) **Equal Remuneration Act 1979:** The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.
- i) **Payment of Bonus Act 1965:** The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.7000/-per month or the minimum wage as fixed by the appropriate government whichever is higher. The Act does not apply to certain

establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

- j) **Industrial Disputes Act 1947:** The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.
- k) **Industrial Employment (Standing Orders) Act 1946:** It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.
- l) **Trade Unions Act 1926:** The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.
- m) **Child and Adolescent Labour (Prohibition & Regulation) Act 1986:** The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.
- n) **Inter-State Migrant Workmen's (Regulation of Employment & Conditions of Service) Act 1979:** The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upto the establishment and back, etc.
- o) **The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996:** All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

As per Central Government's Notification No.S.O.2899 dated 26.09.1996 under this act, the cess shall be levied @1% of cost of construction works which shall be deducted from each bill of the payment due to the contractor.

- p) **Factories Act 1948:** The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It

is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

- q) **The Employees State Insurance Act, 1948 (Act No. 34 of 1948) (Provisions as extended from time to time):**An Act to provide for certain benefits to employees in case of sickness, maternity and 'employment injury' and to make provision for certain other matters in relation thereto.

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K-RIDE

SECTION 8A
PART-1

**EMPLOYER'S REQUIREMENT –
GENERAL INFORMATION AND
SCOPE OF WORK**

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SECTION 8A: PART-1

WORKS/EMPLOYER'S REQUIREMENTS

EPC TENDER.

GENERAL INFORMATION & SCOPE OF WORK

Brief Scope

“NAME OF WORK: “DESIGN AND CONSTRUCTION OF ELEVATED VIADUCT OF LENGTH 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 Km) INCLUDING RAMPS AND FORMATION IN EMBANKMENTS /CUTTINGS INCLUDING BLANKETING, MAJOR BRIDGES, MINOR BRIDGES, RUB, ROB, ROR, RETAINING WALL, SACRIFICIAL RETAINING WALL AND DRAINS, UTILITY DIVERSIONS OF AT-GRADE SECTION OF LENGTH 17.551 Km (CH: -0.964 Km to CH:-0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) AND OTHER RELATED INFRASTRUCTURAL WORKS FROM BENNIGANAHALLI TO CHIKKABANAVARA, EXCLUDING STATION BUILDINGS, OF CORRIDOR - 2 OF BENGALURU SUBURBAN RAILWAY PROJECT (BSRP)”.

The proposed work is in connection with the Corridor- 2 of Suburban railway work between Benniganahalli and Chikkabanavara from approx. Km: (-) 0.964 to 24.425 (Including sidings).

- A. **“Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.**

This bid is for construction of elevated (viaduct) structures comprising pile foundation/open foundation, Piers, cast in situ /pre-cast post tensioned pier cap and cast in situ/ precast portal beams. Elevated structure includes, Pre-cast PSC I – Girder, PSC T– Girder, Pre-cast Box segments/ Pre-cast full span U Girder including casting, transporting, launching and erection in position, the work also includes road widening, side drains & other allied works, and construction of service roads at required locations. Design, construction & maintenance of at least 3 nos of Site /project offices for Engineer and an office at each of the casting yards for Site Engineers are also kept in the scope of the bid.

- B. **“Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.**

This bid is for construction of at-grade section comprising, earthwork in embankment in cutting and filling, Major Bridges, Minor Bridges, ROB/RUB's, including side drains & allied works approach road work viz., Retaining wall, Sacrificial retaining wall, R E Wall, elimination of level crossings by constructing RUB's and construction of service roads at required locations.

The scope of work includes the following:

- a. Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor – 2.
- b. Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor – 2.
- c. The elimination of level crossings works between Ch: 5.700 Km and 10.575 Km has involved raising of embankment, construction of minor bridges for full length, RUBs of full length for accommodating both BSRP and IR tracks and retaining walls, sacrificial walls and the work will have to be carried out in stages for continuing the IR traffic by diverting through the newly constructed formation.
- d. Minor bridges (53 no's). The details are in schedule of Employer's requirement.
- e. Major bridges (1 no). The details are in schedule of Employer's requirement. Major bridge with open web girder for two BSRP tracks and two IR tracks with pile and pile cap arrangements. The open web girder are four numbers for four tracks of this major bridge.
- f. RUB's (12 nos) in at-grade section, one number RUB in Nagavara station and one number RUB in Kanaka nagar station. The details are in schedule of Employer's requirement. One pre cast RCC box for accommodating one BSRP track at Ch: 20.590 Km below existing ROB (407 A) along with supporting the existing water pipe line including retaining wall.
- g. Two ROB's (1X60m span cable stay/Suspension bridge, 1X30m span cable stay/Suspension bridge)
- h. Benniganahalli viaduct structure to support both corridor-2 and corridor-4 lines from CH: -0.675 Km to CH: -0.190Km. (Foundation, substructure, Portals, U-Girders/I-Girders up to formation are included).
- i. Earthwork, retaining wall, Drains for Corridor-4 along with corridor-2 lines from CH: -0.964 Km to CH: -0.675 Km are included.
- j. Benniganahalli bridge special span for viaduct over Railway lines is 1X50m open web girder for double track with portal arrangements are included.
- k. The portal arrangements for crossing over the Railway track between Hebbal and Lottegollahalli station are included for traversing from RHS to LHS.
- l. The portal arrangement between Ch: 16.225 Km to 16.275 Km are included as per GAD.
- m. The single line tracks structures in the approaches of Yeshwantpur station are included.
- n. Yeshwantpur station: The portal structure for Yeshwantpur station for supporting corridor-2 and corridor-1 tracks are included. The three-legged portal with beams at L1 and L2 level, track beds at L1 and L2 level along with foundation are included.

- o. Hebbal station and Lottegollahalli station: The foundation, pier, pier arm at concourse level, pier arm at track level, track bed slab and track bed supporting structures are included.
- p. The single-track structures for corridor-2 and Portal structure for Corridor-2 and corridor-1 up to ramp are included at Yeshvanthpur. The super structure is for corridor-2 only.
- q. The special spans of 44m over Lottegollahalli ROB for track supporting structure (double track) are included.
- r. The special spans in Yeshwantpur Yard for single track are shown in tender drawings and tentative. The approximate spans are 50m, 42m, 35m, 50m, 40m, 44m, for single tracks composite girders. The Open web girders for 65m span and 67m span for single track are also included. The span length may vary during detail designing and the tender drawings are tentative.
- s. The portal legs are with 6 pile group / 8 pile group as per the span of portal beam and the tender drawings are indicative.
- t. The RCC drains of 4.580Km (Approx.) is required in viaduct portion and 39.977Km is required in At-grade section (i. One line of 17.551Km on BSRP toe side, one line of 17.551Km between IR and BSRP track and one line of 4.875Km on IR toe side where elimination of LC's is involved. The minor variations in lengths may take place during construction.
- u. The retaining walls: The retaining walls of 12.450Km is required to be construction and the approximate height is varying from 1m to 9m. for supporting the embankment/cutting slope and the details are in Tender drawing. The retaining wall of length approximately 7.2km has no surcharge (Slope) and remaining retaining wall length of 5.25 Km has surcharge (slope).
- v. Road work: The road work is required for diversion of traffic during construction at viaduct location, earthwork/retaining wall locations, major and minor bridge locations, RUB locations and ROB locations. After completion of ROB and RUB structures, the permanent roads are required to be constructed on ramps and approaches of ROB/RUB and also on ROB / RUB structures. The approximate quantity is about 80,000Sqm road area for each layer (GSB, WMM, DBM and BC layers) and this may vary during execution.

EMPLOYERS REQUIREMENT - SCOPE OF WORK

1. OBJECTIVE

The objective of the contract is the Design and construction, testing and commissioning of the permanent works, construction and removal of the Temporary Works and the rectification of defects appearing in Permanent Works by the contractor in the manner stipulated by the Contract. In full recognition of this objective, and with full acceptance of the obligations, liabilities and risks which may be involved, the Contractor shall undertake the execution of the Works. The general and specific requirements of the employer are detailed out in this document for understanding of the bidders and for mandatory compliance by the successful bidder/contractor. The Employer's requirements have been divided into different sections / sub-heads for convenience only. They do not restrict any cross-references. The Contractor shall take into account inter-relations between various parts of works. No claim shall be entertained on account of compartmental interpretations.

1.1 SCOPE OF THE WORK.

A. VIADUCT WORK:

- 1) "Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".
- 2) Construction of elevated (viaduct) structures comprising pile foundation/open foundation, Piers, cast in situ /pre-cast post tensioned pier cap and cast in situ/ precast portal beams. Elevated structure includes, Pre-cast PSC I – Girder, PSC T– Girder, Pre-cast Box segments/ Pre-cast full span U Girder including casting, transporting, launching and erection in position, station pier arms
- 3) Provision of foundation works for different structures i.e., viaduct/track structure etc. including piles (1000mm dia for the structure carrying single track and minimum 1200mm dia for structure carrying two tracks) and pile caps /open foundations / rafts for columns/ piers (wherever required) up to the minimum founding depths in accordance with the actual soil parameters as obtained from detailed sub-surface exploration as specified or directed. The Construction methodology is required to be approved by K-RIDE before carrying out the works. The founding level will be decided by Geotechnical Engineer/ Employer during construction.
- 4) Provision of RCC piers, pier caps, precast pier caps & precast pier arms /portal pier beams, bearings, as specified or as directed.
- 5) Provision of superstructure for viaduct consisting of precast (Pre-Tensioned & Post- Tensioned) reinforced cement concrete Box- Girders, U-Girders, I-Girders, parapet & cast-in-situ deck slab works.
- 6) Provision of Composite/Open Web Girders for Obligatory or Railway Spans according to RDSO standards or any standards decided by K-RIDE.
- 7) Design & Construction Contractor has to design the Viaduct ensuring 5.5m vertical clearance above the existing roadlevel & adequate vertical clearance at railways crossings as per DBR & SOD.
- 8) Design and Construction of super structure of standard spans, non-standard spans/specials spans, spans supporting special track layouts are in the scope of work. The super structures are U-Girders of full length. Wherever, U-Girders not possible, the segmental box girder will be allowed with the approval of K-RIDE. U-Girder is the K-RIDE preferred choice. The scope of work of the Viaduct contractor also includes pile foundations, substructure (pier and pier arm) for platform and concourse meant for station. The track bed including I-girders and slab at elevated stations are in the scope of work. **The contract includes station piers @ approximate 15-22 m span in station portion.**
- 9) The indicative spans are 19m, 22m, 25m, 28 m, 31m & 34m. Wherein indicative structural spans are 28m or 31m on straights and 22m, 25m on sharp curves. At obligatory portions or where there are constraints, they could be 31 m & 34 m or longer based on site conditions. **The small variations for spanning and height variation may take place for any height in single piers and portal piers, no extra payment will be given. The rates shall be inclusive of all minor variations. The number of piers and portal beams may increase or decrease during finalization/validation of GAD and during construction period and for which no extra payment shall be given and the same is included in the lumpsum price.**

- 10) **Spanning Arrangements to be decided by bidder subject to GADs enclosed with this Tender. The final decision will be by K-RIDE.**
- 11) Transporting pre-cast full spans U-Girder (in Viaduct Split flyover) of simply supported span from the casting yard to work site by trailer/ trucks, erection in position including temporary supports, erection equipment, lifting cranes (using GOLIATH Crane in Split flyover/Critical location), transporting etc, and positioning on bearings etc for viaduct into completed structures conforming to required lines, grades and dimensions complete as per drawings and specifications. (Note: The suitable launcher for U-girder launching fully automatic, capable of negotiating 200m radius curve and 4% gradient, speed of trolley carrying U-girder for launching with load 2km/hr. and without load 3km/hr. to be mobilized. The minimum of two numbers of LG for launching of U-girders with motorised bogies for handling and transportation of U-girders to be mobilised.)
- 12) Transportation of pre-cast box segments from casting yard to the site launching and erection in position. Loading, transporting precast segments from casting yard to work site, launching and erection in position with launching girder, including erection and shifting of launching girder (Min. two No of launching girders to be mobilised), temporary supports, launching girders, erection equipment's, transporting etc., applying epoxy based bonding agent on end surface of segments after dry matching including temporary prestressing required during its curing period and positioning on bearings etc. This shall be operated for any type of launching scheme adopted.
- 13) Conducting Load Testing of PSC U-Girder/ PSC Box girder/ I Girder of span length 22m/25m/28m/31m or more as per IRC SP51, including making all arrangement and conducting satisfactory Load testing on simply supported span constructed by pre-cast U-Girder/ Box Girder/ I Girder, erected in position on the piers at site
- 14) The superstructure type at station location shall be U- girder /I-girder with slab. The span arrangement may be 15-22m approximately. Exact inter-distance shall be decided at detailed design stage in consultation with DDC of station buildings.
- 15) Ramp: The work is to be constructed and maintained as per relevant codes, specifications, Special Specifications and drawings and/or as directed by the Engineer. This is the part of Lumpsum quoted price.
- 16) Supply fabrication and erection of OPEN WEB GIRDER (OWG) as per RDSO drawing, as per BSRP /DBR, IRS/IS specification for fabrication of steel bridge girders., IRS B-1/2001, IRS Welded bridge code (as corrected up to date), using contractors supply of steel conforming to IS:2062 quality 'BO', grade E 250 from SAIL/TISCO/RINL/JSW complete including load testing.
- 17) The structure height from ground level to rail level is about 10.5m (approximately) in case of normal viaduct and 20m (approx.) in case double decker up to rail level.
- 18) The inspection platforms to be provided at pier and pier cap for inspection of bearings etc., at spans of Railway crossings.
- 19) The interchange stations are Benniganahalli station (Corridor-2 and Corridor-4) and Yeshwantpur station (Corridor-2 and Corridor-1) of BSRP. The scope of work is indicated in the tender drawings. The common structure (Foundation, substructure and superstructure) at Benniganahalli station and viaduct portion for corridor-4 is included in the scope of work. The common structure (Foundation and substructure) at Yeshwantpur station and in yard portion for corridor-1 is included in the scope of work.

20) **GAD enclosed in the tender documents may be referred. Salient details of GAD are given below:**

A. Main Viaduct:

- i) Design & Construction Contractor has to design the Viaduct ensuring 5.5m vertical clearance above the existing roadlevel & adequate vertical clearance at railways crossings as per DBR & SOD.
- ii) Whole length has to be designed for double line Broad gauge track. System is planned with end evacuation and 25 KV AC OHE traction.
- iii) Design and Construction of super structure of standard spans, non-standard spans/specials spans, spans supporting special track layouts are in the scope of work. The super structures are U-Girders of full length. Wherever, U-Girders not possible, the segmental box girder will be allowed with the approval of K-RIDE. U-Girder is the K-RIDE preferred choice. The tenderer will have to use Segmental Box girder/U-girder integrated with the parapet (Segmental Box girder or U-Girder is K-RIDE's preferred choice)/ I-Girders with slab in superstructure and proposed spans within the limitations laid by this document elsewhere and also according to site condition etc., Any new design or span arrangement being proposed by the Tenderer shall be in conformity with the contemporary best practice. Some spans will have to be designed as special spans/obligatory spans for crossing the existing railway tracks.

B. PIER ARMS FOR PLATFORMS

Design & Construction Contractor have to design and construct pile, pile cap, pier and pier arm to support the station platform and concourse. The pier arm shall be so designed that it shall allow viaduct through the station portion in a station length. Details of station portion will be furnished to the successful bidders, suitable assumptions may be made. The GAD is enclosed with this document to facilitate the design of support structure taking into account the prevalent code, manual and best practices. It may be noted that station support structure will have to conform to the acceptable deflection and vibration norms and the viaduct spans will be constrained in terms of span. The location of piers and the span arrangements suggested by the contractor have to be got approved by the Engineer before execution. The contractor shall not have any claims if any changes are suggested by the engineer. Following loads should be considered for designing the pier arm which will support station platform beam and deck slab also

- i. Floor loads, viz., self-weight, Live load of 5kN/sqm.
- ii. Staircase loads – will be furnished after freezing the station concept plans.
- iii. Escalator support loads – 15MT each. No. of escalators will be furnished after freezing the station concept plans.
- iv. Connecting bridge support beam loads – be furnished after freezing the station concept plans.
- v. Roof column loads – Approx. 15 T each. Will be confirmed after freezing the station concept plans.
- vi. I girders / Beams will be seated on the extended pier arm.

- vii. The present Tender includes pier arm for the stations both at platform level as well as concourse level. It means the foundation, pier and pier arm for the station area are to be designed and constructed, taking into account station load. A typical cross section and size of pier arm is enclosed along with this document. The contract includes station piers @ approximate 15-22 m span in station portion.
- viii. The scope of work of the Viaduct contractor also includes pile foundations, substructure (pier and pier arm) for platform and concourse meant for station. The contract includes station piers @ approximate 15-22 m span in station portion. These station piers will also have platform pier arms (to support platform girders) as well as concourse pier arms (to support concourse girders). The viaduct will pass through at all station locations in elevated portion. The design and Construction cost of the present Tender to include above aspects. **The platform girders and concourse girders are not in the scope of present Tender.**
- 21) The scope of work in brief is given below but the scope includes all other requirements stipulated in various parts/volumes of the contract document including appendices and annexure thereto. Entire scope of work is in lumpsum price. The Schedule-A of Price schedule includes: -
- 22) Design and Construction of open/raft/footing/ pile foundations and construction including pile cap, pier, pier cap, bearing pedestals, bearings, shear keys, seismic restrainers, hold down devices if required etc. complete. Provision of Seismic restrainer is mandatory.
- 23) Design and Construction of super structure of standard spans, non-standard spans/specials spans, spans supporting special track layouts. Girders to be constructed by segmental construction (Segmental Box Girder/U-Girder is K-RIDE's preferred choice). The scope of work of the Viaduct contractor also includes pile foundations, substructure (pier and pier arm) for platform and concourse meant for station. The contract includes station piers @ approximate 15-22 m span in station portion. These station piers will also have platform pier arms (to support platform girders) as well as concourse pier arms (to support concourse girders). The viaduct will pass through at all elevated station locations. The Design and Construction cost of the present Tender to include above aspects. **The platform Girders and concourse girders are not in the scope of present Tender.**
- 24) The indicative spans are 19m, 22m, 25m, 28 m, 31m & 34m. Wherein indicative structural spans are 28m or 31m on straights and 22m, 25m on sharp curves. At obligatory portions or where there are constraints, they could be 31 m & 34 m or longer based on site conditions.
- 25) In sharper curves and pocket track (for stabling) I-Girder maybe permitted. Steel Columns/Steel Piers are not permitted. Indicative spans may be followed for standard units as far as possible. However, in case of obligatory span and sharper curves, I-Girders maybe resorted to with K-RIDE's permission. Bidders have to make sure while submitting their proposal and superstructure design that the rail levels as indicated in GAD as final. However, minor variation shall be allowed as per Technical Requirement & Site conditions with K-RIDE's approval.
- 26) Purely Steel Structures shall not be allowed however, in obligatory locations, composite structures may be permitted with prior approval of K-RIDE.
- 27) Providing & laying plain cement concrete M35 grade using 20mm maximum nominal size aggregates, pile foundations with socketing in weathered rock, soft rock, hard rock of any type and any depth if arising. The piling with temporary liners/permanent liners & socketing in soft rock/hard rock are included. The initial load test, routine load test, dynamic load test, lateral load test, pullout test, pile integrity test, cross hole

sonic test, plate load test are included. The lumpsum cost also includes cutting/chipping of pile up to cut off level or up to good concrete and built up of pile up to required level. The lumpsum cost also includes loading, unloading and disposal of surplus excavated material along with pile heads using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out.

- 28) If at any location, permanent liners are required, the same is inclusive in lumpsum cost price.
- 29) Pile caps / Open Foundations (M35 Grade) resting at any depth depending upon the site condition shall include excavation, leveling course, PCC, dewatering, sheet piling/soldier piling & wooden lagging, if required, Backfilling complete in all respects. Driving 'Z' section MS sheet piles by using 8mm to 10mm thickness, side by side in all kinds of soil mechanically using vibro hammer / suitable means/manually as per directions of Engineer-in-charge for earthwork excavation in foundations for all depths and removing the sheet piles after the work.
- 30) Placing precast girders in position on the piers by suspended type or under slung type launching system for Box segment & suitable Launching Girder for U-Girders. There will be nothing extra payable for cast in situ spans and no deductions will be made, either.
- 31) Stray current corrosion prevention measures (including extra rebars in various RCC/PSC structural members) to be applicable for earthing only.
- 32) Elastomeric bearings on BSRP spans up to 31m (based on detailed design) including bearing pedestals, seismic restrainers, shear keys.
- 33) POT/PTFE bearings on all 31m and above spans (based on detailed design) /continuous spans/special spans/sharp curves/cross overs including vertical stoppers. The choice of bearing whether POT/PTFE or neoprene will depend on accepted design by K-RIDE. The spherical bearings/ rocker, roller bearings or suitable type for special spans like open web girder, composite girder etc., to be used.
- 34) MS railing over Parapet as per tender drawing including epoxy painting on man holes. Integrated Parapet shall be provided with grooves with design approved by K-RIDE.
- 35) Providing and fixing G.I. brackets with suitable covering arrangement on both parapet walls of viaduct for electric cables & Signaling and Telecom cables as per tender drawing.
- 36) Crash Barrier for piers, portal legs etc., as per Tender drawing.
- 37) Insert/shear connectors/starter bars for Track plinth is within the scope of this contract. (Track plinth is not in the Scope of this work).
- 38) Expansion joint (omega/stripseal), sealant in the expansion joints as per concept plan as per specification.
- 39) Manholes with manhole covers made of Cast Iron on the deck with locking arrangement as per drawing, details will be furnished to successful bidder, suitable assumptions maybe made.
- 40) Earthing arrangement, drainage system, inserts for signaling masts in the parapets and other systems as may be required.

- 41) Arrangements for ground water recharging /Rain water harvesting systems in alternate span to cater all the piers. Bidder may assume suitably as per practices for bidding purpose. Drainage arrangement will be as per detailed design.
- 42) Cast in situ piers, portal beam, deck slab etc., Piers including Cantilever, Portal piers and Portal beams. Shape and appearance of Piers shall be as decided by K-RIDE from aesthetic point of view. Size shall be as per design requirement. Maximum eccentricity of alignment center line from the center line of pier is given in the GAD (Maximum 1.8m). Providing and laying grade M50 grade concrete, using 20mm maximum nominal size aggregates of reinforced cement concrete at all levels including the cost of cement, fine aggregates, coarse aggregates for Viaduct & piers of all size, shapes & heights (standard pier, portal pier & cantilever pier), pier head/Cap, shear key, portal beams, pier-arms, corbels, pier-ledge, diaphragms, pedestals, deck slabs over pre-cast I girders/steel girders and cross girders and stich concrete etc., including centering, shuttering, propping, staging, scaffolding, curing, necessary tools, plants, machinery and all related operations etc. using steel shuttering & steel props. Form work to be designed using of shutter vibrators & traffic on road and IR track is allowed during the work at all times. The Lumpsum price shall include cost of providing grooves, chamfers, mouldings, cut-outs, necessary fixtures, insert plates, sleeves for various purposes, shear connectors & providing of K-RIDE logo on every pier etc., complete as per drawings, specifications and as directed by the Engineer. The Lumpsum price shall also include preparation of construction joints as per specification and providing approved wire mesh/weld mesh at such locations as approved by Engineer or as shown in drawings. The Lumpsum price shall also include cost of using required dosage of admixture in concrete for obtaining required workability as per specification & approval of Engineer.

Note:

(i) No cold joints are permitted. However cold joint at the junction of "pile cap-pier" and at the top surface of the starter of pier (which is normally less than 2m height), cold joints are unavoidable. In that case old concrete surface should have adequate shear key depressions, reinforced dowels and a layer of concrete bonding compound. Concrete retarder compound may also have to be used at the concrete surface of starter pier above the pile cap. The Lumpsum price is inclusive of all above bonding agents/methods. However, if any additional cold joints are unavoidable due to the reasons not beyond the control of contractor, all above bonding measures shall be on account of the contractor.

(ii) The Lumpsum price is included for provision of HDPE pipes for pre-stressing system in piers.

- 43) Pre-cast piers and pier cap of viaduct: Rapid viaduct construction is in high demand in the project, due to strict requirements on work zone safety, traffic control during construction and working adjacent to railway track with OHE lines. The pre-cast piers and pier caps in viaduct portion required to be constructed for the viaduct structures up to 10m height (GL-RL=10m) and beyond 10m height, the cast in situ piers to be constructed.

The pre-cast piers are with segmental type of approximately 2m height segments with necessary pre-stressing arrangements connecting pre-cast pier cap, pre-cast pier segments, cast in situ starter and foundation. The foundation and the starter of pier with variable height (as per rail level) is with cast in situ concrete. The pier segments for the portion above starter to be cast with match casting at casting yard by using suitable short line /long line methods with required shutters, supporting arrangements, lifting, curing, grinding and transportation to site for erection. The cable ducts are to placed in foundation, starter, pier segments and pier cap. The epoxy treatment shall be done at the joints before placing the column pier

segments. After erecting the column pier segments, the pre-cast pier cap element is placed on top of column pier and the pre-stressing strands are inserted from the top of pier cap to foundation. Then the pre-stressing of all the cables is done in symmetrical fashion to the specified extent and then grouting will be done. The necessary safety precautions to be taken at casting yard, transportation and erection to adjacent to railway tracks. The suitable capacity cranes of adequate numbers required to be mobilized. The suitable supporting system to be provided for pre-stressing activity and its equipment's. The suitable supporting system for stability of erected pier segments to be provided at site as directed, if required. The doglegged staircases of adequate numbers to be provided for accessibility and inspection. The lumpsum price quoted are inclusive for the above work. The contractor has to design for the pre-cast piers and pier cap of viaduct up to 10m height (GL-RL=10m). The Employer will prefer pre-cast piers than cast in situ for the above heights.

- 44) Pre-Cast Concrete: Providing M50/M55 using 20mm maximum nominal size aggregates in concrete for Providing, casting, pre-stressing and curing precast Standard Pier Caps supporting superstructure, including shear key, pedestals, in-situ connection with pier. The item includes lifting the pier caps from the mould and shifting the same to the stacking yard. The item includes provision of holes for lifting and filling of holes after erection using non-shrink grout. Pre-stressing strand/system. The Lumpsum price shall include cost of using required dosage of admixture in concrete for obtaining required workability as per approval of Engineer and all related operations as required to complete the work as per drawing & specifications.

The cost shall be inclusive of the cost of centering, shuttering, scaffolding, providing cut-out where specified, curing arrangements as required, steam curing arrangement if deemed necessary, all handling etc. complete Cast in situ connection concrete is included in the Lumpsum price.

Note: All the Pier caps shall be checked for UPV (Ultra sonic pulse velocity) test, before dispatching from casting yard to site rates included in same item.

- 45) Pre-Cast: Providing M50/M55 Grade using 20mm maximum nominal size aggregates in concrete as per technical specifications, including the cost of cement, fine aggregates, coarse aggregates for casting, pre-stressing and curing of precast full span U-girder/ Box segments of all simply supported spans (straight or curved) in the casting yard including provision of shear connector for secondary pour concrete (rail plinths), additional bars for earthling, bars/ strands/ hooks for lifting of U-Girder/Box segments, cutting of bars/ strands/ hooks after transportation and sealing of lifting recess as specified in drawings, lifting the full spans from the mould and shifting the same to the stacking yard. The Lumpsum price shall be inclusive of the cost of centering, shuttering, scaffolding, providing cut-outs where specified, curing arrangements as required, steam curing arrangement if deemed necessary, all handling etc. complete. Pre-stressing strand. The Lumpsum price shall include cost of using required dosage of admixture in concrete for obtaining required workability as per approval of Engineer, anti-corrosive paints for lifting hooks, insert plates and exposed steel surfaces and all other related operations as required to complete the work as per drawings and specifications.

Note: All the segments shall be checked for UPV (Ultra sonic pulse velocity) test, before dispatching from casting yard to site rates included in same item.

- 46) Providing and laying M50 Grade reinforced cement concrete for precast PSC I-Girder, portal beams and pier-arm etc. (Post-Tensioned), simply supported standard/special spans of all types (straight or curved as per approved GAD), in the casting yard including provision of lifting the girders from the mould and shifting the same to the stacking yard. The Lumpsum price shall be inclusive of all infrastructure in the casting yard, gantry cranes, moulds, shuttering, casting beds, mobile cranes, stores, concrete batching

plant, testing labs, bulk heads, approved curing arrangements as required, all handling etc. complete, Teflon sheet at the end for placing on portal / arrangement for placing bearing as required and shown in drawing etc. complete. Pre-stressing system (Strands, Anchorages, sheathing, vent pipe, etc.). The Lumpsum price shall include cost of lifting hooks and using required dosage of admixture in concrete for obtaining required workability as per approval of Engineer.

Note: All the PSC precast I girders shall be checked for UPV (Ultra sonic pulse velocity) test, before dispatching from casting yard to site rates included in same item.

- 47) Pre-cast: Providing and laying M40 reinforced cement concrete using 20 mm graded aggregates for precast parapet, over Deck slab on both side of viaduct, including transition span (straight or curved), pre-cast drains, cable troughs, crash barriers etc., in the casting yard including provision of lifting the elements from the mould and shifting the same to the stacking yard. The Lumpsum price shall be inclusive of all infrastructures in the casting yard, gantry cranes, moulds, shuttering, casting beds, mobile cranes, stores, concrete batching plant, testing labs, approved curing arrangements as required. The Lumpsum price shall be inclusive of shuttering, scaffolding, special adjustable props for alignment of units, moulds, providing cut outs, required dosage of admixture for concrete. The Lumpsum price shall also inclusive of Loading, transporting precast parapets and other elements from casting yard to work site, launching and erection in position using gantry or crane complete with cast in situ stitch concrete of same grade. The Lumpsum price is inclusive of providing bolts & inserts for fixing hand rails. The Lumpsum price inclusive of providing K RIDE logo in parapet.
- 48) Providing and laying M35 grade concrete using 20mm maximum nominal size aggregates, reinforced cement concrete including the cost of cement, fine aggregates, coarse aggregates for Viaduct and all structures of all size, shape & heights for crash barrier, Median, entry structure columns, beam, plinth beam, staircase, lift walls, parapets, diaphragms, cross-girder, deck slab including centering, shuttering, propping, staging, scaffolding, curing, necessary tools, plants, machinery and all related operations etc. using steel shuttering & steel props. Form work to be designed in such a way that traffic on road/ IR track is allowed during the work at all times. The Lumpsum price shall include cost of providing grooves, chamfers, mouldings, cut-outs, necessary fixtures, insert plates, sleeves for various purposes, shear connectors etc. complete, specifications and as directed by the Engineer.
- 49) Transporting pre-cast Standard Pier Caps, I-Girders (PSC/RCC) from the casting yard / storage yard to the work site by trailer/ trucks, erection in position including temporary supports, erection equipment, lifting cranes, (Using Mobile crane having required capacity or 500MT or as per Site requirement), transporting etc, positioning and fixing on pier / positioning on bearings etc., for viaduct into completed structures conforming to required lines, grades and dimensions complete specifications.
- 50) Transporting pre-cast full spans U-Girder of simply supported span from the casting yard to work site by trailer/ trucks, erection in position including temporary supports, erection equipment, lifting cranes (using GOLIATH Crane in Split flyover/Critical location), transporting etc., and positioning on bearings etc. for viaduct into completed structures conforming to required lines, grades and dimensions complete as per drawings and specifications. (Note: The suitable launcher for U-girder launching fully automatic, capable of negotiating 200m radius curve and 4% gradient, speed of trolley carrying U-girder for launching with load 2km/hr. and without load 3km/hr. to be mobilized. The minimum of two numbers of LG for launching of U-girders with motorized bogies for handling and transportation of U-girders to be mobilized.)
- 51) Transportation of pre-cast box segments from casting yard to the site launching and erection in position. Loading, transporting precast segments from casting yard to work site, launching and erection in position

with launching girder, including erection and shifting of launching girder (Min two No of launching girders to be mobilized), temporary supports, launching girders, erection equipment's, transporting etc., applying epoxy based bonding agent on end surface of segments after dry matching including temporary prestressing required during its curing period and positioning on bearings etc. This same item shall be operated for any type of launching scheme adopted.

- 52) Conducting Load Testing of PSC U-Girder/ PSC Box girder/ I Girder of span length 22m/25m/28m/31m or more as per IRC SP51, including making all arrangement and conducting satisfactory Load testing on simply supported span constructed by pre-cast U-Girder/ Box Girder/ I Girder, erected in position on the piers at site. Arrangement for application of actual design serviceable vertical load of approx. 400 MT / 500 MT for simply supported U Girder/ Box segment span, 150 MT to 200 MT for I Girder spans or as directed by Engineer and arrangement for measurement of deflection at various salient points of the girder and submitting a report. The details of placement, position, increment of load on the simply supported span and installation of measurement devices etc. shall be as directed by the Engineer.
- 53) Provision for cutouts in the viaducts required for services in coordination with various system contractors.
- 54) Grooves & K-RIDE logo on the parapets and retaining walls to be provided.
- 55) Provision for MS/ RCC ladders / staircases complete along with railing for approaching the viaduct track bed from station platforms at both ends for up & down lines shall be inclusive.
- 56) For all spans, the design needs to be done by contractor and shall be approved by K-RIDE. The design of bearings, shear keys of seismic restrainers, hold down devices if required shall also be done by the contractor, which shall be approved by K-RIDE. All spans should have similar GI brackets for cables laying, walkway, parapets and railing arrangements. The approval of K-RIDE will be after proof checking of the same by the Engineer. The 18mm dia sleeves/ suitable sleeves for PVC pipes along with the attachment of insert plate will be in the scope of viaduct contractor. The lug for cable trays will not be in the scope of viaduct contractor.
- 57) On the parapets of viaducts, solar panels are planned to be fixed. The designer shall take into account in their design & all fixtures required to mount the panels shall be fixed by the contractor at his own cost. The bidder is supposed to provide 20mm finished dia holes with PVC liner (IS code) through the parapet thickness at a longitudinal spacing of 50 cm c/c in two layers of 60 cm apart (vertically). The loading of 50 Kg / m shall be considered on both the parapets while designing for bidding purpose.
- 58) The superstructure type at station location shall be U-girder/I-girder with slab. The span arrangement maybe 15-22 m approximately. Exact inter-distance shall be decided at detailed design stage in consultation with DDC of station buildings.
- 59) Maximum width of median including crash barrier shall be limited to 3m.
- 60) The track structures of Yeshwantpur station entry and exit lines over the station yard with tracks at different levels are in the scope of work.

NOTES: -

1. Pile foundation for viaduct shall be of minimum of 1000mm dia for the structure carrying single track and minimum 1200mm dia for structure carrying two tracks and above with Hydraulic rotary piling

rigs. The socketing work in hard rock to be done with Hydraulic Rig using diamond bits/core barrels / suitable cutting tools as first option in rock boring as directed by the Engineer. Open footing/raft foundation will be provided in case pile foundation is not required.

2. Earth filling of pile cap area to be done with proper compaction with Contractor's own good earth up to plinth level wherever required. For the area falling on the road, backfilling shall be done with sand only.
 3. It is obligatory for the contractor to provide a single pier structure in the viaduct in most of the locations. The portals to be provided as per the site conditions.
 4. Contractor has to maintain a minimum vertical clearance of 5.5 m from road surface to bottom of any structure and adequate Clearance at railway line crossings as per DBR/SOD.
 5. GAD is attached with this tender for the location of piers. However, it should be verified at site in such a way that they do not disturb the road geometry and also should not obstruct any water flow for which K-RIDE's decision shall be final.
- 61) There is possibility of some of the items not getting mentioned in the above list of works of viaduct. However, contractor has to execute the work as per the requirement of BSRP Railway line as per the latest and best engineering practices. Employer decision shall be final in this regard in case of dispute.

Some of the major utilities cannot be diverted. Contractor shall take into consideration the existence of these utilities and suggest the foundations at these locations accordingly.

- 62) The work is to be constructed and maintained as per relevant codes, specifications, Special Specifications and drawings and/or as directed by the Engineer. This is the part of Lumpsum quoted price.
- 63) The work content against the lump sum component of the work shall also include but not limited to the following:
- a) Obligatory pier locations are provided by the Employer to the Contractor. Utility identification at all the foundation locations will be done by the Contractor before starting piling/excavation and in case utility(s) is encountered or obligatory requirements of Local Authorities are to be met out, the Contractor would suggest the span configuration at such locations to save the utility(s) or to meet the obligatory requirements within the accepted price. The-shifting of the utility(ies) can be undertaken only in exceptional circumstances where in the opinion of the Engineer the other option is not available. Such utility shifting will be executed by K-RIDE directly. No claim as regard to delay in execution of the diversion can be entertained.
- 64) Providing & fixing UPVC pipes outside the piers and pier cap/pier arm/portal of OD 200mm, 6.00kg/Sq. cm working pressure, approved make with pipe fittings (door bend, door tee, plain tee, plain bend, end cap, reducer, collar, etc.), including cost of fixing arrangement, such as clamp, anchor fasteners etc. with concrete structure, cost of scaffolding, cost of all materials, labour charges, handling of materials, equipment and testing complete as per specifications.

- 65) Providing & fixing PVC pipes inside superstructure of OD 200mm, 6.00kg/Sq. cm working pressure, approved make with pipe fittings (door bend, door tee, plain tee, plain bend, end cap, reducer, collar, etc.), Including cost of fixing arrangement with concrete structure, cost of all materials, labour charges, handling of materials, equipment and testing complete as per specifications.
- 66) Providing TMT-500 D grade steel bar reinforcement (conforming to IS:1786, HYSD Fe 500 grade) at all heights & depth including straightening bars, cutting, bending, hooking binding with approved quality 18 gauge G.I binding wire, after placing in position tying, lapping and /or welding wherever required and anchoring to the adjoining members wherever necessary as per drawings (Laps , Hooks and Wastages shall not be measured and paid) including cost of all materials, bar bending charges, labour, lead & lifts etc., Complete as per specifications and as directed including welding involved towards stray current protection effects as per the system approved by Engineer. Note (i) Laps joints are permitted in Pile, Pile cap, raft, piers, pier caps, portals, pier-arm, I Girders girder and portal beams. However, mechanical couplers can be used only in pile cap and raft without extra cost for dia more than 25mm. (ii) For pile reinforcement, welding of lap joint is allowed. (iii) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (iv) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (v) Anti-corrosive treatment/ paints exposed steel surfaces and all other related operations as required to complete the work as per specifications.
- 67) Supplying, placing and threading uncoated stress-relieved low relaxation steel (HTS) conforming to IS :14268 (class -II) in already positioned pre-cast box segments (For post tensioning), pre-cast pier-arm, pier cap, precast I girder, portal beams in casting yard including Providing corrugated 2.3 mm (Tolerances + 0.3 mm) thick HDPE duct 107 mm ID (Tolerances + 1 mm), OD 124 mm (Tolerances + 1 mm) for 19K15 & 90 mm ID (Tolerances + 1 mm), OD 104 mm (Tolerances + 1 mm) for 12K15 with couplers & vent pipes, spacers, anchorages, stressing using 19K15 or 12K15 system or any other approved pre-stressing system and grouting as per approved methodology including water testing, epoxy protection of anchorages, related operations to complete the work, with all lead and lift and as per specifications. This item shall include Providing and fixing all Strands, Corrugated HDPE Duct (including blister portion) for Laying the Strands, Required Anchorages for live & dead end and at blister portion for future pre-stressing, stressing up to required level using all tools and equipment's & consumables. After stressing is completed, the voids in all ducts are to be grouted with non-shrink cement grout, and filling of all recess with concrete with adequate reinforcement as per drawing & specifications, all complete, as directed by the Engineer.
- 68) High Tensile Prestressing Steel (viaduct)
- (1) Supplying of uncoated stress-relieved low relaxation steel strands conforming to IS: 14268 (class-II), for pretension of precast full span U-girders (simply supported spans) including spacers, stressing of strands, protection of exposed cut-strands, anti-corrosive paints, HDPE debonding tubes at ends of strands if required, and all related operations to complete the work for viaduct. (i) Strands (ii) HDPE debonding tubes for prestressing strands (to be cut off flush to concrete after casting), epoxy-based sealing compound at edges of strand and epoxy putty to avoid slurry ingress during concreting. The quantity given is the net length of tubes without extra tube length required during construction. Lumpsum cost includes filling HDPE debonding tubes with grease as specified in ASTM.

- 69) Supply, fabrication, transportation and erection of fabricated steel girder work of Grade E450/B0 (as per Railway requirement) conforming to IS 2062-2011 (with all latest amendments) including painting, fully killed and fully normalized at appropriate location using various structural steel sections including MS plates, etc. as per approved QAP and drawings for composite girders including cutting, bending, drilling holes with necessary field rivets welding HSFG bolts tightened by Torque wrench as per drawings supply of necessary templates, etc. complete for fixing accessories such as bolts and nuts, etc. complete duly providing necessary scaffoldings arrangements, temporary staging and metalizing the girders in accordance with the Indian Railway bridge manual and any other incidental work as required with all leads and lifts, etc. complete and as directed.

Note:

- (i) In case of superstructure over flyover all steel girders with bracings together shall be launched using push and pull methodology/ suitable launching schemes including Crib Crane method, etc.,
- (ii) All labour, materials, tools and plants consumables such as welding rods, etc., by contractor.
- (iii) Metalizing treatment of all steel surfaces shall be done by spraying aluminium having 99.5% purity with a coating of 150 microns by minimum 2 passes.
- (iv) Painting of metalized steel sections shall be done as below.
 - a. First coat- Primer to IS: 5666
 - b. Second coat- Zinc chromium paint to IS: 104
 - c. Third & fourth coat- Aluminium paint to IS: 2339
- (v) The LS cost are inclusive of testing of all raw materials, shear connectors, HSFG bolts, nuts and welding, etc. including allowances for all types of wastages. (vi) The LS cost is inclusive of surface preparation, sand blasting, etc.
- (vi) The LS cost shall also include supplying and providing of detailed fabrication drawing based on the GFC drawings, required for all permanent and temporary structure and their approval from Engineer-In-charge prior to execution. (viii) The LS cost shall also include provision and installation of base plates, chequered plate for pathway, anchor bolts (measured in Tonnes, etc.) as per relevant drawings, specifications and directions of the Engineer.
- (vii) Using standard plate sections, rolled sections, tubular rolled sections, angles, channels, I section, T sections, C sections, H sections, hollow round/square/rectangle sections etc., welded and built.
- (viii) The launching scheme has to be submitted by the contractor using sufficient capacity cranes and get it approved by K RIDE. When girder is to be erected over existing flyover then each girder is to be launched with proper care and with proper frame to avoid toppling during launching. The girders so placed will be temporarily braced with bolts and nuts before freeing from the frame. (xi) The fabrication of the girder shall be done by RDSO approved agency/workshop.

- 70) Supply and fabrication of OPEN WEB GIRDER (OWG) as per RDSO drawing, as per BSRP /DBR, IRS/IS specification for fabrication of steel bridge girders., IRS B-1/2001, IRS Welded bridge code (as corrected up to date), using contractors supply of steel confirming to IS:2062 quality 'BO', grade E 450 from SAIL/TISCO/RINL/JSW complete. The work includes supply of steel, fillet or butt welding, post weld treatment, steel drifts, shop welding, shop riveting, HSFG Bolts, jigs, fixtures, testing of weld by NDT/radiography or any specified method. The work includes transportation of fabricated girder components from contractor's workshop to bridge site including loading and unloading with contractor's own labour, materials, tools, plants, machinery, scaffolding etc., with all lead, lift, ascent, descent, crossing obstruction etc., including all taxes, royalties etc., complete in all respects and as directed by the Engineer. NOTE: 1. Rolled sections would be confirming to IS:2062 quality 'BO' E 250, Fully killed and normalized. 2. 3. The LS price includes, preparation, submission and getting approval of fabrication (shop) drawings/schemes from railways by contractor, cutting, shaping, drilling holes, welding of components, welding consumables, all inspection and testing of raw materials, fabrication process and fabrication material, connections of all the types of ties, stiffeners, packing, diaphragm, HSFG. bolts, steel drifts, welding shop, rivets, templates, gigs, fixtures back up supports, accessories etc., and marking each member for site identification and transporting various components from contractor's fabrications yard/workshop to bridge site in packages bundles and other means with due care and safeguards, as described in the contract conditions and specifications and as directed/approved by engineer-in-charge including loading, unloading, sorting, member-wise systematic matching etc., complete with contractor's own labour, material, tools & plants including all lead, lift and taxes complete. 4. All works shall be carried out as per approved drawings, relevant codal provisions, technical specifications (corrected up to date) and as directed by the engineer-in-charge. 5. The girder components transported to the site shall be stacked at site properly as directed by engineer-in-charge and no extra payment will be made for the same. 6. The LS Price shall also include trial assembling in the shop yard or at site as directed by the engineer-in-charge, contractor has to arrange for laboratory testing of steel and submission of the results to the Railways. no extra payment will be made for this. 7. The contractor has to engage 3rd party as a consultant/inspection (approved by RDSO/RITES/ any other approved agency) for testing of the weld of the fabricated welded type girders, as required. 8. The LS price is inclusive of conducting of welding procedure specification sheet (WPSS) and procedure for qualification record (PQR) to qualify welder and welding procedures. 9. The LS price is inclusive of conducting laboratory tests on samples of steel materials and welds like physical and chemical tests as per IS respectively, as and when required. 10. The LS price is inclusive of conducting test on welds like Dye penetration test (DP), Magnetic particle test (MP) Ultrasonic test (UT) and Radiography test (RT) as required. 11. In case of Rolled steel section confirming to IS:2062 quality "B" or "C" are not available in market; Railway may permit use to steel confirming to IS 2062 quality "BR" on case-to-case basis by satisfying about non availability of quality "B" or "C". The metallization and painting are included in all steel superstructure.
- 71) Assembling and launching of fabricated OPEN WEB GIRDER, corrected up to date and alterations, riveting with contractors' rivets, HSFG bolts, welding wherever required with contractor's welding material. This item includes preparation and the approval of erection/assembly/launching scheme (contractor has to submit the same to K-RIDE for approval). it includes contractors' own cranes of sufficient capacity and boom length, steel trestles as per site conditions or floating barge of safe and adequate capacity or other manual/mechanical methods of erection and launching of truss members/girders. it also includes the work of battens, placings, ties, stiffeners, packing, diaphragms, T and F bolts, steel drift, field rivets, HSFG bolts, templates, jigs, fixtures, back up support accessories, temporary staging of CC cribs of sufficient quantity for flooring and camber jacks mechanical and hydraulic jacks steel wire ropes and winch crabs, launching Nose of steel for cantilever launching (if any), dead anchorages and any other suitable material such as small cranes for field assembly, shifting of leaves of steel girders from horizontal position to vertical position and vice versa, scaffolding, and air compressors welding plants, pneumatic tools and

mini workshop facilities etc., This also includes cost of material, fabrication, erection and dismantling of all temporary components like gap structure, tower, high tensile cables (including anchorages), truss strengthening members restraining devices such as sway ropes, restraining cables, counter weights, dead anchorages and other preliminary arrangements used for launching of truss members etc., to suit requirement as required for the work for which no extra payment shall be made. "The item also includes lowering and placing of the girder on bearing and its centring/alignment. all additional steel (over and above approved payable weight as per approved structural drawings) required for permanent/temporary strengthening for proper launching/erection of the girders shall be arranged by contractor at his own cost. Metalizing of Full fabricated components of through type for OPEN WEB GIRDER duly preparing surfaces by sand/grit blasting as per the specification of metalizing and sand/grit blasting (Metalizing thickness of minimum 115 microns with average thickness of 150 micron) and painting with one coat of each primer to IS:5666 (1970) followed by one coat of zinc chromatic primer to IS:104 (45micron) and two finishing coat of aluminium paint to IS 2339 (each of 35 micron) with contractor's materials, labour, tools and plants scaffolding etc., complete and as directed by the engineer-in-charge. Detailed procedure shall be followed as per additional special conditions and as per IRS B-1/2001.

- 72) Performing load test on OPEN WEB GIRDER as per design loading standard, including loading unloading the spans taking observation and all other activities and submission of results to engineer. The complete load test will be carried out as per scheme approved by K-RIDE. This test shall be conducted at the stage of commissioning of the bridge.
- 73) Fabricating, supplying and erecting in position BEARING as per approved drawing OWG span complete in all respect including transportation, loading, unloading with own labours, materials, fuels, equipment etc., testing of bearings for relevant tests to be arranged by the contractor and results to be submitted to Railways.

Note;

One set means all 4 bearings of one span i.e., two roller and two rockers bearing. work is to be done strictly in the presence of K RIDE's authorized representative. The Lumpsum Price is inclusive of anchor bolts, pins, drilling and grouting complete in all respects to correct specifications. The Lumpsum Price is inclusive of lead from manufacturer to the bridge site. The Lumpsum Price also includes greasing of knuckle and roller of free bearing and knuckle of fixed bearing by approved grease graphite as per IS:508-1987 and painting the bearings as per the schedule of painting girder.

- 74) Fabrication and supply of H-Beam sleepers with all fittings and fixtures as per RDSOs drawing (For open Web Girder/Major Bridge). (With up-to-date correction). Fabrication as per RDSO specification no.BS:45, Hot dip galvanizing as per IS:4759, spring washer as per K RIDE, suitable for axle loading standard and specifications there to complete as corrected up to date including supply and riveting of canted bearing plates. The Lumpsum Price shall be including of all cost of preparing and supplying H-beam (ISHB) from standard rolled section conforming to IS:2062 Grade including supplying and fixing of all required fittings and fixtures duly galvanized as per specification and transporting the sleepers from contractor's workshop to bridge site, including loading, unloading and stacking with all lead, lift, descent, ascent, crossing of obstruction, nallah, track etc., hanging/re-hanging and other incidental works etc.,
- 75) Design, manufacture, supply & installation of the approved expansion joint (Omega Seal) at the site at formation level under the supervision of manufacturer's representative as per specification and expected movement (25 to 50 mm) as mentioned in relevant drawings.

- 76) Design, manufacture, supply & installation of the approved expansion joint (Strip Seal) at the site at formation level under the supervision of manufacturer's representative as per specification and expected movement (25 to 50 mm) as mentioned in relevant drawings (wherever required).
- 77) Supply and fixing in position true in line & level, Elastomeric bearings of approved make, placing and fixing in location as per specification and as directed by the engineer.
- 78) Supplying to site and placing of POT Cum PTFE Bearings (Free POT bearing, Fixed POT bearing, Longitudinal guide POT bearing and Transverse guide POT bearings) and its components in position during casting of pier / pedestal and superstructure, including, grouting of holes for anchor bolts and underside of base plate with approved non-shrink cementitious grout as per specification. The forces and movements as per the design.
- 79) Fabrication & Supply of drainage spout hot dip galvanized of dimension 300mmx180mm with MS Flat 50mmx6mmx100mm long with gratings of MS Flat 25mmx6mm with spacing of 50mm c/c and MS pipe 122mm dia. verticals as per drawing including installation of the spout with all tools, plants, leads and lifts and in position in complete and as directed by the Engineer.

B. EARTHWORK IN EMBANKMENT AND CUTTING INCLUDING RETAINING WALL AND DRAINS:

- 1) Earthwork in embankment in cutting and filling, Major Bridges, Minor Bridges, ROB/RUB's, including side drains & allied works approach road work viz., Retaining wall, Sacrificial retaining wall, R E Wall, elimination of level crossings by constructing RUB's and construction of service roads at required locations.
- 2) Earthwork in formation and cuttings for the full length, laying of a blanket layer as per RDSO guidelines with suitable materials as approved by Engineer.
- 3) Earthwork shall be provided with contractor's own earth. The top width of embankment and cutting of BSRP lines and stabling lines will be as per GAD. The drainage arrangement between IR tracks and BSRP tracks at formation level, side drains at toe/ground level, drains at berm level, catch water drains/saucer drains are included in the scope of work.
- 4) The elimination of level crossings works between Ch: 5.700 Km and 10.575 Km has involved raising of embankment, construction of minor bridges, RUBs of full length for accommodating both BSRP and IR tracks and retaining walls, sacrificial walls and the work will have to be carried out in stages for continuing the IR traffic by diverting through the newly constructed formation. The contractor to work out the methodology suitably for stagewise construction for continuing the IR traffic without any hinderances and this aspect may be considered while quoting the Lumpsum Price. Nothing extra shall be payable on for phase wise construction. The 5 RUBs of IR need to be extended in BSRP tracks portion. The improvement of existing RUBs of IR with plastering, painting, pitching and lighting also to be carried out along with the new construction of RUB. The plastering, painting, lighting and electrification is required to be carried out in all 7 new RUBs for full length.
- 5) Earth Works For Formation: The details given in DBR shall be referred. As per Comprehensive guidelines and specifications for railway formation, specification no. RDSO/2020/GE: IRS-0004-2020. The Design of formation and specification for 25MT axle load to be referred. The IRS Codes shall be followed for minor Bridges, Major Bridges, ROB & RUB.

- 6) The retaining wall height varies from section to section and approximately 1m to 8m and for any variations nothing shall be paid extra.
- 7) Pre-cast: Providing and laying M40 reinforced cement concrete using 20 mm graded aggregates for precast parapet, pre-cast drains, cable troughs, crash barriers etc., in the casting yard including provision of lifting the elements from the mould and shifting the same to the stacking yard. The Lumpsum price shall be inclusive of all infrastructures in the casting yard, gantry cranes, moulds, shuttering, casting beds, mobile cranes, stores, concrete batching plant, testing labs, approved curing arrangements as required. The Lumpsum price shall be inclusive of shuttering, scaffolding, special adjustable props for alignment of units, moulds, providing cut outs, required dosage of admixture for concrete. The Lumpsum price shall also inclusive of Loading, transporting precast parapets and other elements from casting yard to work site, launching and erection in position using gantry or crane complete with cast in situ stitch concrete of same grade. The Lumpsum price is inclusive of providing bolts & inserts for fixing hand rails. The Lumpsum price inclusive of providing K RIDE logo in parapet.
- 8) Manufacture, provide and fixing concrete canvas i.e., concrete in impregnate fabric CC-5 or similar with 5mm thickness for wall reinforcement for embankment to resist seepage of water inside the structure as directed by Engineer. The concrete canvas i.e., concrete impregnate fabric CC-5 as per specifications must be laid in proper way with all required fixtures & fastening as complete job as per instructions and satisfaction of engineer in charge with contractors' own materials, labour, tool, lead, lift TNP etc.,
- 9) Earth work in filling with COE: Earthwork in embankment in making formation with contractors own earth of approved quality in specified layers not exceeding 200mm thickness from approved earth quarries outside railway limits in all soils with loading, unloading, all lead and lifts, rehandling, transportation, spreading in layers, compaction using vibratory compactors of adequate capacity, benching of slopes, sectioning to profile, clearing of debris/garbage/ vegetation/ shrubs etc., using contractor's vehicles, machinery, labour, consumables etc., on both sides of the bridge approaches to be compacted with plate vibrator. The lumpsum cost includes loading, unloading and disposal of surplus excavated material using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out. The contractor to ensure sprinkling of water over the road regularly to avoid the dust formation.
- 10) Earthwork in excavation by mechanical means (Hydraulic excavator) in cutting, in formation, trolley refuges, side drains, yard drains, catch water drains, etc. including leading usable cut spoils up to required lead and lifts and making formation in filling using the cut spoils, site clearances, setting out and demarcation, disposing off surplus unusable cut spoils as per directions of the engineer, and top and side dressing and compaction of cutting formation to provide final formation as per designed profile. The lumpsum cost includes loading, unloading and disposal of surplus excavated material using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out. The contractor to ensure sprinkling of water over the road regularly to avoid the dust formation.
- 11) Earthwork in excavation by mechanical means (Hydraulic excavator) in cutting, in formation, trolley refuges, side drains, yard drains, catch water drains, etc. to the designed profile including leading disposing off the surplus unusable cut spoils to outside of Railway limits as per directions of the engineer for hard rock requiring blasting, cutting in rock requiring controlled blasting. The lumpsum cost includes loading, unloading and disposal of surplus excavated material using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that

during transportation, the carried material does not spill out. The contractor to ensure sprinkling of water over the road regularly to avoid the dust formation.

- 12) Earthwork in excavation by mechanical means (Hydraulic excavator) in cutting, in formation, trolley refuges, side drains, yard drains, catch water drains, etc. to the designed profile including leading disposing off the surplus unusable cut spoils to outside of Railway limits by chiselling. The lumpsum cost includes loading, unloading and disposal of surplus excavated material using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out. The contractor to ensure sprinkling of water over the road regularly to avoid the dust formation.
- 13) Providing and laying blanketing materials of specifications as per RDSO guidelines using well graded granular material having $C_u > 7$, C_c between 1 and 3, fines (passing 75 microns) between 3% to 10%, minimum Soaked CBR value of 25 and compacted at 100% of MDD in layers of maximum 20 cm thickness in loose state using graders and compaction using vibratory compactors, top and side dressing to provide final formation as per designed profile. Specification No: RDSO/2020/GE: IRS-0004.
- 14) Turfing / planting, including all lead and lift, and watering as required until properly rooted in embankment and cutting. The turfing to be provided on slopes of the embankment and cutting for one side of BSRP slope and on both the sides of embankment and cutting between KM 5.700 to 10.575 KM. The turfing to be provided on the approach roads of RUB.
- 15) Providing and laying Jute Geo-Textile (JGT) in slopes of Railway embankment in accordance with RDSO's guidelines for application of Jute Geotextile in Railway embankments, cutting and hill slopes no. RDSO/2007/GE: G-0008 or its subsequent versions.
- 16) Supply, planting ornamental plants including mixing of good earth, sand saw dust and leaf mould watering with contractor's materials, transportation etc., with all lead and lift complete etc., and plant should be maintained for three months till after the completion of project and as directed by the Engineer-in-charge.
- 17) Construction of Trolley/Man Refuges in cutting as per K RIDE's drawing No. K RIDE/ BSRP/ TR /01/2021, including i) Earthwork in excavation for wall foundation ii) Levelling course with CC 1:3:6 mix iii) Fly ash brick/brick/stone masonry work in CM 1:5 iv) Casting and erection of precast RCC slabs/cast in situ RCC slabs with all lead and lifts and as directed by Engineer in charge (All labour, materials, consumables including cement and steel by contractor).
- 18) Fabrication and construction of Trolley/Man Refuges in high embankment using K RIDE's rails/ contractor's structural steel, including earthwork in excavation, erection of rail posts and RCC ballast retainers and RCC slabs as per K RIDE's drawing no. K RIDE / BSRP/ TR/02/ 2021, as directed by the Engineer in charge (All labour, materials, consumables, leads, lifts including cement and steel by contractor).
- 19) Providing safety barricading as per drawing. No. K RIDE/BSRP/SBAR/03/2021 with contractor's materials and labour including all leads and lifts complete as directed by Engineer in charge. (Size 100 mm x 100mm x 1650 mm RCC pole) including foundation work as per the drawing Note: 1. Casting of RCC pillars shall be carried out in nominated depot and submerged water curing. 2. The precast RCC posts shall be transported to duly handling carefully without causing any damage and erect it at nominated locations as per drawing duly ensuring safety of running trains.

- 20) Maintaining including watch & ward and repairs of the barricading provided as per above item no. including cost of all contractors' men, materials, tools and plants required in this regard.
- 21) Supplying, laying Non-woven Needle Punched and Mechanically or Thermally bonded type Geotextile for use as Separator/Filtration for Railway formation as per RDSO Specification No. RDSO/2018/GE: IRS-0004 - Part I made of Polypropylene / Polyethylene / Polyamide or combination thereof having apparent opening size of ≤ 85 microns and elongation at failure $> 50\%$ in both directions including transportation labour, lead & lift complete as directed by Engineer. On top of subgrade or prepared subgrade before laying blanketing layer with minimum strengths in Grab test, Trapezoidal Tear test and Puncture test of 700N, 250 N and 1800 N respectively. Below the ballast and above blanket layer with minimum strengths in Grab test, Trapezoidal Tear test and Puncture test of 1750N, 800 N and 5800 N respectively. (Geotextile one layer below blanket of 14.200 Km length of formation width and another layer below ballast of 4.00 Km length of formation width)
- 22) Geogrid to be used as reinforcement/ Stabilization for Railway formation as per RDSO specification No. **RDSO/2018/GE: IRS-0004 PART-III.** (The tentative length of Geogrid of 4Km of formation width is considered).
- a. **Material/Polymer:** Polypropylene
 - b. **Tensile strength at 2% strain.** For use below blanket in new line: 9KN/m X 9KN/m
 - c. **Strain at ultimate tensile strength:** 6-15%
 - d. **Aperture stability/Torsional Rigidity Modulus:** For use below blanket in new line as per ASTM-D7864-2015, Average Torsional Stiffness $\geq 0.40\text{N-m/deg}$
 - e. **Junction Efficiency:** ASTM-D7737-2015 minimum 90%.
 - f. **Durability Characteristics:**
 - i. Resistance to installation damage (% tensile strength at 2% strain):
ASTM-D5818-2018= 90%
 - ii. Resistance to chemical degradation (% Average ultimate rib tensile strength):
ASTM-D6213-2017=100%
 - iii. Resistance to U.V light weathering (% strength retained in breaking strength after 5000 Hrs. of exposer.:
ASTM-D435-2018= 95%
 - iv. Minimum retained ultimate tensile strength:
EN ISO- 13438-2004= 50% (Tested as per clause B.4.2 of EN:13250-2016, for 100 Year service life)
- 23) A layer of hot mix asphalt (as per design subject to minimum 3 inch) over the formation below the ballast at bridge approaches and junction points of ramps (approximate length of 3.35 Km of formation width) to be provided as per the following specification.

- 24) Providing and laying dense graded bituminous macadam using crushed aggregates of specified grading, premixed with VG30 grade bituminous binder and transporting the hot mix to work site, laying to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction in all respects complete as per specifications. Clause 505 of MORTH V revision. Using 40/60 TPH capacity H.M.P with sensor paver Gr-II with 4.5% VG-30 Bitumen.
- 25) The Geo-grid to be used below the blanket layer as a reinforcement/ Stabilization for Railway formation (Specification No: RDSO/2018/GE: IRS-0004- PART-3, Feb-2020 is given in technical specifications.
- 26) Supplying & placing of Mechanically Woven Double Twisted Hexagonal Shaped Wire Mesh Gabion Boxes of required sizes, Mesh Type 10cm x 12cm, Zn and PVC coated Mesh Wire dia.2.7/3.7mm (ID/OD), edges of meshes mechanically edged / selvedge with heavy coating for earth retaining structure temporarily.
- 27) Compaction of embankment slope using hydraulic vibratory plate slope vibratory plate compactor attached to Excavator by doing 2 or more passes as required to get firm and neat compacted slope of embankment as directed by Engineer. The item is inclusive of all men, materials, equipment, watering arrangement, fuel etc. complete.
- 28) Earth Works For Formation: The details given in DBR shall be referred. As per Comprehensive guidelines and specifications for railway formation, specification no. RDSO/2020/GE: IRS-0004-2020. The Design of formation and specification for 25MT axle load to be referred. The IRS Codes shall be followed for minor Bridges, Major Bridges, ROB & RUB.
- 29) Providing & laying plain cement concrete M35 grade using 20mm maximum nominal size aggregates, reinforced cement concrete using Portland slag cement (Directly from manufacture or blending of OPC+GGBS) for following concrete works: Open Foundation /stepped foundation /Raft, Combined Footing, Columns, Grade beam, monopile pedestals, U/G water tank and Structures of road widening works such as foundation, substructures and superstructures of culverts, retaining walls, return walls, precast/cast-in-situ culvert deck slabs, road median, drains, etc. including excavation for all depths from lowest ground level through existing water bound macadam road / bituminous road / concrete road /soil/murum/ hard rock /soft rock old structures below ground as encountered of all thicknesses ,dismantling other structures, dead utilities, dewatering, pumping and bailing out water, strutting and shoring, formwork, backfilling in foundation with good earth/quarry dust/sand watering, compacting with a vibratory plate compactor complete as per specifications. Note: The provision for electrical duct to be made in RUB box and concealed.
- 30) Providing & laying plain cement concrete M35 grade using 20mm maximum nominal size aggregates, reinforced cement concrete using Portland slag cement (Directly from manufacture or blending of OPC+GGBS) for following concrete works: Open Foundation /stepped foundation /Raft, Combined Footing, Columns, Grade beam, monopile pedestals, U/G water tank and Structures of road widening works such as foundation, substructures and superstructures of culverts, retaining walls, RE Wall foundations, return walls, precast/cast-in-situ culvert deck slabs, road median, drains, RUB etc. including excavation for all depths from lowest ground level through existing water bound macadam road / bituminous road / concrete road /soil/murum/ hard rock /soft rock old structures below ground as encountered of all thicknesses ,dismantling other structures, dead utilities, dewatering, pumping and bailing out water, strutting and shoring, formwork, backfilling in foundation with good earth/quarry dust/sand watering, compacting with a vibratory plate compactor complete as per specifications. The lumpsum cost includes loading, unloading and disposal of surplus excavated material using covered

trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out. The lumpsum rate shall include cost of using required dosage of admixture in concrete for obtaining required workability as per approval of Engineer, curing of concrete.

- 31) Levelling Course: Providing & laying plain cement concrete M15/M20 grade using 20mm maximum nominal size aggregates in open foundation, stepped foundation, combined footing, raft foundation, retaining walls, return walls, walls, U/G water tank, culverts, drains, slab on grade, tie beams, basements, levelling course or any other works as directed by the Engineer, etc. rate is inclusive of required dosage of admixture in concrete for obtaining required workability and as per specifications, approved drawings, laid in layers not exceeding 15cms thick layers, as per drawing including cost of all material, form work/shuttering, dewatering during concreting, vibrating, compacting, curing, hire charges of machinery, all lead and lift, loading, unloading, transporting, stacking, finishing the exposed faces etc., complete. Note: Skin reinforcement, if necessary, will have to be provided.
- 32) Providing Boulder backing behind wing wall, return wall, retaining wall with hand packed boulders & cobbles with smaller size boulders toward the back including all lead, lift, labour & other incidental charges as complete work in all respect.
- 33) Providing and laying of filter media consisting of granular materials of GW, GP, SW groups as per IS 1498-1970 in required profile behind boulder filling of abutments, wing walls / return walls etc., above bed level with all labour and material complete job as per drawing and technical specification of RDSO.
- 34) Supplying & laying of drainage composite for use behind abutments, wing walls, return walls and retaining in walls Geo composite drain (Vertical) as per Specification, with all material, labour, equipment, tools and plants, lead, lift etc. complete in all respects as per the direction of Engineer.
- 35) Providing and laying Pitching with stone boulders weighing not less than 35 kg each with the voids filled with cement sand mortar 1:4 on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per technical specifications.
- 36) Drilling holes up to required diameter or 32 MM diameter, providing Weep Holes in stone masonry/Plain/ Reinforced concrete abutment, wing wall, return wall with 100 mm AC pipe extending through the full width of the structure with slope of 1V;20H towards drawing force.
- 37) Providing cast in situ plaques for bridge foundations details of size 45x45x5 cm in cement concrete 1:2:4 mix using 20mm hard stone aggregate embedded in 30mm deep notch over abutment & piers, engraving the letters & figures with CM 1:3 and finished smooth.
- 38) Design of high bank/deep cutting slope based on slope stability analysis as specified by RDSO/theoretical methods, for railway cuttings/ embankment more than 6m in height/depth based on the material available in cutting/embankments, including collecting required number of soil samples and conducting required laboratory tests as per RDSO specifications so as to find out soil parameters required in slope stability analysis, working out design slope based on manual method/computer software including furnishing detailed calculations in a report form with contractor's men, material, machinery etc. and as directed by Engineer-in-charge.

Note: Recommended slopes designs shall be from reputed designers and shall include detailed calculations to be submitted in 3 copies.

- 39) Providing TMT-500 D grade steel bar reinforcement (conforming to IS:1786, HYSD Fe 500 grade) at all heights & depth including straightening bars, cutting, bending, hooking binding with approved quality 18 gauge G.I binding wire, after placing in position tying, lapping and /or welding wherever required and anchoring to the adjoining members wherever necessary as per drawings (Laps , Hooks and Wastages shall not be measured and paid) including cost of all materials, bar bending charges, labour, lead & lifts etc., Complete as per specifications and as directed including welding involved towards stray current protection effects as per the system approved by Engineer. Note (i) Laps joints are permitted in Pile, Pile cap, raft, piers, pier caps, portals, pier-arm, I Girders girder and portal beams. However, mechanical couplers can be used only in pile cap and raft without extra cost for dia more than 25mm. (ii) For pile reinforcement, welding of lap joint is allowed. (iii) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (iv) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (v) Anti-corrosive treatment/ paints exposed steel surfaces and all other related operations as required to complete the work as per specifications.

C. MINOR BRIDGES, MAJOR BRIDGES, RUB, ROB AND ROR:

- 1) Two ROBs 408 B & 410 A at km. 8/800-900 and at km. 8/100-200 respectively between Jalahalli and Chikkabanvara are proposed to be reconstructed as as Cable stay bridge / Suspension bridge for bridge no: 410A and as Cable stay bridge / Suspension bridge for bridge no:408B as part of this work including lighting arrangements for both the ROB's.
- 2) There are 53 no's (approximately) of minor bridges/ slab culverts of varying spans up to 8.4m, One Major Bridge, 12 number of RUB's, one number RUB in Nagavara station and one number RUB in Kanaka nagar station. (approximately) and one pre cast RCC box for accommodating one BSRP track at Ch: 20.590 Km below existing ROB (407 A) along with supporting the existing water pipe line including retaining wall.
- 3) Provision of foundation works for different structures i.e., track structure, Major bridges, Minor bridges etc. including piles (1000mm dia for the structure carrying single track and minimum 1200mm dia for structure carrying two tracks) and pile caps /open foundations / rafts for columns/ piers (wherever required) up to the minimum founding depths in accordance with the actual soil parameters as obtained from detailed sub-surface exploration as specified or directed. The Construction methodology is required to be approved by K-RIDE before carrying out the works. The founding level will be decided by Geotechnical Engineer/ Employer during construction.
- 4) Provision of Major bridges, Minor bridges, RCC abutments/piers, Pier caps/Bed blocks, bearings, as specified or as directed.
- 5) The elimination of level crossings works between Ch: 5.700 Km and 10.575 Km has involved raising of embankment, construction of minor bridges, RUBs of full length for accommodating both BSRP and IR tracks and retaining walls, sacrificial walls and the work will have to be carried out in stages for continuing the IR traffic by diverting through the newly constructed formation. The contractor to work out the methodology suitably for stagewise construction for continuing the IR traffic without any hinderances and this aspect may be considered while quoting the Lumpsum Price. Nothing extra shall be payable on for phase wise construction. The 5 RUBs of IR need to be extended in BSRP tracks portion. The improvement of existing RUBs of IR with plastering, painting, pitching and lighting also to be carried out

along with the new construction of RUB. The plastering, painting, lighting and electrification is required to be carried out in all 7 new RUBs for full length.

- 6) Provision of Composite/Open Web Girders for Obligatory or Railway Spans according to RDSO standards or any standards decided by K-RIDE.
- 7) The Standard Drawings of box culverts (25 MT loading) of RDSO for minor bridges may be referred and the tentative spans are given in the minor bridges list. The standard drawings of RDSO for major bridges & ROB may be referred. The standard RUB Drawings (Segmental Construction) as per IRS/RDSO may be referred, if available otherwise the same has to be designed as per IRS Codes/DBR. The IRS Codes shall be followed in-principle and the design criteria is based on IRS Codes viz. IRS-Bridge Rules, IRS Concrete Bridge Code & IRS Bridge Substructure & Foundation Code.
- 8) Supply fabrication and erection of OPEN WEB GIRDER (OWG) as per RDSO drawing, as per BSRP /DBR, IRS/IS specification for fabrication of steel bridge girders., IRS B-1/2001, IRS Welded bridge code (as corrected up to date), using contractors supply of steel conforming to IS:2062 quality 'BO', grade E 250 from SAIL/TISCO/RINL/JSW complete including load testing.
- 9) Pile caps / Open Foundations resting at any depth depending upon the site condition shall include excavation, leveling course, PCC, dewatering, sheet piling/soldier piling & wooden lagging, if required, Backfilling complete in all respects. Driving 'Z' section MS sheet piles by using 8mm to 10mm thickness, side by side in all kinds of soil mechanically using vibro hammer / suitable means/manually as per directions of Engineer-in-charge for earthwork excavation in foundations for all depths and removing the sheet piles after the work.
- 10) Providing & laying plain cement concrete M35 grade using 20mm maximum nominal size aggregates, pile foundations with socketing in weathered rock, soft rock, hard rock of any type and any depth if arising. The piling with temporary liners/permanent liners & socketing in soft rock/hard rock are included. The initial load test, routine load test, dynamic load test, lateral load test, pullout test, pile integrity test, cross hole sonic test, plate load test are included. The lumpsum cost also includes cutting/chipping of pile up to cut off level or up to good concrete and built up of pile up to required level. The lumpsum cost also includes loading, unloading and disposal of surplus excavated material along with pile heads using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out.
- 11) Elastomeric bearings based on detailed design including bearing pedestals, seismic restrainers, shear keys.
- 12) POT/PTFE bearings based on detailed. The choice of bearing whether POT/PTFE or neoprene will depend on accepted design by K-RIDE.
- 13) MS railing over Parapet as per tender drawing including epoxy painting on man holes. Integrated Parapet shall be provided with grooves with design approved by K-RIDE.
- 14) Expansion joint, sealant in the expansion joints as per concept plan as per specification.
- 15) Manholes with manhole covers made of Cast Iron on the deck with locking arrangement as per drawing, details will be furnished to successful bidder, suitable assumptions maybe made.

- 16) Earthing arrangement, drainage system, inserts for signaling masts in the parapets and other systems as may be required
- 17) Arrangements for ground water recharging /Rain water harvesting systems in alternate span to cater all the piers. Bidder may assume suitably as per practices for bidding purpose. Drainage arrangement will be as per detailed design.
- 18) Pre-cast: Providing and laying M40 reinforced cement concrete using 20 mm graded aggregates for precast parapet, pre-cast drains, cable troughs, crash barriers etc., in the casting yard including provision of lifting the elements from the mould and shifting the same to the stacking yard. The Lumpsum price shall be inclusive of all infrastructures in the casting yard, gantry cranes, moulds, shuttering, casting beds, mobile cranes, stores, concrete batching plant, testing labs, approved curing arrangements as required. The Lumpsum price shall be inclusive of shuttering, scaffolding, special adjustable props for alignment of units, moulds, providing cut outs, required dosage of admixture for concrete. The Lumpsum price shall also inclusive of Loading, transporting precast parapets and other elements from casting yard to work site, launching and erection in position using gantry or crane complete with cast in situ stitch concrete of same grade. The Lumpsum price is inclusive of providing bolts & inserts for fixing hand rails. The Lumpsum price inclusive of providing K RIDE logo in parapet.
- 19) The RCC boxes in Nagavara and Kanaka Nagar stations are in the scope of the work. The boxes of size 9.5x3.6m (inside size approximately) for station access and the barrel length is as per GAD/ site condition.
- 20) The Standard Drawings of box culverts (25 MT loading) of RDSO for minor bridges may be referred and the tentative spans are given in the minor bridges list. The standard drawings of RDSO for major bridges, ROR & ROB may be referred. The standard RUB Drawings (Segmental Construction) as per IRS/RDSO may be referred, if available otherwise the same has to be designed as per IRS Codes/DBR. The IRS Codes shall be followed in-principle and the design criteria is based on IRS Codes viz. IRS-Bridge Rules, IRS Concrete Bridge Code & IRS Bridge Substructure & Foundation Code.
- 21) Providing & laying plain cement concrete M35 grade using 20mm maximum nominal size aggregates, reinforced cement concrete using Portland slag cement (Directly from manufacture or blending of OPC+GGBS) for following concrete works: Pile cap, Open Foundation /stepped foundation /Raft, Combined Footing, Columns, Grade beam, monopile pedestals, U/G water tank and Structures of road widening works such as foundation, substructures and superstructures of culverts, retaining walls, return walls, precast/cast-in-situ culvert deck slabs, road median, drains, etc. including excavation for all depths from lowest ground level through existing water bound macadam road / bituminous road / concrete road /soil/murram/ hard rock /soft rock old structures below ground as encountered of all thicknesses ,dismantling other structures, dead utilities, dewatering, pumping and bailing out water, strutting and shoring, formwork, backfilling in foundation with good earth/quarry dust/sand watering, compacting with a vibratory plate compactor complete as per specifications. Note: The provision for electrical duct to be made in RUB box and concealed.
- 22) Providing & laying plain cement concrete M35 grade using 20mm maximum nominal size aggregates, reinforced cement concrete using Portland slag cement (Directly from manufacture or blending of OPC+GGBS) for following concrete works: Open Foundation /stepped foundation /Raft, Combined Footing, Columns, Grade beam, monopile pedestals, U/G water tank and Structures of road widening works such as foundation, substructures and superstructures of culverts, retaining walls, RE Wall foundations, return walls, precast/cast-in-situ culvert deck slabs, road median, drains, RUB etc. including excavation for all depths from lowest ground level through existing water bound macadam road /

bituminous road / concrete road /soil/murum/ hard rock /soft rock old structures below ground as encountered of all thicknesses ,dismantling other structures, dead utilities, dewatering, pumping and bailing out water, strutting and shoring, formwork, backfilling in foundation with good earth/quarry dust/sand watering, compacting with a vibratory plate compactor complete as per specifications. The lumpsum cost includes loading, unloading and disposal of surplus excavated material using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out. The lumpsum rate shall include cost of using required dosage of admixture in concrete for obtaining required workability as per approval of Engineer, curing of concrete.

- 23) Levelling Course: Providing & laying plain cement concrete M15/M20 grade using 20mm maximum nominal size aggregates in pile foundation, open foundation, stepped foundation, combined footing, raft foundation, retaining walls, return walls, walls, U/G water tank, culverts, drains, slab on grade, tie beams, basements, levelling course or any other works as directed by the Engineer, etc. rate is inclusive of required dosage of admixture in concrete for obtaining required workability and as per specifications, approved drawings, laid in layers not exceeding 15cms thick layers, as per drawing including cost of all material, form work/ shuttering, dewatering during concreting, vibrating, compacting, curing, hire charges of machinery, all lead and lift, loading, unloading, transporting, stacking, finishing the exposed faces etc., complete. Note: Skin reinforcement, if necessary, will have to be provided.
- 24) Providing Boulder backing behind wing wall, return wall, retaining wall with hand packed boulders & cobbles with smaller size boulders toward the back including all lead, lift, labour & other incidental charges as complete work in all respect.
- 25) Providing and laying of filter media consisting of granular materials of GW, GP, SW groups as per IS 1498-1970 in required profile behind boulder filling of abutments, wing walls / return walls etc., above bed level with all labour and material complete job as per drawing and technical specification of RDSO.
- 26) Supplying & laying of drainage composite for use behind abutments, wing walls, return walls and retaining in walls Geo composite drain (Vertical) as per Specification, with all material, labour, equipment, tools and plants, lead, lift etc. complete in all respects as per the direction of Engineer.
- 27) Providing and laying Pitching with stone boulders weighing not less than 35 kg each with the voids filled with cement sand mortar 1:4 on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per technical specifications.
- 28) Drilling holes up to required diameter or 32 MM diameter, providing Weep Holes in stone masonry/Plain/ Reinforced concrete abutment, wing wall, return wall with 100 mm AC pipe extending through the full width of the structure with slope of 1V;20H towards drawing force.
- 29) Providing cast in situ plaques for bridge foundations details of size 45x45x5 cm in cement concrete 1:2:4 mix using 20mm hard stone aggregate embedded in 30mm deep notch over abutment & piers, engraving the letters & figures with CM 1:3 and finished smooth.
- 30) Preparation and submission of detailed GAD, design and drawing for minor bridges for MBG loading including all details such as new bridge location with respect to existing bridge, methodology of construction without disturbing the existing bridge structure, drawing and detailed design shall be based on hydraulic data, geotechnic investigations, etc., collected and paid under separate item. Drawing and design shall be as per SWR's standard specifications and schedule of dimensions. (Design calculation for the bridges are to be submitted and approval obtained from Railway's competent authority.

- 31) Providing TMT-500 D grade steel bar reinforcement (conforming to IS:1786, HYSD Fe 500 grade) at all heights & depth including straightening bars, cutting, bending, hooking binding with approved quality 18 gauge G.I binding wire, after placing in position tying, lapping and /or welding wherever required and anchoring to the adjoining members wherever necessary as per drawings (Laps , Hooks and Wastages shall not be measured and paid) including cost of all materials, bar bending charges, labour, lead & lifts etc., Complete as per specifications and as directed including welding involved towards stray current protection effects as per the system approved by Engineer. Note (i) Laps joints are permitted in Pile, Pile cap, raft, piers, pier caps, portals, pier-arm, I Girders girder and portal beams. However, mechanical couplers can be used only in pile cap and raft without extra cost for dia more than 25mm. (ii) For pile reinforcement, welding of lap joint is allowed. (iii) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (iv) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (v) Anti-corrosive treatment/ paints exposed steel surfaces and all other related operations as required to complete the work as per specifications.
- 32) Supply and fabrication of OPEN WEB GIRDER (OWG) as per RDSO drawing, as per BSRP /DBR, IRS/IS specification for fabrication of steel bridge girders., IRS B-1/2001, IRS Welded bridge code (as corrected up to date), using contractors supply of steel confirming to IS:2062 quality 'BO', grade E 450 from SAIL/TISCO/RINL/JSW complete. The work includes supply of steel, fillet or butt welding, post weld treatment, steel drifts, shop welding, shop riveting, HSFG Bolts, jigs, fixtures, testing of weld by NDT/radiography or any specified method. The work includes transportation of fabricated girder components from contractor's workshop to bridge site including loading and unloading with contractor's own labour, materials, tools, plants, machinery, scaffolding etc., with all lead, lift, ascent, descent, crossing obstruction etc., including all taxes, royalties etc., complete in all respects and as directed by the Engineer. NOTE: 1. Rolled sections would be confirming to IS:2062 quality 'BO' E 250, Fully killed and normalized. 2. 3. The LS price includes, preparation, submission and getting approval of fabrication (shop) drawings/schemes from railways by contractor, cutting, shaping, drilling holes, welding of components, welding consumables, all inspection and testing of raw materials, fabrication process and fabrication material, connections of all the types of ties, stiffeners, packing, diaphragm, HSFG. bolts, steel drifts, welding shop, rivets, templates, gigs, fixtures back up supports, accessories etc., and marking each member for site identification and transporting various components from contractor's fabrications yard/workshop to bridge site in packages bundles and other means with due care and safeguards, as described in the contract conditions and specifications and as directed/approved by engineer-in-charge including loading, unloading, sorting, member-wise systematic matching etc., complete with contractor's own labour, material, tools & plants including all lead, lift and taxes complete. 4. All works shall be carried out as per approved drawings, relevant codal provisions, technical specifications (corrected up to date) and as directed by the engineer-in-charge. 5. The girder components transported to the site shall be stacked at site properly as directed by engineer-in-charge and no extra payment will be made for the same. 6. The LS Price shall also include trial assembling in the shop yard or at site as directed by the engineer-in-charge, contractor has to arrange for laboratory testing of steel and submission of the results to the Railways. no extra payment will be made for this. 7. The contractor has to engage 3rd party as a consultant/inspection (approved by RDSO/RITES/ any other approved agency) for testing of the weld of the fabricated welded type girders, as required. 8. The LS price is inclusive of conducting of welding procedure specification sheet (WPSS) and procedure for qualification record (PQR) to qualify welder and welding procedures. 9. The LS price is inclusive of conducting laboratory tests on samples of steel materials and welds like physical and chemical tests as per IS respectively, as and when required. 10. The LS price is inclusive of conducting test on welds like Dye penetration test (DP), Magnetic particle test

(MP) Ultrasonic test (UT) and Radiography test (RT) as required. 11. In case of Rolled steel section confirming to IS:2062 quality "B" or "C" are not available in market; Railway may permit use to steel confirming to IS 2062 quality "BR" on case-to-case basis by satisfying about non availability of quality "B" or "C". The metallization and painting are included in all steel superstructure.

- 33) Assembling and launching of fabricated OPEN WEB GIRDER, corrected up to date and alterations, riveting with contractors' rivets, HSFG bolts, welding wherever required with contractor's welding material. This item includes preparation and the approval of erection/assembly/launching scheme (contractor has to submit the same to K-RIDE for approval). it includes contractors' own cranes of sufficient capacity and boom length, steel trestles as per site conditions or floating barge of safe and adequate capacity or other manual/mechanical methods of erection and launching of truss members/girders. it also includes the work of battens, placings, ties, stiffeners, packing, diaphragms, T and F bolts, steel drift, field rivets, HSFG bolts, templates, jigs, fixtures, back up support accessories, temporary staging of CC cribs of sufficient quantity for flooring and camber jacks mechanical and hydraulic jacks steel wire ropes and winch crabs, launching Nose of steel for cantilever launching (if any), dead anchorages and any other suitable material such as small cranes for field assembly, shifting of leaves of steel girders from horizontal position to vertical position and vice versa, scaffolding, and air compressors welding plants, pneumatic tools and mini workshop facilities etc., This also includes cost of material, fabrication, erection and dismantling of all temporary components like gap structure, tower, high tensile cables (including anchorages), truss strengthening members restraining devices such as sway ropes, restraining cables, counter weights, dead anchorages and other preliminary arrangements used for launching of truss members etc., to suit requirement as required for the work for which no extra payment shall be made. "The item also includes lowering and placing of the girder on bearing and its centring/alignment. all additional steel (over and above approved payable weight as per approved structural drawings) required for permanent/temporary strengthening for proper launching/erection of the girders shall be arranged by contractor at his own cost. Metalizing of Full fabricated components of through type for OPEN WEB GIRDER duly preparing surfaces by sand/grit blasting as per the specification of metalizing and sand/grit blasting (Metalizing thickness of minimum 115 microns with average thickness of 150 micron) and painting with one coat of each primer to IS:5666 (1970) followed by one coat of zinc chromatic primer to IS:104 (45micron) and two finishing coat of aluminum paint to IS 2339 (each of 35 micron) with contractor's materials, labour, tools and plants scaffolding etc., complete and as directed by the engineer-in-charge. Detailed procedure shall be followed as per additional special conditions and as per IRS B-1/2001.
- 34) Performing load test on OPEN WEB GIRDER as per design loading standard, including loading unloading the spans taking observation and all other activities and submission of results to engineer. The complete load test will be carried out as per scheme approved by K-RIDE. This test shall be conducted at the stage of commissioning of the bridge.
- 35) Fabricating, supplying and erecting in position BEARING as per approved drawing OWG span complete in all respect including transportation, loading, unloading with own labours, materials, fuels, equipment etc., testing of bearings for relevant tests to be arranged by the contractor and results to be submitted to Railways.

Note: One set means all 4 bearings of one span i.e., two roller and two rockers bearing. work is to be done strictly in the presence of K RIDE's authorized representative. The Lumpsum Price is inclusive of anchor bolts, pins, drilling and grouting complete in all respects to correct specifications. The Lumpsum Price is inclusive of lead from manufacturer to the bridge site. The Lumpsum Price also includes greasing of knuckle and roller of free bearing and knuckle of fixed bearing by approved grease graphite as per IS:508-1987 and painting the bearings as per the schedule of painting girder.

- 36) Fabrication and supply of H-Beam sleepers with all fittings and fixtures as per RDSOs drawing (For open Web Girder/Major Bridge). (With up-to-date correction). Fabrication as per RDSO specification no.BS:45, Hot dip galvanizing as per IS:4759, spring washer as per K RIDE, suitable for axle loading standard and specifications there to complete as corrected up to date including supply and riveting of canted bearing plates. The Lumpsum Price shall be including of all cost of preparing and supplying H-beam (ISHB) from standard rolled section conforming to IS:2062 Grade including supplying and fixing of all required fittings and fixtures duly galvanized as per specification and transporting the sleepers from contractor's workshop to bridge site, including loading, unloading and stacking with all lead, lift, descent, ascent, crossing of obstruction, nallah, track etc., hanging/re-hanging and other incidental works etc.,
- 37) Design, manufacture, supply & installation of the approved expansion joint (Omega Seal) at the site at formation level under the supervision of manufacturer's representative as per specification and expected movement (25 to 50 mm) as mentioned in relevant drawings.
- 38) Design, manufacture, supply & installation of the approved expansion joint (Strip Seal) at the site at formation level under the supervision of manufacturer's representative as per specification and expected movement (25 to 50 mm) as mentioned in relevant drawings (wherever required).
- 39) Supply and fixing in position true in line & level, Elastomeric bearings of approved make, placing and fixing in location as per specification and as directed by the engineer.
- 40) Supplying to site and placing of POT Cum PTFE Bearings (Free POT bearing, Fixed POT bearing, Longitudinal guide POT bearing and Transverse guide POT bearings) and its components in position during casting of pier / pedestal and superstructure, including, grouting of holes for anchor bolts and underside of base plate with approved non-shrink cementitious grout as per specification. The forces and movements as per the design.
- 41) Fabrication & Supply of drainage spout hot dip galvanized of dimension 300mmx180mm with MS Flat 50mmx6mmx100mm long with gratings of MS Flat 25mmx6mm with spacing of 50mm c/c and MS pipe 122mm dia. verticals as per drawing including installation of the spout with all tools, plants, leads and lifts and in position in complete and as directed by the Engineer.
- 42) Waterproofing for RCC Boxes of Minor Bridges & RUBs.
- 43) RE Wall for ROBs: Casting and laying in position M35 grade pre cast concrete facia panel / pre cast CC blocks with architectural finish of suitable size and thickness as per approved drawing but not less than minimum 140mm thick excluding architectural finishes and including (Earth work excavation for foundation. providing initial levelling pad (minimum 150mm thick and having suitable width] as necessary, using M15 grade plain cement concrete. PCC shall be taken separately as per site situation) necessary connection arrangements for soil reinforcement necessary coping beam, neoprene sponge joint material between reinforced soil wall facia and crash barriers, the backfill material and the drainage material shall be separated using permeable non-woven geotextile or synthetic geo grid and approved design, necessary anchor rods at the toe of wall for laying first pre cast CC blocks. Including all materials, labour, lead and lift, hire charges of all plants, machinery, lead lifts, loading. unloading etc., complete as per MORTH specifications and as directed by Engineer-in-charge.
- 44) For ROBs: Supplying and providing well graded crushed aggregate as drainage bay backing along the retaining wall/ RE Wall including supplying and providing perforated drainage pipes connecting to the

nearby drain including compaction of the filled material at a specified layer thickness as per MORTH specifications and as directed by Engineer-in-charge.

- 45) For ROBs: Filling coarse grained soil/earth in embankment for road approach as per approved reinforcement earth technology behind the precast fascia panels with contractors supply of back fill materials which shall be free from organic or other deleterious materials and shall conform to the mechanical and physio chemical requirements including mechanical compaction as per MORTH specifications and as directed by Engineer-in-charge.
- 46) For ROBs: Supplying Assembling joining and laying of soil reinforcing elements connecting with precast modular blocks, including connecting arrangements, all materials, labour, lead and lift. hire charges of machinery, complete. complying MORTH specifications and as directed by Engineer-in-charge.

D. MISCELLANEOUS: INCLUDING ROADS, BARRICADING, QUALITY, INTERFACE WORK, CASTING YARD, SITE OFFICE AND EQUIPMENT'S, PERSONAL ETC.,

- 1) The work of road widening, side drains & other allied works, and construction of service roads at required locations.
- 2) Design, construction & maintenance of at least 3 nos of Site /project offices for Engineer and an office at each of the casting yards for Site Engineers.
- 3) Before carrying out the work at site, necessary permissions from various local agencies / Railway authorities / road authorities such as SWR, BBMP, PWD, Traffic Police etc., shall be required to be obtained by the contractor. The Employer shall assist only by way of issue of necessary support letters.
- 4) The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct and indicative, but the contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any error or omission in the levels or strata turning out different during execution from what is shown on the drawings. The contractor should validate the L- Section and horizontal alignment using MX Rail/ applicable latest software.
- 5) The preliminary works such as site clearance, barricading, trial trenching etc., wherever required, shall be taken up simultaneously along with mobilization activities.
- 6) All temporary traffic diversion works, which will be required for the smooth flow of running traffic in order to carry out the works without any interruption including all safety precautions, signage, barricading, emergency lighting, traffic marshals, look-out men / watchmen etc.; shall be carried out. The permanent traffic diversions shall be carried out in consultation with traffic police. Contractor has to provide traffic diversion proposals, traffic marshals, cones, traffic diversion boards etc., as desired by Traffic Police. The text for painting will be given by K-RIDE.
- 7) The road works and allied works shall be carried out in co-ordination with BBMP as per MoRTH, specifications. On award of work, the contractor has to start the road work along and complete the same.
- 8) Tree cutting and disposal (or) transplanted along the alignment for cutting/disposal/transplantation to be arranged by Contractor at her/his own cost. The applicable permits/ permissions for felling of trees /

transplantation shall be arranged by Employer. The tree cutting and disposal to be arranged by contractor and the Lumpsum amount is inclusive for same. The cut trees are the property of contractor.

- 9) Demolition of RCC framed structures, Brick masonry buildings including basement etc. as existing at site without making damage to adjacent structures, utilities and taking away and disposing all the debris and released materials etc. Shall be done by contractor. The Lumpsum amount is inclusive of the same.
- 10) Geotechnical investigation bores as per the design requirement at alternate pier locations of viaduct, in major bridges, minor bridges, ROB's, RUBs required to be carried out as directed by Engineer/Employer. The Lumpsum amount is inclusive of the same. The GTI report of tender document is based on preliminary investigation and it is tentative and for reference only. In case of any variation in Geotechnical details during construction, no claim (Financial or otherwise) shall be entertained by Employer.
- 11) The work of conducting survey and fixing bench marks and alignment markers before the start of any work on this tender is included in the works covered by the present Tender. The Contractor to fix alignment reference points at regular intervals all along the alignment. The contractor along with the Engineer should verify the details of these alignment pillars.
- 12) The Design and drawings is the responsibility of contractor. GFC drawing requirement shall be planned by the contractor based on his three-month rolling programme and the GFC drawings to be issued accordingly.
- 13) The Contractor shall make the detailed traffic diversion plans in consultation with Bengaluru Traffic Police. The work is to be executed with proper liaison with Bengaluru Traffic Police. Necessary assistance will be given by K-RIDE. The scheme should be such that minimum of two lane of traffic on each direction of the road should be available for the smooth flow of traffic. The Contractor should inspect the site.
- 14) Necessary permanent diversion of utility services (Charted utilities) shall be undertaken by Employer through separate agency/contract. The Contractor will liaise with the Utility Diversion contractor for carrying out the work expeditiously wherever required so that works at particular locations are not delayed. In case he comes across any utilities (Uncharted utilities) also he will liaise with the agency concerned for necessary diversion; the cost of diversion shall be paid by Employer under the relevant item of Schedule-C of Price schedule. Contractor shall provide any temporary support for the utilities if called for, but at no extra cost.
- 15) The contractor shall provide temporary barricade during construction at site, work areas (i.e., Construction Depot, store, site office, casting yard etc.) and locations where road vehicles / pedestrians are moving, along the at-grade section/ Viaduct / Stations / Construction sites as directed by Engineer. The temporary barricade of 2m height along the alignment near to railway boundary/acquisition line and road footpath and the railway standard barricade along the alignment in between IR tracks and BSRP tracks are included in the scope of work for At-grade section. In elevated section, the temporary barricade of 2m height along the alignment near to railway boundary/acquisition line, road footpath and in between IR and BSRP tracks are included in the scope of work.

In case the Railway land/ Govt. land is arranged adjacent to near to railway track for casting of U-Girders & for initial erection and launching activity temporarily, the necessary land rent /lease charges shall be levied as per Railway guidelines / Govt. norms /K-RIDE norms and the same will deducted from RA bills of the Contractor.

- 16) In addition, the Contractor shall be required to carry out various interface works as per interfacing requirements.
- 17) **Casting Yard:** The land for setting up two numbers of casting yard and stacking yard as required shall be arranged by the Contractor at his own cost. However, assistance can be provided by K-RIDE by giving recommendatory letters etc., to the concerned authorities. The desirable area for each casting yard shall be 7 to 8 acres. No land for casting yard or offices/laboratories etc., will be provided by the employer.
- 18) **The contractor shall carry out**
 - a. Setting up of fully fledged site laboratory as per the requirements.
 - b. Setting up concrete batching & mixing plant.
 - c. Contractor's site office setup.
 - d. Casting yard with complete facilities.
- 19) The Contractor shall implement a Project Quality Management Plan in accordance with ISO-9001 "Quality System – Model for Quality Assurance in Design/Development, Production, Installation and Servicing" or any other system as approved by Engineer to ensure that all materials, workmanship, plant and equipment supplied and work done under the contract meets the requirements of the contract.
- 20) The Contractor shall provide the Key Personnel as per Appendix-04.
- 21) The Contractor shall provide the Key Plant and Equipment's as per Appendix-05.
- 22) The Contractor shall provide the Office accommodation and equipment's as per Appendix-06.
- 23) Design & Construction Contractor has to design the Viaduct ensuring 5.5m vertical clearance above the existing roadlevel & adequate vertical clearance at railways crossings as per DBR & SOD.
- 24) Whole length has to be designed for double line Broad gauge track. System is planned with end evacuation and 25 KV AC OHE traction
- 25) Siding line, stabling lines, pocket tracks and cross overs as shown in the GAD are in the scope of work.
- 26) GAD is attached with this tender for the location of piers. However, it should be verified at site in such a way that they do not disturb the road geometry and also should not obstruct any water flow for which K-RIDE's decision shall be final.
- 27) Construction of Trolley/Man Refuges.
- 28) Deployment of adequate manpower (Traffic marshals and watchmen) for management of traffic at intersection, junctions, traffic diversions etc.
- 29) Boring of 150 mm dia. (confirmatory bore holes), in all types of soil at alternate Pier locations (Locations to be decided by the Engineer) of viaduct, Major bridges, Minor bridges, ROB's and RUB's up to 3m in hard rock or 30m boring whichever is earlier and collecting core samples in rock for determination of core recovery, RQD and carrying out compressive strength test on rock samples.

- 30) Carrying out GPR survey to locate underground utilities up to 6m depth with a corridor width of 5mx5m grid as directed by Engineer.
- 31) Diagonal Cross trenching works for identifying underground utility at every Pier location, Minor Bridge, Major Bridge, ROBs, RUBs, Retaining Wall location, sacrificial wall etc., to the required length, width and depth, which includes excavation in all types of soil, hard soil, rock, footpath, bitumen road, concrete road, medians etc. cutting of all types road surfaces and backfilling the same with available excavated earth.
- 32) Road works and maintenance.
- 33) **Traffic Management:** The Contractor shall make the detailed traffic diversion plans in consultation with Bangalore Traffic Police. The work is to be executed with proper liaison with Bangalore Traffic Police.
- 34) Design and Drawings shall be developed in conformity with the Specifications and Standards set forth in Schedules and Employers Requirement and scope of work. The Contractor shall appoint a proof check consultant (the "Proof Consultant")
- 35) Wherever night working is carried out by Contractor, temporary lighting arrangements as per approved layout shall be provided, installed, maintained for the duration of the contract.
- 36) The contractor shall at all-time carryout the work on either side of existing IR tracks/ highway/road/service road in a manner creating least interference to the flow of traffic. The contractor shall take prior approval of the Engineer and traffic police regarding traffic arrangements and diversion of traffic during construction.
- 37) The contractor shall take suitable and sufficient measures as per SHE manual for working at height.
- 38) Instrumentation of bridges and viaduct: The viaduct and iconic bridges have unique design and therefore their actual performance in field is required to be monitored with respect to the design parameters. The settlement of foundation, deflection of super structure, deformations, loss of camber etc., to be monitored by the contractor and the cost is included in the lumpsum price.

The measurement of deflection in bridge decks using electrolevel beam sensors, measurement of bearing loads/ design loads using load cells of suitable load capacity, measurement of movement of bridge deck using displacement transducer, measurement of force in pre-stressing cable using load cells, measurement of deflection of RE panels, Pore pressure behind RE panels, measurement of earth pressure below foundation, measurement of temperature inside concrete, measurement of stress in concrete by using strain gauges are included. The read out unites, cables, junction boxes, selector switches, splicing switch are included. All cables and junction boxes shall be concealed inside the structure.

- a. Standard span of PSC super structure along with foundations and special spans: One span per two (2) Km in viaduct section.
- b. ROB's: Two numbers

Instrumentation shall be carried out for the following.

SI NO	Description	Instrument	Quantity		Remarks
1	Measurement of deflection in Bridge Decks.	Electro-level beam sensors Make: ACE/SOIL	4x3	12	EL beam sensors will be supplied with 3m beam, suitable for Data logging.
2	Measurement of bearing Load (Capacity should be 10% more than design load).	Load cell of capacity up to 300 MT (Approximate). Make: ACE/HB/AIMIL	4x4	16	Load Cell will be supplied with top/bottom load distribution plates and with 3 m cable, suitable for Data logging.
3	Measurement of movement of Bridge Deck.	Displacement transducer Make: AIMIL	4x4	16	Along with mounting fixtures, suitable for data logging.
4	Measurement of force in prestressing cables (All the cables in one span to be provided with load cells).	Load cell for prestressing (380MT), with 200 mm ID Make: ACE/SISGEO	4x16	64	Load Cell will be supplied with top/bottom load distribution plates and with 3 m cable, suitable for Data logging.
5	Measurement of Deflection of reinforced earth panels.	In-Place Inclinometer-depth: 7m Make: SISGEO/ACE		2	MEMS based sensors. Suitable for data logging.
6	Measurement of Pore pressure behind reinforced earth panels / retaining wall	Pore pressure meter. Make: AIMIL		2	Suitable for Data logging.
7	Measurement of earth pressure behind reinforced earth panels / retaining wall.	Earth pressure cell Make: AIMIL		4	Suitable for Data logging.
8	Measurement of earth pressure below open foundation.	Earth pressure cell Make: AIMIL	2x4	8	Suitable for Data logging
10	Measurement of pile loads	Load cell of 500 MT, with top & bottom load distribution plates. Make: ACE/ H. Berger	6x2x4	48	Load Cell will be supplied with top/bottom load distribution plates and with 3 m cable, suitable for Data logging
11	Measurement of temperature inside concrete across the depth.	Temperature sensors Make: AIMIL		18	Suitable for Data logging.
12	Measurement of stress in the concrete.	Strain gauge Make: ACE/SISGEO		6	Suitable for data logging.
Accessories Required for the above Sensor's					
1	Measurement of VW Sensors	VW Readout Unit		2	Supplied with data transfer cable and a carrying case.

2	Junction Boxes	10-Way Junction boxes Make : AIMIL		70	40-Core armored cable will be taken out from Junction boxes.
3	Cable splicing kits	Made of PVC Make: AIMIL		700	
4	Cable Sealing adhesive	(Hardener & Softener)		500	
Data Logging System with in-built GSM /GPRS Modem					
05 (a)	Data acquisition & logging	Data Logger		2	Data logger is with in-built GSM/GPRS modem for data transmission.
		Make: Data Taker , TS Australia			
		Model: DT-85GM			
		No-of Channels: 890			
(b)	Channel expander/multi Plexer	Model: CEM-20		16	
		Make: Data Taker, TFS, Australia			
(c)	Data management software	ARMS Aimil web based data management software	L.S / per month	12	Aimil provide services through Amazon Cloud Server -24X7.
Multi-core Cables Requirement for above sensors for On-line monitoring					
(a)	4-Core armored JF Cable	4-Core armored PJF cable			Rate only, as per actual site requirements.
(b)	6/8-Core armored	6/8-Core armored PJF Cable			DO
(c)	12-Core armored	12-Core armored PJF cable			DO
(d)	20-Core armored	20-Core armored PJF cable			DO
(e)	40-Core armored	40-Core armored PJF Cable			DO

Note: All sensors are supplied with 1m, 4-Core shielded cable, except VW Load Cells (which are supplied with 3m cable).

- I. Scope Includes procurement, installation, embedment during concreting, keeping record of readings and Interpretation of results during the defect liability period, submission of monthly reports & training of Client's personnel in handling of the instruments and interpretation of results and maintenance. Reputed agency approved by K-Ride shall carry out the instrumentation work.
- II. Instrumentation agency should have local registered office in Bangalore, with experienced service/Installation personnel's employed on their rolls.

- III. Instrumentation Agency should also in house data Analysis and interpretation division with experienced Geo-technical personnel on his Pay-rolls.
 - IV. Instrumentation Agency should have own NABL Accredited laboratory.
 - V. Instrumentation Agency should have an annual turn over of 65 Crores or more.
 - VI. All Instrumentation shall be of vibrating wire OR MEMS type and shall be suitable for installation all appropriate locations. The measuring range and accuracy of the instruments shall be furnished by the supplier. The schematic diagram for the entire instrumentation shall be submitted and got approved before commencement of the work
 - VII. Readout Units: The recording Instrument shall be suitable for taking direct readings (output) from the sensors through digital indicator cum amplifier which shall also work on any range of voltage, frequency and on batteries. Its main feature is that with the help of a special switch provided on it, every parameter is displayed on the digital display as required to be read. The read out set shall be rugged and shall be a portable type, so as to easily carry it within the battery limit. It shall not be unduly heavy. The system should also provide for excitation to the meters.
 - VIII. Cables: The cable shall be used to connect each instrument (sensor) to the respective junction boxes. The cable shall contain appropriate number or conductors, suitable tor embedment. Each cable shall contain colour coded standard Insulated conductors within a rugged jacket. Damaged or short cable shall be made good by replacing al appropriate time. The cable Installation material should satisfy standards regarding resistance etc. The cable supplied should be teak proof and withstand the load developed during construction, leakage and entry of water into cables. The cable of each type of instrument shall be suitable for transmitting the signal from the transducer (instrument) to the readout unit. The number of wires, diameter installation, braiding, sheathing etc. of the cable shall be appropriate to the requirement of each.
 - IX. Junction boxes: The cable from each of the instruments embedded shall be taken for connection to the junction boxes. These will have provision for connection of input leads from various transducers. The cables I conductor shall be suitably connected to the selector switch so that by using the selector switch, readings of all the instruments connected to the particular junction box in the sequence of the connections can be taken by a mere operation of the selector switch connected to the readout unit.
 - X. The junction boxes with selector switch, shall be suitable for mounting at appropriate location preferably under via duct having least disturbance.
 - XI. Splicing kits: The splicing kits are required for jointing the lead cables In case of extension of length of cable or for other reasons. It shall consist of cables splices, tools and other accessories and chemicals required for achieving water tight and teak proof joint.
 - XII. All cables and junction boxes shall be concealed inside the structure.
- 39) Plantation of Bougainvillea plant works along the median of viaduct: The debris, waste materials of the median to be cleared and disposed properly. Supply of site garden soil well sieved, farm yard manure, mixing garden soil with manure thoroughly well, watering, planting required plant species, lawn grass,

shrubs has directed and maintenance of the plants for six months with watering, trimming of branches etc., complete are included in the scope of work.

- 40) Pre-cast: Providing and laying M40 reinforced cement concrete using 20 mm graded aggregates for precast parapet, over Deck slab on both side of viaduct, including transition span (straight or curved), pre-cast drains, cable troughs, crash barriers etc., in the casting yard including provision of lifting the elements from the mould and shifting the same to the stacking yard. The Lumpsum price shall be inclusive of all infrastructures in the casting yard, gantry cranes, moulds, shuttering, casting beds, mobile cranes, stores, concrete batching plant, testing labs, approved curing arrangements as required. The Lumpsum price shall be inclusive of shuttering, scaffolding, special adjustable props for alignment of units, moulds, providing cut outs, required dosage of admixture for concrete. The Lumpsum price shall also inclusive of Loading, transporting precast parapets and other elements from casting yard to work site, launching and erection in position using gantry or crane complete with cast in situ stitch concrete of same grade. The Lumpsum price is inclusive of providing bolts & inserts for fixing hand rails. The Lumpsum price inclusive of providing K RIDE logo in parapet.
- 41) The scope of work shall include detailed survey of the alignment for the viaduct, soil investigation at each pier, fixing an optimized span configuration avoiding shifting of utilities. K-RIDE has got done the investigations of utilities falling in the alignment. However, this information will only be indicative and EPC Contractor is advised to carry out his own investigation and collect necessary site details while quoting his rates. K-RIDE will not be responsible for any cost implications due to any hindrance due to utilities falling in the alignment. Chartered Utilities shifting will be responsibility of K-RIDE, however the chainage/drawings of major utilities which may not be possible to be shifted and the bidder is advised to consider the same while planning/locating the foundation. Utilities maybe verified by bidder physically at site. The bidder should ensure that no foundation of pier is located throughout the length in such locations. If at all, bidder is required to take up diversion of unchartered utilities, payment towards the same shall be made as per Schedule-C of Price Schedule.
- 42) Demolition/dismantling of RCC framed /steel structures/buildings, masonry buildings, station platforms, compound walls, drains, Toe walls & retaining walls including basement, ground and above floors as existing at site on the alignment of viaduct without making damages to the adjacent structures, utilities, etc. including disposing off retrieved materials out of site of work. Demolition /dismantling of road, footpath, kerb stone, central verge, boundary wall, etc. Tenderer must visit the site and ascertain actual magnitude of quantum of work involved for footpaths, kerb stone, central verge, boundary wall, etc. and nothing shall be payable on this account. Retrieved materials obtained from demolition/dismantling shall be property of the Owner. Acquiring and evacuation of the properties will be done by the concerned authorities.
- 43) The contractor has to get necessary permission/ NOC from the railway, road, police and other concerned regulatory authorities for blocking services and working in such locations. K-RIDE will Facilitate for getting them permission from concerned regulatory authorities for working in such locations.
- 44) Bidders may study traffic pattern all along the Corridor & may be optimized at the detailed design stage taking into consideration of traffic requirement and width of road.
- 45) Disposal of surplus materials including excavation spoils etc. to the dumping site approved by the engineer, irrespective of lead and lift(ascent/descents).
- 46) Siding line, stabling lines, pocket tracks and cross overs as shown in the GAD are in the scope of work.

- 47) Nallah diversions and drain diversions are in the scope of work.
- 48) Site clearance and dismantling of obstructions etc., before commencement of work as specified or as directed;
- 49) True and proper setting out and layout of the Works, bench marks and provision of all necessary labour, instruments and appliances in connection therewith as specified or as directed;
- 50) Electric traction & Signaling & Telecom structures themselves are excluded from the scope of the work, but civil works required for fixing the structures including strengthening if required and providing inserts/similar arrangements etc. are included. These shall be finalized and provided in co-ordination with the Traction/Signaling/Telecom Contractor and the Engineer. The necessary coordination with system contractors and Engineer shall form a part of the work.
- 51) Conducting load test on piles as per BIS-2911- Part IV and on girders as per IRC-SP-37. Conducting load test on completed span as per the choice of the Engineer.
- 52) All aspects of quality assurance, including testing of materials and other components of the work, as specified or as directed. The payment shall be included in lump sum price.
- 53) The Contractor has to ensure cleanliness of the roads and footpaths by deploying man power for the same. The Contractor shall have to ensure proper brooming, cleaning and washing of roads and footpaths at regular intervals or as and when required or directed throughout the entire stretch till the currency of the contract including disposal of sewage. Regular interval implies that Roads and Foot-paths should be maintained in clean condition throughout. Nothing extra shall be payable on this account.
- 54) Day to day cleaning of worksite throughout the execution period.
- 55) Clearing of site and handing over of all the Works, as specified or as directed.
- 56) Maintenance of the completed Work during the period as specified. Contractor has to do maintenance during the defect liability period. If any damage occur due to third party, then liability will not remain with the tenderer of this work.;
- 57) Submission of completion (i.e., 'As-Built') drawings and other related documents as specified;
- 58) Preparing detailed designs, general drawings and working drawings for various components of the works and obtaining approval in respect thereof from the Engineer, inclusive of incorporation of all modifications, alterations, changes, etc. that may be required to be carried as directed.
- 59) Barricading: The contractor shall have to provide boundary wall/ barricading as per drawing to be approved by Engineer at all the land to be used for Construction Depot, store, site office and casting yard. The barricading of same are included in lumpsum quoted price except the barricading required for traffic diversion purpose. Other requirements of Safety, Health & Environment as specified in condition of contract in SHE manual is included in Lumpsum quoted price.
- 60) Results of sub-surface investigations conducted at project site are enclosed with the tender document. This information about the soil and sub-soil water conditions is being made to the contractor in good faith and the contractor shall have to obtain the details of investigation independently. No claim whatsoever on account of any discrepancy in the sub surface conditions that may be actually encountered at the time

of execution work and those given in these tender documents shall be admissible to the contractor under any circumstances.

- 61) Maintenance of existing roads, service roads, footpaths, etc. along the alignment of viaduct during the entire contract period is included in Lump sum quoted price. Construction of temporary road as required for diversion/widening to facilitate the movement of traffic is also included in the lump sum quoted price of Schedule 'A' head 'G' (General). Dismantling of any existing roads/ footpaths etc for temporary diversion/widening and construction of temporary footpaths, diversion/widening for traffic diversion and its regular maintenance for entire contract period is included in Lump sum quoted price of Schedule 'A' head diversion/widening of roads, footpaths during entire contract period including extended period in a satisfactory condition as directed by the-Engineer-in-Charge. 'G' (General). Thus, all the repairs, maintenance, upkeep of existing roads, temporary is included in Lump sum quoted price of Schedule 'A' head 'G' (General). The cost of final carpeting of the roads or new road construction before handing over the roads to road owning agency is included in the lumpsum cost. Also, final restoration of footpaths as per modified specifications and drawings as per requirements of the road owning agency also included in the lumpsum cost. Contractor has to maintain a minimum clearance of 5.5 m from road surface to bottom of structure. It is mandatory requirement, if needed the Rail level shall be suitably amended with K-RIDE's approval.
- 62) Deployment of adequate traffic guards, supervisor, in-charge and provision of traffic signboards, hand delineators, portable signals etc. and as accepted by K-RIDE & the cost of the same are included in the lumpsum price.
- 63) Any other item of work as may be required to be carried out for completing the construction of elevated structure & At-Grade Section of specified length including all necessary interfaces works with station and system-wide Contractors in all respects in accordance with the provisions of the Contract and/or to ensure the structural stability and safety during and after construction Works to be performed shall also include all general works preparatory to the construction and works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and meaning of the drawings adopted and technical specifications, to best Engineering standards and orders that may be issued by the Engineer from time to time, compliance by the agency with all Conditions of Contract, supply of all materials, apparatus, plants, equipment, tools, fuel, water, strutting, timbering, transport, offices, stores, workshop, staff, labour and the provision of proper and sufficient protective works, diversion, temporary fencing, lighting and watching required for the safety of the public and protection of works on adjoining land; first -aid equipment, sanitary accommodation for the staff and workmen, effecting and maintenance of all insurances, the payment of all wages, salaries, fees, royalties, duties or the other charges arising out of the execution of works and the regular clearance of rubbish, clearing of garbage/debris/pile heads from the embankment, clearing up, leaving the site perfect and tidy on completion.
- 64) Providing & laying plain cement concrete M40 grade using 20mm maximum nominal size aggregates, reinforced cement concrete using Portland slag cement (Directly from manufacture or blending of OPC+GGBS) for following concrete works: Pile cap, Open Foundation /stepped foundation /Raft, Combined Footing, Columns, Grade beam, monopile pedestals, U/G water tank and Structures of road widening works such as foundation, substructures and superstructures of culverts, retaining walls, return walls, precast/cast-in-situ culvert deck slabs, road median, drains, etc. including excavation for all depths from lowest ground level through existing water bound macadam road / bituminous road / concrete road /soil/murum/ hard rock /soft rock old structures below ground as encountered of all thicknesses ,dismantling other structures, dead utilities, dewatering, pumping and bailing out water, strutting and

shoring, formwork, backfilling in foundation with good earth/quarry dust/sand watering, compacting with a vibratory plate compactor complete as per specifications. Note: The provision for electrical duct to be made in RUB box and concealed.

- 65) Providing & laying plain cement concrete M40 grade using 20mm maximum nominal size aggregates, reinforced cement concrete using Portland slag cement (Directly from manufacture or blending of OPC+GGBS) for following concrete works: Open Foundation /stepped foundation /Raft, Combined Footing, Columns, Grade beam, monopile pedestals, U/G water tank and Structures of road widening works such as foundation, substructures and superstructures of culverts, retaining walls, RE Wall foundations, return walls, precast/cast-in-situ culvert deck slabs, road median, drains, RUB etc. including excavation for all depths from lowest ground level through existing water bound macadam road / bituminous road / concrete road /soil/murrum/ hard rock /soft rock old structures below ground as encountered of all thicknesses ,dismantling other structures, dead utilities, dewatering, pumping and bailing out water, strutting and shoring, formwork, backfilling in foundation with good earth/quarry dust/sand watering, compacting with a vibratory plate compactor complete as per specifications. The lumpsum cost includes loading, unloading and disposal of surplus excavated material using covered trucks to contractor's dumping yard with all leads and lifts and as directed by the Engineer. The contractor has to ensure that during transportation, the carried material does not spill out. The lumpsum rate shall include cost of using required dosage of admixture in concrete for obtaining required workability as per approval of Engineer, curing of concrete.
- 66) Levelling Course: Providing & laying plain cement concrete M15/M20 grade using 20mm maximum nominal size aggregates in pile foundation, open foundation, stepped foundation, combined footing, raft foundation, retaining walls, return walls, walls, U/G water tank, culverts, drains, slab on grade, tie beams, basements, levelling course or any other works as directed by the Engineer, etc. rate is inclusive of required dosage of admixture in concrete for obtaining required workability and as per specifications, approved drawings, laid in layers not exceeding 15cms thick layers, as per drawing including cost of all material, form work/ shuttering, dewatering during concreting, vibrating, compacting, curing, hire charges of machinery, all lead and lift, loading, unloading, transporting, stacking, finishing the exposed faces etc., complete. Note: Skin reinforcement, if necessary, will have to be provided.
- 67) Providing Boulder backing behind wing wall, return wall, retaining wall with hand packed boulders & cobbles with smaller size boulders toward the back including all lead, lift, labour & other incidental charges as complete work in all respect.
- 68) Providing and laying of filter media consisting of granular materials of GW, GP, SW groups as per IS 1498-1970 in required profile behind boulder filling of abutments, wing walls / return walls etc., above bed level with all labour and material complete job as per drawing and technical specification of RDSO.
- 69) Supplying & laying of drainage composite for use behind abutments, wing walls, return walls and retaining in walls Geo composite drain (Vertical) as per Specification, with all material, labour, equipment, tools and plants, lead, lift etc. complete in all respects as per the direction of Engineer.
- 70) Providing and laying Pitching with stone boulders weighing not less than 35 kg each with the voids filled with cement sand mortar 1:4 on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per technical specifications.
- 71) Drilling holes up to required diameter or 32 MM diameter, providing Weep Holes in stone masonry/Plain/ Reinforced concrete abutment, wing wall, return wall with 100 mm AC pipe extending through the full width of the structure with slope of 1V;20H towards drawing force.

72) Providing cast in situ plaques for bridge foundations details of size 45x45x5 cm in cement concrete 1:2:4 mix using 20mm hard stone aggregate embedded in 30mm deep notch over abutment & piers, engraving the letters & figures with CM 1:3 and finished smooth.

73) Excavation along the alignment of signaling cable OFC/Power cable carefully and exposing the same without any damage, and excavating the new trench along the railway alignment or along the alignment as specified by the railway Engineer-in-charge, laying of removed cable, filling up all complete with sand and laying a layer of brick with, contractor's own material, tools and plants etc. as directed by the Engineer-in-charge.

NOTE: In case the cable is damaged cost of restoration and the cost of cable will be recovered from the contractor. The decision of the railway with regard the cost to be recovered will be final.

74) Providing TMT-500 D grade steel bar reinforcement (conforming to IS:1786, HYSD Fe 500 grade) at all heights & depth including straightening bars, cutting, bending, hooking binding with approved quality 18 gauge G.I binding wire, after placing in position tying, lapping and /or welding wherever required and anchoring to the adjoining members wherever necessary as per drawings (Laps, Hooks and Wastages shall not be measured and paid) including cost of all materials, bar bending charges, labour, lead & lifts etc., Complete as per specifications and as directed including welding involved towards stray current protection effects as per the system approved by Engineer. Note (i) Laps joints are permitted in Pile, Pile cap, raft, piers, pier caps, portals, pier-arm, I Girders girder and portal beams. However, mechanical couplers can be used only in pile cap and raft without extra cost for dia more than 25mm. (ii) For pile reinforcement, welding of lap joint is allowed. (iii) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (iv) The LS cost quoted should cover all welding and providing mechanical couplers, all types of laps, standard laps, spacer bar, U-bar, chair, bend deduction as required and nothing extra is payable on this account. (v) Anti-corrosive treatment/ paints exposed steel surfaces and all other related operations as required to complete the work as per specifications.

75) Supplying, Providing, fabricating, transporting and erecting structural steel for hand railing/ inspection platform, inspection ladder, height gauges and other structural members for viaduct/ OHE including transition span consisting of tubular and rolled sections profiled to require shape, insert plates, steel plates, sheets, strips and flats for structural and general engineering purposes/ inserts for cable tray, inserts for OHE/ signalling mast, steel brackets over parapet for fixing signalling post, earthing arrangement consisting of flats/plates with welded hold fast, welded headed nuts, internal threaded sleeve, studs in the form of U bars (grade 8.8), bolts (class 4.6) etc., with welded hold fasts for walk-way, earth terminal plates, insert plates with welded hold-fast, internal threaded sleeves including MS bolts Confirming to IS 3757:1985 (Reaffirmed:2008)&IS 4000:1992 (reaffirmed:2013)(Code of practice for high strength bolts in steel structures)tightened by Torque wrench and primer coat and aluminium paint as per specification and drawing, with all lead and lifts and as per the directions of engineer. The LS cost shall also include required surface preparation (sand blasting). Painting of metalized steel sections shall be done as below.

a. First coat- Primer to IS: 5666

b. Second coat- Zinc chromium paint to IS: 104

c. Third & fourth coat- Aluminium paint to IS: 2339

d. structural steel confirming IS: 226

76) During the contract period including the extended contract period till the final completion of the work, the contractor shall provide Surveying by establishing DGPS control points and TBMs, marking of alignment and pier locations, vertical & horizontal clearances for the elevated section including modifications, if any, as per drawings. No extra amount will be paid to re-do or to re-establish any of the survey points. The control points are to be fixed using DGPS double frequency and the accuracy of 1 in 50,000 or better are to be assured.

77) Providing temporary barricade of 2m height of plain MS sheet 16 Gauge fixed with steel frame as per drawing, painting (including primer of approved quality) with synthetic enamel paint of approved colour, quality and brand, writing lettering and logo of K RIDE including maintenance of the same duly cleaning the same on fortnightly basis and painting if required, arrangement for blinker lights on barricades during night as per requirement and as per the instruction of the engineer. Barricading should be rugged and fixed/anchored in ground firmly during the construction, barricading has to be kept continuously. Nothing extra will be paid for dismantling and re-erecting the barricades at a different location. The barricades have to be relocated as the work progresses and as directed by Engineer.

Note: (i) Barricades on either side shall be measured individually.

(ii) Once barricade has been provided and work started, removal of barricade is not permitted till completion of pile, pile cap, pier and pier caps, portal beams, segment (U-Girder/BOX segments) erection, I girder erection, till completion of construction. (iii) While erecting barricade, the bottom gap between barricade and road/ground should be plugged with cement concrete from inside.

(iv) There should be minimum openings at the end of barricade to allow access of trucks / lorries and machine to site work area. (v) Adequate blinking lights on barricade during night time must be ensured. The cost of this item should include provision for power pack / Generator set etc. so as to ensure the blinking of lights in night time as long as barricades are in position at the work spot.

(vi) After completion of the entire work, the barricades shall be the property of the contractor.

78) Deployment of adequate manpower (Traffic marshals) for management of traffic at intersection, junctions, traffic diversions etc. at various levels to the complete satisfaction of local traffic police and as directed by engineer. Note: The traffic marshals should be familiar with traffic rules and regulations.

79) Supply of caution watchman at locations where caution orders is imposed and at all work sites near the IR track at the rate of one caution watchman per 8 hours shift round the clock with necessary three cell electrical torch, banner flags, hand flags etc. to be on continuous vigil and to exhibit necessary signals to the trains for their passage over the caution spot as directed by the engineer in charge.

80) Felling trees of girth (measured at a height of 1m above ground level) including lead and stacking of material.

81) Boring of 150 mm dia. (confirmatory bore holes), in all types of soil at alternate Pier locations (Locations to be decided by the Engineer) and major bridges, minor bridges, RUB, ROB up to 3m in hard rock or 30m boring whichever is earlier and collecting core samples in rock for determination of core recovery, RQD and carrying out compressive strength test on rock samples. The Lumpsum Price inclusive of boring in soil, conducting SPT and collecting samples at 3m depth intervals and submitting bore log reports with soil classifications / SPT, Drilling 3m in hard rock with double barrel core for obtaining samples for testing of

core recovery, RQD and compressive strength as per standard practice, Preparation and submission of report containing core recovery, RQD, Compressive strength at Hard Rock Locations with all lead and lifts and as per the directives of Engineer. The Lumpsum Price also includes refilling and reinstating surface and disposing off surplus materials.

- 82) Submitting colour photographs of the works as directed by the engineer at intervals as instructed by the engineer. One set shall comprise of 25 photographs in 3 copies each of size not less than 225mm x 175mm each in album form, apart from 3 soft copies of all photographs on DVD. The photographs chosen should cover important activities of the work.
- 83) Supply of drone digital video in suitable means of 180 minutes duration comprising one master copy and two extra copies duly edited titled showing the progress of works and methodology and at interval as directed by the engineer. One set consists of one master copy and two extra copies.
- 84) Carrying out GPR survey to locate underground utilities up to 6m depth with a corridor width of 5mx5m grid as directed by Engineer. The Lumpsum Price should include preparation of report and drawings both in soft and hard copy.
- 85) Diagonal Cross trenching works for identifying underground utility at every Pier location, Minor Bridge, Major Bridge, ROBs, RUBs, Retaining Wall location, sacrificial wall etc., to the required length, width and depth, which includes excavation in all types of soil, hard soil, rock, footpath, bitumen road, concrete road, medians etc. cutting of all types road surfaces and backfilling the same with available excavated earth. The Lumpsum Price includes surveying and taking coordinates of the existing utility and submitting the reports (hard & soft copy) of the same as per the directions of the Engineer.

ROAD WORKS:

- 86) Direction and Place identification signs up to 0.9 sqm size board as per IRC:67.
- 87) Portable barricades in construction Zone: Installation of steel portable barricade with horizontal rail 300mm wide, 2.5m in length fitted on a 'A' frame made with 45x45x5mm angle iron section, 1.5m in height, horizontal rail painted (2 coats) with yellow and white stripes, 150mm in width at an angle of 45 degree, 'A' frame painted with two coats of yellow paint, complete as per IRC: SP:55-2001 including cost of all materials, labour, loading, lead, lift, transporting etc., complete as per specification.
- 88) Traffic cones: Supplying of red fluorescent with white reflective sleeve traffic cones made of low-density polyethylene (LDPE) material with a square base of 390x390x35mm and a height of 770mm, 4Kg in weight, placed at 1.5m interval all as per BS-873 including cost of all material, labour, loading, unloading, lead, lift, transporting, etc., complete.
- 89) Retro-Reflectorized Road traffic signs: Supplying and fixing of retro-reflectorized cautionary, mandatory and informatory sign as per IRC: 67- 2001 made of high intensity grade micro prismatic HIP type-IV sheeting, including lettering fixed over aluminium sheeting, 2 mm thick firmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing.
- 90) Manufacturing of Retro-reflective board - Caution Indicator / Stop indicator / Speed indicator / Whistle Board / any other board with 1.50 mm thick MS plate and MS plate stiffeners on M.S. T angles 75 mm x 75 mm x 6 mm and 4.75 m long approximately as per the specified drawing including cutting, drilling holes in the angles, providing hold fasts, bolts and nuts with washers of required size, bolting, welding and;

- 91) Providing supplying and fixing in position, boundary pillars of standard design as per IRC-25-1967 with K-RIDE/Railway logo on it with reinforced cement concrete of M15 grade.
- 92) Clearing and grubbing road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300mm. Removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, with all lead and lifts including removal and disposal of top organic soil not exceeding 150mm in thickness including all labour, hire charges of all machineries etc., complete with all lead & lifts. By Mechanical Means or any other means.
- 93) Excavation for roadwork in all types of soil by mechanical means including cutting and loading to tippers, trimming bottom and side slopes, in accordance with requirements of lines, grades and cross section, and transportation with all & lift lead complete as per specifications, including scarifying the existing bituminous.
- 94) Construction of embankment for road work with approved materials gravel/Murum with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement complete as per specification, including cost of gravel/murum, watering charges & compaction by vibratory roller to 95% of modified proctors density. MORTH Specification No.305.
- 95) Construction of sub grade and earthen shoulder with approved material Gravel/Murum with all lifts & lead, transporting to site, Spreading, grading to required slope and compacted to meet requirement of table No.300-2 complete as per specification, including cost of earth, watering charges & compaction by vibratory roller to 97% of modified proctors density MORTH Specification No.305 including compaction.
- 96) Construction of granular sub-base Grading-V as Sub-base and drainage layer by providing coarse graded crushed stone aggregates of granite/trap/basalt material, mixing in a mechanical mix plant at OMC, Carriage of mixed material to work site, spreading in uniform layers with motor grader on prepared surface and compacting with vibratory power roller to achieve the 98% proctor density, complete as per specifications. Clause 401 of MORTH V revision.
- 97) Providing, laying, spreading and compacting crushed stone aggregates of granite/trap/basalt to Wet Mix Macadam specifications including pre mixing the material with water at OMC in mechanical mix plant carriage of mixed materials by tipper to site, laying in uniform layers with paver in sub-base/base course on well prepared surface and compacting with vibratory roller to achieve the desired density complete as per specifications, MORTH specification No.406.
- 98) Providing and applying primer coat with S.S bitumen emulsion on prepared surface of granular base such as WMM including cleaning of road surface and spraying primer at the rate of 0.60kg per sqm using mechanical means complete as per specifications. Clause 502 of MORTH V revision.
- 99) Providing and applying tack Coat using 80/100 grade bitumen (VG10) on the bituminous surface at the rate of 0.25Kg per Sqm, heating bitumen in boiler fitted with spray set (excluding cleaning of Road Surface) as per Specifications. Clause 503 of MORTH V revision.
- 100) Providing and laying dense graded bituminous macadam using crushed aggregates of specified grading, premixed with VG30 grade bituminous binder and transporting the hot mix to work site, laying to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction in all respects complete as per specifications. Clause 505 of MORTH V revision. Using 40/60 TPH capacity H.M.P with sensor paver Gr-II with 4.5% VG-30 Bitumen.

- 101) Providing and laying bituminous concrete using crushed aggregates of specified grading, premixed with bituminous binder and filler, transporting the hot mix to work site, laying with a paver finisher to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction in all respects as per specifications. Clause 507 of MORTH V revision. Using 40/60 TPH capacity H.M.P with sensor paver Gr-II with 5.4% VG-30 Bitumen.
- 102) Filling pot holes and patch repairs with bituminous concrete.
- 103) Road Marking with Hot Applied Thermoplastic Compound with Reflectorizing Glass Beads on Bituminous Surface/Concrete Surface. Painting lines, dashes, arrows etc., on roads in two coats on new work with ready mixed road marking paint conforming to IS: 164 on bituminous surface.
- 104) Painting two coats on new concrete surfaces: Painting two coats after filling the surface with synthetic enamel paint in all shades on new plastered concrete surfaces including cost of all materials, labour, loading, unloading, lead, lift, transporting etc., complete as per specification.
- 105) Road delineators: Supplying and installation of delineators (Roadway indicators, hazard markers, object markers), 80-100cm high above ground level, painted black and white in 15cm wide strips, fitted with 80x100mm rectangular or 75mm circular reflectorized panels at the top, buried or pressed into the ground and conforming to IRC-79 as per drawings including cost of all materials, labour, loading, unloading, lead, lift, transporting, etc., complete as per specification.
- 106) Supplying and fixing pre cast solid concrete kerb stones made out of M15/20 (CC 1:2:4) and finished with CM 1:3 Plastering and finishing, cutting, with all lead and lifts etc., complete of size 450 x 200x 400mm.
- 107) Striking out of centre line of railway alignment by using total station theodolite either before commencing work or after completion of earthwork on finished formation and fixing centre line stones of size 150x150x600 mm with CC 1:3:6 mix with 40mm metal in a pit of size 300x300x600 at every 100-meter interval on straight and at every 50m interval on curve etc. complete.
- 108) Preparation of computer aided GAD/completion drawings in AO size in tracing film and 6 copies of ammonia paper print for each Minor bridge by contractor with his own materials, man power, tools and etc complete with bridge details submitted by the railway and as directed by Engineer in charge. drawings in 7 copies, 1 tracing film, 6 ammonia paper print copies and soft copy should be handed over to K-RIDE.
- 109) Salvaging the ballast from the dismantled track by beaters/wire brushes duly separating the muck by screening the same with contractors 25mm sieve, disposing off the muck at specified locations including crossing of track under traffic/non traffic conditions, making the stack of good sieved ballast along the formation or outside the formation as instructed by the Engineer-in-charge.
- 110) Demolition and removing of signal post/ water columns/ lighting towers/ BG gate boom posts & rail columns etc., including foundation in concrete, masonry to entire satisfaction of the Engineer-in charge, with all men, material & equipment.
- 111) Fixing of reference pillars at the edge of formation.
- 112) Preparation and submission of Hydraulic /Hydrologic calculations for bridges including Waterway and scour depth calculations as per RDSO guidelines and Railway Bridge Substructure Code with all calculations and details in three copies in CD and six sets of booklets, including collection of field details from the site

with contractor's men, materials and equipment etc complete and as directed by the Engineer in-charge a) for Major bridges & Minor Bridges.

- 113) COMPLETION DRAWING: Preparation and submission of GAD/Completion drawing for the Major bridges/ROBS/RUBs based on soil exploration and water way calculation for fixing suitable span as per RDSO design and drawing in AutoCAD on 100micron film double mat finish as per Railway standard approved by the Engineer-in-charge to specified scales including submission of check print for proof check to incorporate suggested corrections and modifications and supply final copy in compact disk and 6 copies in ammonia print in A0 size with all contractor's materials, labours, tools, plants etc., complete.
- 114) Dismantling of existing structures like culverts, bridges, buildings, retaining walls, Railway Platforms, Compound walls and other structure comprising of masonry, cement concrete, pre-stressed/ reinforced cement concrete, brick/tile work in cement mortar, stone masonry rubble in cement mortar, stone pitching/dry stones spalls, removal of all types of Hume pipes, cement concrete pavements, kerb stones, BS slabs/precast slabs of drain / footpath, paver blocks of footpaths, removal of silt or silt mixed with sand, etc. including T&P and scaffolding wherever necessary, including disposal of dismantled material with all lead and lifts including all labour, hire charges all machineries etc., complete by any mechanical means or any other means as direct by Engineer. Loading/Unloading G.I. sheets, rails, joists, built up sections, angles, C.I., Ductile pipes, A.C Pipes, or G.I. pipes RCC/PCC beams / slabs and other miscellaneous ironwork or wood work. The scrap materials will be the property of the contractor except the materials of local authorities (BBMP, BWSSB, BESCO) and railway.
- 115) Supplying and laying interlocking pre-cast CC block pavers of approved design factory manufactured of specified grade cement concrete on foot paths, circulating area, road junctions etc, including setting in position over 25mm thick bedding layer of fine sand, filling the joints with fine sand, levelling including compaction as per IS 15658.: minimum of minimum of 50mm thick blocks of M35 grade for medium traffic.
- 116) Providing and laying non-pressure NP3 class (medium duty) R.C.C. pipes including bends etc. with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1cement: 2fine sand) including testing of joints etc. complete up to 800mm: 600mm, 900mm dia. R.C.C. pipe.
- 117) Supplying and fixing precast RCC gratings including cost of all materials, transportation, labour etc. complete (60x40 cm) with all lead and lifts.
- 118) Transplanting the marked trees of various species and girth (300mm to 5000mm girth) to the place shown by Engineer with all leads and lifts, tools, plants men & machinery and necessary preparation such as: (i) Preparation of earth ball of tree roots of desired depth & diameters. (ii) Dislodging, lifting, transportation and transplanting tree from original place to the new place including all arrangements, labour etc. for successfully completing the work. (iii) Excavating pits of adequate size, arranging loose soil, mixing of manure, fertilizer, insecticides etc. to ensure survival of the trees being transplanted. (iv) Maintenance of tree i.e., watering, soil heaping, spray of insecticides for six months. All above operations shall be executed as per specification.
- 119) Supplying & constructing granite/basalt rubble masonry in CM 1:3 for foundation/ sub structure for drain walls, retaining walls, return walls, toe wall etc., as per drawing.
- 120) Providing & fixing hard drawn steel wire fabric reinforcement, straightening, cutting, cleaning, bending, tying, lap/butt welding placing including binding with mild steel annealed binding wire of 18 SWG in all structural concrete at all heights and depths, with all lead and lift. etc. complete as per drawing,

specifications and directions of Engineer for fencing including vertical posts & RCC foundations for At-Grade Section.

- 121) Rain water harvesting: Providing and constructing the Rain water harvesting system in the median of the road/Embankments including boring/drilling of bore well of 300mm dia for casting/ strainer pipes prescribed in the drawing, excavation in all type of soils/rock, constructing BW chamber, foundation, RCC top slab, plastering, CI manhole cover, filling/ packing gravels in the chamber and the annular space in the bore, filling granules in the vertical pipe, laying HDPE pipe from piers to chamber, etc., complete as per the approved drawing.
- 122) Transportation of all usable materials like B.S slabs/precast RCC slab, cement concrete blocks, interlocking paver blocks, kerb stones, steel items, Telephone Poles. Electric Poles to designated site as directed by Engineer by mechanical transportation including all lift, lead, loading, unloading, labour, machinery etc., complete.
- 123) Transportation of tree trunks, branches, roots, complete including loading and unloading up to a lead of 25 Km as directed.
- 124) Supplying and filling in foundations/backfilling in marshy/clayey foundation pits with granite/trap broken stones of 300mm and downsize with approved sand including hand packing, ramming, watering, including the Lumpsum Price of all materials and labour with all lead and lifts etc., complete as directed by Engineer.
- 125) Painting pier identification number on piers & parapet inner face at different locations as directed by Engineer.
- 126) Design, build and maintaining project & site offices fully furnished for the use of Engineer as per the layout drawing, specifications, & Employer Requirements-Scope of work.
 - a. Project office, location as per the instruction of engineer. (Total three site offices).
 - b. Site office in Casting Yard (Total two casting yard offices)
- 127) CCTV Cameras at various locations along the alignment, casting yard, all worksites. The contractor to install CCTV cameras at various locations along the alignment, Casting yard, all worksites of corridor-2 along with monitoring system LED TV connected to internet including software for BSRP project. The CCTV cameras to be installed at every 1 km intervals along the alignment and at important junctions and wherever the works are in progress, the cameras to be installed including mobile app. The outdoor network termination box with electrical junction box for each camera, media convertor, cable for power up to CCTV cameras, OFC cable, installation of CCTV on MS poles, storage provision, central monitoring etc. to be provided. All the installed cameras will be connected to central console and will be installed at BSRP HQ office, Bangalore where the monitoring will be done. The power supply arrangements and cables to be provided by contractor. The location of CCTV cameras will be finalized by Employer/Engineer. The security and safety of the equipment will be the responsibility of the contractor. The necessary precautions for avoidance of accident at site by any equipment or cable to be ensured by contractor. The dedicated service Engineer/Service provider Engineer to be deputed for full time. The repair/replacement to be done within 24Hrs. positively. The shifting of cameras wherever required are also included in the lumpsum price.

2. RELEVANT DOCUMENTS

The Contractor shall execute the Works in two phases, the Design Phase and the Construction Phase. The Design Phase shall commence upon the date of issue of Letter of Acceptance. This

phase shall include the preparation and submission of:

- a) The Preliminary Design
- b) The Definitive Design; and
- c) The GFC Drawings.

The Design Phase will be complete upon the issue of a Notice in respect of the comprehensive and complete GFC Drawings Submission for the whole of the Permanent Works.

The requirements for the Preliminary Design, Definitive Design and GFC Drawings are stated in Employer's Requirements-Design.

The GFC drawings shall be submitted by contractor and after scrutiny, Engineer shall issue Good for Construction (GFC) drawings to Contractor for the execution of works in accordance with the agreed terms and conditions of the Contract Agreement.

The following Documents shall be referred in conjunction with each other by the Contractor for construction work as these are mutually complimentary to each other:

- a) Good for Construction Drawings issued by the Engineer
- b) Employer's Requirements as part of Contract
- c) Technical Specifications and explanatory notes to the BOQ, as part of Contract
- d) Bill of Quantities as part of Contract
- e) Indian and International Standards referenced therein.
- f) The schedules and any other documents forming part of the Contract.

The Contractor shall always seek advice from the Engineer in the event of conflicts among above cited documents. In case of conflict, Engineer's decision shall be final and binding.

3. GENERAL

The project site is located in and around Bengaluru City. The tendered work is BSRP project for Corridor-2 Suburban Rail Project between Benniganahalli to Chikkabanavara. The at-grade section and elevated Viaduct structure are proposed parallel to the existing track on the left/right side of existing Indian railway line.

The scope of work includes construction of at-grade section and elevated (viaduct) section, earthwork in formation, bridge works, and miscellaneous works, casting, transportation and launching of precast boxes/segments, supply of cement & steel and provision of site facility.

Availability of Land:

The major portion of the required land for the execution of works is available along the alignment. The remaining land or portion of land shall be acquired and handed over to the contractor progressively. However, the contractor may have to take lease of the land temporarily for installation of his facilities like batching plant/ Casting Yard/ Site Work Shop etc. The bidders are advised to make detailed study and cater for such expenditure in the bid.

Approaches to the project site:

The land acquired for the project caters for construction and operation of the proposed line. The contractor shall plan for approach roads to various sites of work conducting detailed survey and should include the cost of inputs for any such approach roads in his bid for the work.

However, in case any existing road outside railway land has to be utilized for transportation of materials to the site of work and in the process the road gets damaged or needs to be strengthened and the authority owning the said road submits demand to GM (Civil)/ K-RIDE to carry out some specific works in order to strengthen/repair the road, GM (Civil)/ K-RIDE shall get such works executed through the existing contractor and the amounts are included in lumpsum amount of price schedule.

Bidders should find out the capacity of the quarries and accordingly plan procurement of coarse/fine aggregates either from the existing quarries or establish their own quarries and crushing arrangements.

It is the responsibility of the contractor to thoroughly examine the site of work and all constraints before submitting the bid(s).

- i. Before carrying out the work at site, necessary permissions from various local agencies / Railway authorities / road authorities such as SWR, BBMP, PWD, Traffic Police etc., shall be required to be obtained by the contractor. The Employer shall assist only by way of issue of necessary support letters.
- ii. Any services affected by the works must be temporarily supported by the contractor. The work of temporarily supporting and protecting the public utility, services during execution of the works shall be deemed to be part of the contract and the amounts are included in lumpsum amount of price schedule. Nothing extra shall be payable on this account.
- iii. The contractor shall take all precautions for safeguarding the environment during the course of the construction of the works. He shall abide by all laws, rules and regulations in force governing pollution and environmental protection that are applicable in the area where the works are situated. The contractor must take all necessary steps to fix specially dust nuisance during the construction of the works.
- iv. The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct and indicative, but the contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any error or omission in the levels or strata turning out different during execution from what is shown on the drawings. The contractor should validate the L- Section and horizontal alignment using MX Rail/ applicable latest software.
- v. The present position of preliminary works of the section is as below; any incidental works required to be carried out in this regard shall be the responsibility of the contractor and the amounts are included in lumpsum amount of price schedule. Nothing extra shall be payable on this account. In case any new items are required for such works, the same will be processed as per the need on mutual consent.
 - a. The existing road of BBMP / Road approach of Railway can be used for construction of viaduct structures, at-grade section etc.
 - b. Utilities pertaining to Existing IR track, BBMP, BWSSB, GAIL, BESCO and other private (OFC) have been identified and indicative.

- vi. The preliminary works such as site clearance, barricading, trail trenching etc., wherever required, shall be taken up simultaneously along with mobilization activities.
- vii. Trenching for identification of utilities and re-location / diversion of utilities if encountered;
- viii. The contractor shall at all-time carryout the work on either side of existing IR tracks/ highway/road/service road in a manner creating least interference to the flow of traffic. The contractor shall take prior approval of the Engineer and traffic police regarding traffic arrangements and diversion of traffic during construction.
- ix. All temporary traffic diversion works, which will be required for the smooth flow of running traffic in order to carry out the works without any interruption including all safety precautions, signage, barricading, emergency lighting, traffic marshals, look-out men / watchmen etc.; shall be carried out. The permanent traffic diversions shall be carried out in consultation with traffic police. Contractor has to provide traffic diversion proposals, traffic marshals, cones, traffic diversion boards etc., as desired by Traffic Police.
- x. Works to be performed shall also include all general works, including Road widening and allied works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and meaning of the drawings adopted and technical specifications, to best Engineering standards and orders that may be issued by the Engineer from time to time.
- xi. The road works and allied works shall be carried out in co-ordination with BBMP as per MoRTH, specifications. On award of work, the contractor has to start the road work along and complete the same.
- xii. Road widening works wherever required; widening of road is as in the scope of contract. Further, if diversions of roads need any up gradation as desired by the Engineer contractor will carry out the works and will be paid under the relevant Price Schedule. Road widening and drainage work to be completed before the commencement of viaduct /at-grade section work at any particular location.
- xiii. Restoration of Road and allied works immediately after completion of work up to road level or as per instructions of Engineer.
- xiv. Tree cutting and (or) transplantation along the alignment for cutting/transplantation will be arranged by Contractor at her/his own cost. The applicable permits/ permissions for felling of tress / transplantation shall be arranged by Employer.
- xv. Demolition of RCC framed structures, Brick masonry buildings including basement etc. as existing at site without making damage to adjacent structures, utilities and taking away and disposing all the debris and released materials etc. Shall be done by contractor, the amount of the are included in the lumpsum amount of price schedule.
- xvi. All disposable excavated material shall be collected and transported for disposal at contractors dumping yard which has to be approved by relevant authorities. Dumping yard area cannot be provided by the employer.
- xvii. The tyres of the vehicles leaving Site have to be cleaned with Jet Wash to avoid spillage of earth / mud on public roads. The Contractor has to ensure cleanliness of the roads and footpaths by deploying man power for the same. The Contractor shall have to ensure proper cleaning and washing of roads and

footpaths on all the times throughout the entire stretch till the currency of the contract including disposal of sweep age. Nothing extra shall be payable on this account

- xviii. The CONSTRUCTION PROGRAMME AND PROJECT MONITORING is to be given as mentioned in General Conditions of Contract. The detailed programme has to be in the form of a quantified bar chart or MSP / Primavera activities from start to completion of the work.
- xix. PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS) The Contractor shall utilise a PMIS integrating with BIM software such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer office at site and the Employer's Office by the Contractor.
- xx. Maintaining and keeping the Existing Railway banks, structures and adjacent roads clean in the area of work and where construction machineries ply.
- xxi. Measures to minimize water, air and noise pollution;
- xxii. All aspects of quality assurance, including testing of materials and other components of the work, as specified and as directed;
- xxiii. Clearing of site and handing over of all the Works, as specified or as directed
- xxiv. Maintenance of the completed Work during the maintenance period as directed;
- xxv. Submission of completion (i.e., 'As-Built') drawings and other related documents as specified; and
- xxvi. The contractor shall not display any name-board for the works without the written permission of the engineer.
- xxvii. No labor camp shall be allowed at work site or any unauthorized place.

4. OBTAINING CLEARANCES/CERTIFICATES FROM AUTHORITIES

The contractor shall arrange well in advance stage wise as may be required, submission of all the required documents and drawings for approval from other authorities and installation of the works and their inspection and obtain approval/completion certificates with respect to his work as required for use and connection of the utilities and occupation from the Statutory Authorities. The Contractor shall obtain and deliver to the Engineer, on completion of the works, the final Inspection Report and approval from the Authorities.

5. INTER COMMUNICATION FACILITIES

Telephone and fax services are available at Bengaluru. Should the Contractor wish to use Radio communication on the site, the Employer will recommend to the appropriate authority the application for allocation of radio frequencies to the Contractor

6. SITE INFORMATION

The project site is located in and around Bengaluru City. Bengaluru is well connected to other parts of the country by Road, Rail and Air. It has an international Airport. The location of the work and the General site particulars are shown in the General Arrangement Drawings enclosed in the bid documents.

7. RESTRICTIONS IN WORKING

It has to be noted by the Bidder that,

- a. The various items of construction work have to be carried out in narrow roads / streets of Bengaluru city/Beside/across/Parallel to the existing railway line where there are buildings adjacent to the road/track and railway traffic may be heavy.
- b. There are restrictions for movement of trucks and heavy vehicles (ex: trailers) carrying construction materials, cleaning during the day hours on some roads.
- c. There are some one-way roads where traffic can't move in both directions.
- d. Generally, at least two lanes of traffic in both directions have to be kept while the works are on, including foundation works.
- e. The construction of structures will have to be planned in such a manner that they do not obstruct or interfere with the existing roads; railways tracks and other utilities. Since the entire Alignment is coming in parallel to the existing IR track/ road, the movement of trains/Heavy Vehicles is expected, wherever the stations / approaches to the stations / Viaduct works are at the middle/Beside of the IR Track/road / across the railway tracks/roads, erection of pre-cast members may have to be planned in such a way that the erection shall be done from one end with Back feeding. Unless the competent authorities permit to execute such works using cranes and restricting the movement of the Vehicles/trains, the same may be planned to carry out during night Also, while working in the night hours' noise pollution should be kept to an acceptable level. The bidder should take all these facts into account while quoting rates and devise his methodology of working accordingly.
- f. Where work is required to be carried out at locations adjacent to such Existing IR tracks, roads, utilities, structures, monuments, religious structures, etc., suitable safety and protection arrangements will have to be ensured. Nothing extra will be payable on these accounts. It should also be ensured that no damage is caused to any such element and Engineer/ Employer shall be indemnified against such damage at no extra cost.

8. GENERAL CLIMATIC CONDITIONS

Bengaluru is located in meridians of 12° N latitude and 77°3' E Longitude, spread over an area of 531 sqm km. located at an altitude of 900m, Bengaluru boasts of delightful weather around the year registering maximum temperature of 34° centigrade in summer and minimum temperature of 14° centigrade in winter. Bengaluru receives both the Southwest and Northeast Monsoons, getting an annual average rainfall of 760 mm, generally during the months of May to September/October. Bengaluru falls in Seismic Zone II

9. WORK CONTENT (For at - grade and elevated section)

9.1 Brief Scope

The proposed work is in connection with the Corridor- 2 of Suburban railway work between Benniganahalli and Chikkabanavara from approx. Km: (-) 0.964 to 24.425 (Including sidings).

A “Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.

This bid is for construction of elevated (viaduct) structures comprising pile foundation/open foundation, Piers, cast in situ /pre-cast post tensioned pier cap and cast in situ/ precast portal beams. Elevated structure includes, Pre-cast PSC I – Girder, PSC T– Girder, Pre-cast Box segments/ Pre-cast full span U Girder including casting, transporting, launching and erection in position, the work also includes road widening, side drains & other allied works, and construction of service roads at required locations. Design, construction & maintenance of at least 3 nos of Site /project offices for Engineer and an office at each of the casting yards for Site Engineers are also kept in the scope of the bid.

B. “Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.

This bid is for construction of at-grade section comprising, earthwork in embankment in cutting and filling, Major Bridges, Minor Bridges, ROB/RUB's, including side drains & allied works approach road work viz., Retaining wall, Sacrificial retaining wall, R E Wall, elimination of level crossings by constructing RUB's and construction of service roads at required locations.

Two ROB's 408 B & 410A at km. 8/800-900 and at km. 8/100-200 respectively between Jalahalli and Chikkabanavara are proposed to be reconstructed as Cable stay bridge / Suspension bridge for bridge no: 410A and Bridge no:408B as part of this work. There are 53 numbers (approximately) of minor bridges/ slab culverts of varying spans up to 8.4m, One Major Bridge, RUB's (12 nos) in at-grade section, one number RUB in Nagavara station and one number RUB in Kanaka nagar station. The details are in schedule of Employer's requirement. One pre cast RCC box for accommodating one BSRP track at Ch: 20.590 Km below existing ROB (407 A) along with supporting the existing water pipe line including retaining wall.

- i. Works to be performed shall also include all general works preparatory to the construction of Elevated Viaduct & At-Grade section and works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and meaning of the drawings adopted and technical specifications, to best Engineering standards and orders that may be issued by the Engineer from time to time, compliance by the agency with all as per Contract document,

- ii. Supply of all materials, apparatus, plant, equipment, tools, fuel, water, strutting, timbering, transport, offices, stores, workshop, staff, labor and the provision of proper and sufficient protective works, diversion, temporary fencing, lighting and watching required for the safety of the public and protection of works on adjoining land; first-aid equipment, accommodation and sanitation for the staff and workmen, effecting and maintenance of all insurances, the payment of all wages, salaries, provident fund, fees, royalties, duties or the other charges arising out of the erection of works and the regular clearance of rubbish, clearing up, leaving the site perfect and tidy on completion.
- iii. The work content in this contract consists of, but not limited to, furnishing all labors, materials, equipment's, tools, plants and necessary machinery as required to completely execute all the works relating to Construction of at- grade section/Elevated viaduct structures and utility relocation and diversions if and to the extent required etc.
- iv. The work to be constructed and maintained as per Price Schedule, Technical Specification, relevant Codes, and specifications of RDSO, MORTH, CPWD, KPWD, drawings, best engineering practices and/or as directed by the Engineer.

9.2 The Scope of Civil & Structural works

The scope of works shall, inter-alia, include the following but not be limited to:

- a. Site clearance and dismantling of obstructions, etc., before commencement of work as specified or as directed;

The bidder must visit site and acquaint him with the local conditions before quoting. Site clearance includes dismantling of median, footpath, any temporary structure, small shed etc. All the trees and hoardings/buildings coming in the way of construction of Viaduct and at-grade track work have to be cleared by contractor, cutting of trees / branches also may have to be done by the contractor for which nothing extra shall be payable on this account and the amount is included in lumpsum cost.
- b. True and proper setting out and layout of the works, bench marks and provision of all necessary labor, instruments and appliances in connection therewith as specified and as directed;
- c. Provision of foundation works for different structures i.e., viaduct/track structure, Major bridges, Minor bridges etc. including piles (1000mm dia for the structure carrying single track and minimum 1200mm dia for structure carrying two tracks) and pile caps /open foundations / rafts for columns/ piers (wherever required) up to the minimum founding depths in accordance with the actual soil parameters as obtained from detailed sub-surface exploration as specified or directed. The Construction methodology is required to be approved by K-RIDE before carrying out the works.
- d. Provision of Major bridges, Minor bridges, RCC piers, Pier caps, precast pier caps & precast Pier arms /portal pier beams, bearings, as specified or as directed.
- e. Provision of superstructure for viaduct consisting of precast (Pre-Tensioned & Post- Tensioned) reinforced cement concrete Box- Girders, U-Girders, I-Girders, parapet & cast-in-situ deck slab works.
- f. Provision of cast-in-situ, Major bridges and Minor bridges, RCC columns, beams, slabs, elimination of level crossing by constructing New RUBs.
- g. The elimination of level crossings work between Ch: 5.700Km and 10.575 Km has involved raising of embankment, construction of minor bridges, RUB's of full length for accommodating both BSRP and IR tracks and retaining walls, sacrificial walls and the work will have to be carried out in stages for continuing the IR traffic by diverting through the newly constructed formation. The contractor to work out the

methodology suitably for stagewise construction for continuing the IR traffic without any hinderances and this aspect may be considered while quoting the Lumpsum Price. Nothing extra shall be payable on for stagewise construction.

- h. The girders may be tapering in plan (if and wherever required as per drawings) are to be cast true to the profile as far as possible by suitable formwork system.
- i. Obtaining Approval of Erection scheme for Viaduct and Main Structure including special spans/ obligatory spans.
- j. Provision of Composite/Open Web Girders for Obligatory or Railway Spans according to RDSO standards or any standards decided by K-RIDE.
- k. Provision of Connecting Bridges/ Foot over Bridges with Interchange stations as per details.
- l. Providing footways with provision for cable ducts, parapet walls, verges, expansion joints, drainage spouts/down take pipes in station building / track supporting structures and approach ramp, taking suitable measures for the smooth flow of traffic on road/IR track, including arrangements for OHE, Signaling and Telecommunication structures including Automatic Fare Collection system as specified or as directed.

The Architectural finishes, MEP works, Track, OHE, Signaling & Telecommunication structures including Automatic Fare Collection structures themselves are excluded from the scope of the bid, but civil works required for fixing the structures is included, and shall be done in co-ordination with the respective Engineer /Contractor. The necessary interfacing / liasoning and arrangements for the same will have to be done by the bidder and shall form part of the total work. Inserts for Electrical, OHE, signaling etc., to be provided as per drawing and shall be paid in the relevant item.

- m. Conducting load test on piles and girders. However, the actual numbers will be advised to the successful bidder on award of contract;
- n. Providing, fabricating and fixing MS members to be used as fixtures supports / hangers etc. for system contractors.
- o. Installing and fixing in position holding down bolts supplied by K-RIDE/ other contractor to be used for system contractors
- p. Grouting of anchor bolts with non-shrink compound.
- q. Supplying, pouring and packing non shrink grout under base plates of columns, trusses etc.
- r. Construction of underground water tank and its water proofing work & testing.
- s. Water proofing work of Toilet portion slab & testing
- t. Construction of Pump room, DG room, Rain water harvesting system, etc.
- u. Any other item of work as may be required to be carried out for completing the construction of at-grade/elevated (viaduct) structures, stations, as specified in drawings including all necessary interface works with infrastructure contractors, system contractors, etc. in all respects in accordance with the provisions of the Contract and/or to ensure the structural stability and safety during and after construction

9.3 Civil

A. Formation

Earthwork in formation and cuttings for the full length, laying of a blanket layer as per RDSO guidelines with suitable materials as approved by Engineer.

The minimum top width of the proposed new alignment for embankment and cutting (for double track) shall normally be 13.16 m (Approximately) for two tracks on straight, 13.46 m (Approximately) for two tracks on curves (As per Tender drawings) and 2 (H):1(V) side slopes embankments. Side slopes for cutting shall be as under. The minimum spacing of tracks at grade section is 5.3 m and at elevated section the minimum spacing of tracks is 4.725 m. The minimum center to center distance of straight tracks at station yard is 4.725 m.

		H: V
(a)	Hard rock	¼: 1
(ii)	Soft rock	¼: 1
(iii)	Murum /Hard soil/ Ordinary soil	1: 1

Formation in embankment shall be provided with side slopes of 2:1 or flatter as required. Side slopes shall be turfed. Bank of height more than 6 m shall be designed for slope stability and the slope shall be adopted accordingly. Earthwork shall be provided with contractor's own earth. The top width of embankment and cutting of BSRP lines and stabling lines will be as per GAD. The rates shall be inclusive of all minor variations.

The drainage arrangement between IR tracks and BSRP tracks at formation level, side drains at toe/ground level, drains at berm level, catch water drains/saucer drains are included in the scope of work.

The abstract of specification and thickness of formation layers for 25MT axle load (Two-layer system) as per table 3.4 of technical specification is as below. The contractor has to validate the same.

- e. Blanket thickness = 30cm over SQ3 prepared subgrade, 40cm over SQ2 prepared subgrade.
- f. Prepared subgrade: SQ2/SQ3 (CBR>=8) = 50cm over SQ1 fill, 35cm over SQ2 fill.
- g. Subgrade top layer: SQ1/SQ2/SQ3 (CBR>=5) for SQ2/SQ3 soils, for SQ1 soil (CBR>=4) = 50cm
- h. Lower layer (Fill): SQ1/SQ2/SQ3 soil (+): (CBR>=3) = as per embankment height.

B. Other Activities:

1. Providing and maintaining office accommodation and equipment for the use of the Employer and their Assistants and Staff during the contract and defect liability periods.
2. Setting out the line and level of alignment for the proposed doubling and establishing working bench marks and alignment references, taking the details from bench marks and alignment references established by the Employer/ other designated contractors.
3. For carrying out accurate survey work, survey control points shall be established along the railway line using high end survey equipment such as DGPS or Total Station connected with nearest GTS Bench Mark. Also reference pillars are to be established for relocation. This work is meant for

maintaining & checking proper alignment of mid-section, Elevated Viaduct, bridges, RUBs/ROBs for which the contractor is solely responsible.

4. Every precaution has to be taken such that there shall be least disturbance to road/rail traffic during transportation of construction materials to the site of work.
5. Making and supply of 'As-Built' drawings for the new assets created.

9.4 Special stipulations/features

Civil Work

- 9.4.1 While planning for the work of transportation of bridge construction materials to the bridge site., the finished formation of earth work in banks and cuttings with or without blanket layer should not be used for plying of trucks or other vehicles used for transportation. This restriction has specially been imposed to save the top surface of the formed formation from forming pits and ruts, which later are likely to accumulate water and pose problems for maintenance.
- 9.4.2 The mechanical means required to meet the stipulations mentioned in the above sub-Para should be arranged by the Contractor.
- 9.4.3 Railway land, if available shall be provided for the purpose of stacking of material and setting up of concrete batching plant, etc. However, the Contractor shall be responsible for arranging any such requirement of land and arranging/developing any required approach to site of work, etc. at his own cost.
- 9.4.4 The Contractor shall be required to mobilize resources for taking up work at a number of locations simultaneously. The planning of resources may be done at least to meet these requirements.
- 9.4.5 The bidder may ascertain availability of suitable/preferred type of soil for embankment and lead/lift involved before quoting his rates/lumpsum cost.

9.4.6 Power & Traffic Block

- (i) Track occupation may be granted at any time during day or night to suit convenience of traffic operations and will ordinarily be granted over a distance covered by one or two consecutive block sections. Work trains will normally be allowed to take advantage of block shadows. Normally the total duration of block on any section will be maximum of 1.5 to 2.5 hours at a stretch in a day, once or more than once. Block provided may be utilized for one or more work trains or track Lorries or ladder trolleys to suit convenience of work.
- (ii) Blocks will not ordinarily be given for laying the feeders except where crossing of track is involved, which will have to be laid manually in general.
- (iii) Any traffic / power blocks, temporary speed restrictions and caution orders required in connection with execution of works by the contractor, shall be got sanctioned from the Railway authorities well in advance by the contractor through the Engineer. The Railways may sanction the same for specific sites within the overall recovery time available in the Railway time table. The contractor shall have to schedule his programme according to the convenience of the Railways. No claim from the contractor for any delay / inconvenience / loss on this account shall be entertained by the Employer / Engineer.

- (iv) The contractor shall undertake the work involving Railway track, Railway Electrification installations in co-ordination with the Engineer and Railways in accordance with the programme of work. Where traffic / power blocks are involved, the Contractor shall ensure that interruption to Railway operations, if any, is kept to the bare minimum level.
- (v) In order to minimize blocking of the track for work/material trains, the contractor shall consider the working conditions on the section and assess use of alternative method of construction on a part or whole of the work. He should submit clear proposal along with financial implication if any to the purchaser for such special method of saving of blocks that could be obtained along with reduction / redundancy of the facilities being provided by the Railway / K-RIDE.
- (vi) The protection required for block working i.e., flagmen, flags etc. shall be provided by the contractor. Competency for the above shall, however, be given by the Railway authority. Protection of track by banner flags etc. shall be done in accordance with General Rules of Indian Railway and Subsidiary Rules of the concerned zonal Railway where work is being carried out. Contractor shall provide Safety helmet, Safety belt and Safety Shoes to their staff while working at site.
- (vii) In case of theft/breakdown, the contractor shall restore the traffic in minimum possible time. Failure to do so shall attract suitable penalty.

9.4.7 Provisional Acceptance

- i) Immediately after completion of works/such part of works, the Contractor shall certify and advise the Engineer in writing that the works are (i) complete (ii) ready for satisfactory commercial service and (iii) ready to be handed over. He will also place at the disposal of the Engineer the required staff for checking it and putting it into operation.
- ii) The test or tests as stipulated in approved Technical Specifications shall be carried out jointly by the Railway / Engineer and the contractor within a month after the receipt of the Contractor's notification as stated in sub-Para above.
- iii) The provisions contained in the relevant GCC clause shall be followed for taking over of the installations.

9.4.8 Use of Rejected/Sub Standard Items/ Equipment

In the event of such rejection as aforesaid, the Engineer shall, without prejudice to his other rights and remedies and in particular without prejudice to his rights under the clause just preceding, be entitled to the use of the rejected/substandard equipment/item for a time reasonably sufficient to enable him to obtain other replacement. During such period, if the rejected/substandard equipment/item is used commercially the Contractor shall not be entitled to the payment on energization until such rejected equipment is rectified and/or replaced, but the Engineer shall not be entitled to claim any damages arising out of rejected/ substandard equipment/item in respect of such period.

9.4.9 Guarantee

- (i) The Contractor shall guarantee satisfactory working of the installations erected by him, for a period of 12 (Twelve) months from the date of commercial operation or from the date of Provisional Acceptance by the Engineer whichever is earlier. The guarantee for spares (if any) should be coincident with the guarantee for erected equipment.

The provisions contained in the relevant GCC clause shall be followed for rectification of defects

- (ii) During the defect liability period the Contractor shall keep available an experienced engineer and necessary equipment to attend to any defective installations resulting from defective erection and / or defects in the equipment supplied by the Contractor. The Contractor shall bear the cost of all modifications, additions or substitutions that may be considered necessary due to faulty materials, design or workmanship for the satisfactory working of the equipment. The final decision shall rest with the Engineer/Employer.
- (iii) During the defect liability period the Contractor shall be liable for the replacement at site of any parts which may be found defective in the equipment whether such equipment be of his own manufacture or those of his sub-contractor whether arising from faulty design, materials, workmanship or negligence in any manner on the part of the Contractor provided always that such defective parts as are not repairable at site are promptly returned to the contractor if so required by him at his (Contractor's) own expenses. In case of type defects in Contractor's equipment and components detected during guarantee period, Contractor should replace all such items irrespective of the fact

whether all such items have failed or not. The contractor shall bear the cost of repairs carried out on his behalf by the Engineer at site. In such a case, the Contractor shall be informed about the works proposed to be carried out by the Engineer/Employer.

- (iv) If it becomes necessary for the Contractor to replace or renew any defective portion of the equipment under the Para aforesaid then the provision of the said Para shall also apply to the portions of the equipment so replaced or renewed until the expiration of six months from the date of such replacement or renewal or until the end of the above-mentioned period whichever is later. Such extension shall not apply in case of defects of a minor nature, the decision of the Engineer or his nominee being final in the matter. If any defect be not remedied within a reasonable time during the aforesaid period, the Engineer may proceed to do work at the Contractor's risk and expense, but without prejudice to any other rights and remedies which the Engineer may have against the Contractor in respect of such defects or faults.
- (v) The repaired or renewed parts shall be delivered and erected on site free of charge to the satisfaction of Engineer/Employer.

9.4.10 Accountably and disposal of released materials

- (i) The Contractor shall liaison with the Engineer to finalize the procedure for taking over of the whole or part of the section and for disposal of the released materials.
- (ii) All released materials shall be handed over to the authorized Railway Representative through the Engineer at the nearest OHE/PSI depot or places nominated by Railway/K-RIDE.
- (iii) The material released on account of modifications/alterations shall be accounted by the contractor in the presence of the Engineer and the Railway Representative, except for the material permitted to be re-used by the Engineer. For this material, only erection cost shall be paid, under the appropriate item of the Schedule.

- (iv) If any shortfall of released material is noticed at the time of completion of the work, the contractor shall be liable to pay for the shortfall as per the prevailing rates or the same shall be recovered from the final bill of the contractor as per the extant policy of K-RIDE.

9.5 Codes and specifications

The works shall be carried out as per Standard Specifications of Indian Railways/South Western Railway /IS /IRC which can be obtained on payment. Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished and work performed or tested the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national or relate to a particular country or region, other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be accepted subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the documents.

All goods and materials to be incorporated in the goods be new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials unless provided for otherwise in the contract.

- (a) The Standard Specifications of Indian Railways/South Western Railway/IS / IRC and the list of codes and manuals given in the annexure thereof shall be prime governing (IRPWM, IR Bride Manual, the relevant IR specifications, Specifications of works of concerned zonal Railway, SOD, DBR, IRS codal provisions/ IRC codal provisions/ IS codal provisions.
- (b) Where there is conflict between provisions in IRS & IS specifications, provisions in IRS specifications shall prevail.
- (c) Where there is no provision of specifications in IRS, provisions in IS specifications should be adopted. Where there are no provisions in IRS and IS Specifications, provisions in IRC Specifications should be followed.
- (d) For items not covered in IRS/IS/IRC specifications, BS-5400 Part 1 to 10 may also be considered.
- (e) The decision of Engineer shall be final and binding in the interpretation of the clause of the codes of practice and specifications of this tender and no claim whatsoever shall be entertained on this account from the Contractor.

9.6 Survey and fixing working bench marks and alignment markers

9.6.1 The work of conducting survey and fixing bench marks and alignment markers before the start of any work on this tender is included in the works covered by the present Tender.

9.7 Bench marks

- 9.7.1 All along the length of the proposed benchmarks (Tentative) have been set up by the Employer at intervals of about a kilometer. The details of these bench marks along with their reduced levels have been marked on the design drawings indicating the plan and 'L' section which form a part of the tender. The contractor along with the Engineer should verify the details of these bench marks in the first instance, soon after taking possession of the site. If any mistakes are detected in these details of these bench marks the same should be indicated to the Engineer. The mistakes detected should be corrected in consultation with the Engineer. These corrections should be got approved by the Engineer before starting of any other work.
- 9.7.2 The contractor shall then in presence of the Engineer establish working bench marks at short intervals, adequately connecting them to the reference bench marks set up by the Employer in the Project length. The working bench mark levels should be got approved from the Engineer. An up-to-date record of all bench marks including approved corrections if any, shall be maintained by the contractor and also the Engineer.
- 9.7.3 All levels taken for making out the longitudinal section and cross section should be related only to these working bench marks.
- 9.7.4 While doing the above-mentioned work, the fact that similar work will have to be done once again on the completed earth work in formation for fixing up the longitudinal levels of the installed P. Way should be kept in view.

9.8 Alignment

- 9.8.1 The Contractor to fix alignment reference points at regular intervals all along the alignment. The contractor along with the Engineer should verify the details of these alignment pillars. If any mistakes are detected in these details, the same should be indicated to the Engineer before starting any work. These detected mistakes should be corrected by the Contractor in consultation with the Engineer. These corrections should be got approved from the Engineer.
- 9.8.2 The contractor shall then, in presence of the Engineer, establish working alignment reference markers at shorter intervals, adequately connecting them to the reference pillars set up by the Employer in the Project length. The location of these subsidiary alignment markers should be got approved from the Engineer. An up-to-date record of all alignment pillars, and corrections, if any done, shall be maintained by the contractor and also the Engineer.
- 9.8.3 The alignment for the double line should be related only to these working bench marks.
- 9.8.4 While doing the above-mentioned work, the fact that similar work will have to be done once again on the completed earth work in formation for fixing up the alignment of the installed P. Way should be kept in view.
- 9.8.5 After the formation has been constructed, the center line of track both in Block Sections and Yards should be re-fixed taking guidance from already set up alignment references. Similarly, the rail levels of track both in the block sections and the yards should also be fixed with reference markers. These will be used for installation of track.

9.9 Responsibility for establishing and maintaining working bench marks and alignment markers

- 9.9.1 The Engineer, when necessary, will provide the contractor with the data necessary for setting out of the centerline. All dimensions and levels shown on the drawing or mentioned in the documents forming part of or issued under the contract shall be verified by the contractor on the site; he shall immediately inform the Engineer of any apparent errors or discrepancies noticed in such dimensions or levels. In consultation with the Engineer, the noticed mistakes should be corrected. These corrections should have the approval of the Engineer.
- 9.9.2 The contractor will be entirely responsible for accurate setting out of the works and safeguarding all survey monuments, bench marks, alignment references etc. The work of setting out shall be deemed to be a part of the general works preparatory to the execution of work and no separate payment shall be made for the same
- 9.9.3 The above-mentioned points have been repeated in the respective sections dealing with specifications for different works for laying emphasis on these items.
- 9.9.4 The contractor will be entirely responsible for accurate setting out of the works and safeguarding all survey monuments, bench marks, alignment references etc. The work of setting out shall be deemed to be a part of the general works preparatory to the execution of work and no separate payment shall be made for the same.

9.10 Issue of materials by Employer

- 9.10.1 The issue of materials by the Employer to contractor shall be governed by the following change.
- 9.10.2 The rails and other materials to be issued by the Employer to Contractor will be handed over at any convenient locations within Railway Land in the contract section. The contractor should collect the same from these locations and transport them to the work site as found necessary. He shall use only mechanical means for handling of rails during all stages of work to avoid any damages to the rails. Leading will be paid separately as per relevant item of Price Schedule.

9.11 Interfacing and Integrations of Works

- 9.11.1 As a part of provision of this tendered work providing of road bed viz., earthwork & bridges, are to be executed by one Agency only. The interfacing for the purpose of integration of works between the partners of JV, in case the work is awarded to a JV or between the Contractor and his sub-contractors, (if permitted) will arise. This has to be kept in view.
- 9.11.2 If additional land is required in yards/mid-section, necessary arrangements will be made for acquiring the land without affecting the progress of work and land will be handed over progressively.
- 9.11.3 The contractor shall take full responsibility in terms of organizing, managing, coordinating and administrating the interfacing of all components of works including all issues related to and arising out of such tasks and responsibility. The contractor shall interface with all concerned authorities and other contractors as required to complete the work satisfactorily within the stipulated period.
- 9.11.4 Under consideration and application of the above clause, the contractor shall and has also the obligation to liaise with the other contractors and Authorities to obtain all necessary technical information, all

necessary information concerning organization of works, coordinating the works etc. which are necessary to assess, mitigate, take care of contractual obligations, risks, liabilities and whatsoever arising out of interfacing, engineering issues, organization of the works etc. The employer/engineer shall not be held liable in any way, throughout the preparation of the offer and/or execution of the works and/or maintenance period and/or defects liability period for any omissions, misunderstanding, negligence etc. arising out of interfacing, coordinating, organizing etc. of the works. The employer will not entertain any claim arising out of misunderstanding, miscommunication, omission, withholding of necessary/required information or whatsoever between the concerned contractors/Authorities concerning interfacing, organizing etc. of works. In case of any claim arising from any of the contractors, as aforesaid, referring to interfacing and/or interfacing related issues; the Employer will hold the concerned contractors liable for not taking care of their contractual obligation concerning interfacing, organizing, co-ordination etc. of the related works.

- 9.11.5 Needless to say, that commissioning of this double line project requires close coordination among various agencies executing the works in this section, Engineer, Employer and the Railway authorities. The contractor shall therefore plan all his works requiring interfacing, like works in mid-section, station yards, with other agencies, meticulously, in consultation and coordination with all concerned parties, in advance, for expeditious execution, without causing any delay either to his works or those of others.
- 9.11.6 If, in the opinion of Engineer, any delay in execution of any part of the Project requiring interfacing is attributable to the failures of the contractor to take adequate steps for smooth execution of such works, then the Engineer shall have the right to take necessary steps to organize and streamline such works, including excluding the requisite portion of work from the scope of the Contractor and getting the same executed by other agencies, at the risk and cost of the contractor.

10. DAMAGE TO PROPERTY

The contractor shall organize all his activities so as not to cause any damage to the property of Railway or that of other agencies or any third party. In spite of taking all precautions, in the unfortunate event of any damage to the property, then the contractor shall not only indemnify the Employer of the claims made by the affected parties but also settle the matters with the affected parties as per law. If the nature of damage is one of that affecting the train movements or causing a safety hazard to the public, then the situation will be treated as an emergency and the Engineer reserves the right to take all necessary steps as deemed necessary to restore train operations or to remove the hazardous situation or to mitigate the damage, at the risk and cost of the contractor.

10.1 Survey Equipment

The contractor should provide the survey equipment and other accessories as per the instructions of Engineer as and when required. He should also provide all necessary help as required by the Engineer for checking the works, whenever required.

- 10.2 All power requirements for execution of works shall be arranged by the Contractor from his own resources. Subject to availability of power, the Employer/Engineer will recommend to the Railway Authorities for providing power connection. The Contractor shall bear the cost of installation and payment of necessary charges for providing such power connections as per the Terms and Conditions of the Railway.

10.3 Structural elements, shape and form

The bidder shall note different structural elements in shape, form and structural configuration in plain. The structural elements may be skew, tapered, curved etc. The bidder shall include these factors while quoting his rates. All the above are to be covered in the quoted rates and nothing extra shall be payable towards this.

10.4 Stability of the elements

During construction, the stability of each element must be ensured until the connections through which the stability is achieved, are fully operative. This might require temporary, supporting, bracing etc. This is contractor's responsibility, and no extra payment is to be made.

10.5 Stability of the Structure

The overall stability of the structure must be ensured during each phase of constructions. This might require special provisions. This is also contractor's responsibility and no extra payment will be made.

10.6 Temporary Works

Traffic barricade with reflective tapes and other necessary traffic signages should be provided wherever required so that safety is ensured during day and night continuously. Temporary traffic diversion for smooth flow of traffic during construction including necessary traffic signs, repairs to the diverted route/service lanes, if required, restoration of diverted route to original condition etc. shall be done by contractor at his cost.

Contractor shall also provide any temporary support for the utilities (charted or uncharted), wherever required, at no extra cost to Employer.

The above listed works are only brief but the actual scope of work shall be as specified in the concerned document and/or as specified or directed by the Engineer.

10.7 Design for Temporary Works

The Design should cover all the items pertaining to all temporary works, traffic diversion scheme, form work, casting and stacking yard, staging, launching scheme for girders / beams and/or transportation scheme for various structural elements and materials to be transported to and from site during construction period.

The Contractor shall himself formulate a practical and viable scheme for design/ fabrication of shuttering, casting, curing, testing and launching/erection of girders / beams/ and all other structures. The bidder should, along with the bid, specify the scheme that he proposes to adopt for carrying out all the works including fabrication, transportation, stacking and erection of steel structure and casting, curing, stressing, testing and launching/erection of girders / beams.

The contractor shall formulate the erection scheme, design the staging, including all necessary temporary structure, prepare fabrication drawings in accordance with relevant provision of applicable IRC standards and submit the same to the Engineer for approval with third party certificates. These works will be executed only after the approval has been obtained from Engineer.

11. DRAWINGS

1. The Drawings furnished with the Bid documents are tender drawings are indicative and approximate and may require to change at the time of actual execution of works based on actual site conditions. Drawings

furnished with the Bid Documents show the level of works based on available soil investigation data. These may change at the time of actual execution of works based on actual site conditions.

2. Tender drawings represent Employer's proposal based on preliminary design and conceptual plans are indicative.

11.1 GFC Drawings:

11.1.1 Requirement.

The Design and drawings is the responsibility of contractor. GFC drawing requirement shall be planned by the contractor based on his three-month rolling programme and the GFC drawings to be issued accordingly.

11.1.2 Errors, Omissions and Discrepancies in Specifications and Drawings:

- a. It shall be the responsibility of the Contractor to promptly bring to the notice of Engineer any error, omission fault, defects or discrepancy in the contract documents, specifications and drawings for the work which are discovered while reviewing the contract documents or in the process of execution of the works and obtain his orders thereon.
- b. Only stated dimensions are to be taken and not those obtained from scaling drawings.
- c. In case of errors, omissions, faults, defects and/or disagreement on the drawings or between the drawings and specifications the following principles shall be followed
 - i. As between the written description or written dimensions on the drawing and the corresponding one in the specifications, the former shall apply.
 - ii. As between the written description of the item in Bill of Quantities and the detailed description in the specification of the same item, the former shall prevail.
 - iii. The drawings on a large scale shall take precedence over those on a smaller scale; and
 - iv. Drawings approved as construction drawings from time to time shall supersede corresponding drawings previously approved.

Decision by K-RIDE shall be final on this matter.

11.2 Meaning and intent of specifications and Drawings:

If any ambiguity arises as to the meaning and intent of any portion of the specifications and drawing or as to execution or quality of any work or material, or as to the measurement of the works, the decision of the Engineer thereon shall be final subject to the appeal (within 7 days of such decision being intimated to the Contractor) to Engineer/Employer who shall have the power to correct any errors, omissions, or discrepancies in the specifications, drawings, classifications of works or materials and whose decision in the matter in dispute or doubt shall be final and conclusive.

11.3 Responsibility for Specifications, Design and Drawings

a) Specifications

RDSO/ MORTH / CPWD, KPWD specification / other Specifications / Codes viz. IS, IRS, IRC, DSR etc. shall be procured by the Contractor from the market. One set of these specifications shall always be kept at contractor's site office for reference.

Standards guaranteeing a level of quality or performance equivalent or superior to those indicated will also be accepted. Reference to trademarks or other specific designations that is necessary to explain the nature of the products required means that any other product of equal or superior quality or performance is also acceptable, subject to prior approval of the ENGINEER to be obtained in writing for adopting the new standards which are not provided in the contract.

b) Drawings for Permanent Works:

- i. Preliminary Drawings as listed showing general dimensions & details elaborating the scope of work (not based on detailed design) are supplied along with the bid documents. These drawings are broadly indicative of the work to be carried out. These drawings are not "Construction Drawings" and details indicated therein are for general guidance only and shall be modified by the Contractor, to incorporate additional details as per design, and as described in the Specifications.
- ii. The Permanent Work shall be carried out in accordance with the "Good for Construction" (GFC) drawings as would be issued to the Contractor by the Engineer duly signed and stamped. The Contractor shall not take cognizance of any drawings, designs, specifications, etc. not bearing Engineer's signature and stamp. Similarly, the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Engineer/Employer in writing. Construction drawings shall be supplied progressively by the contractor during execution of work well in time for each activity.
- iii. GFCD/Advance copies required for the next three months' work shall ordinarily be given by the Contractor for his planning, procuring etc.
- iv. The "Good for Construction" drawings to be prepared by the contractor after the award of work.
- v. No deviation shall be made from GFCD drawings by the contractor.

c) Design, Drawings and Specifications for Temporary/ Ancillary works.

- i. Contractor's proposal for erection of all Ancillary and Temporary works shall be in conformity with the proposals submitted along with the bid and / or as approved by Engineer.
- ii. The contractor would design all the Ancillary and Temporary works including temporary supports, false work, formwork, staging scheme etc. and will submit the same and related working drawings to the Engineer for approval, after getting check by an independent third-party designer. Bar Cutting and bending schedule for the reinforcement, shop drawings for fabrication work etc. shall also be prepared by the Contractor and submitted for Engineer's approval.

iii. Shop drawings

- (a) Based on "Good for Construction" drawings issued by the Contractor, the Contractor shall prepare shop/fabrication drawings to scale as specified, indicating the required details. The shop drawings shall be prepared before execution of work, after taking actual site dimensions and all existing and proposed services/structures etc.
- (b) Shop/Fabrication drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, breakdown for packing and shipment, the external connections, fixing arrangements required, the dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required between various portions and any other information specifically called for.
- (c) All reference points shall be in relation to the levels and locations, given in the Architectural and Services drawings duly cross-checked on site and confirmed. All locations and levels should be indicated with respect to grid and reduced levels with respect to the Bench Mark adopted for the Project and indicated in the drawings issued by the Engineer.
- (d) The Contractor shall verify the dimensions of all the necessary structural, architectural, Mechanical, Electrical & Plumbing (MEP) Services and other elements, relevant to the system being done, before proceeding with the preparation of the shop drawings and proceeding with the physical work at site and make suitable adjustments to accommodate within the spaces available.
 - i. Approval of Engineer of any such proposal / drawings shall not relieve the contractor of his responsibility of sufficiency of such works.

ii. Drawing Management

- a) The Contractor shall submit all such drawings for Temporary / Ancillary works and shop drawings to the Engineer well in advance before he desires to commence the works and get the same approved from the Engineer. These drawings should be submitted only after they have been duly detailed, checked and verified within the Contractor's organization ensuring that the details and data shown/furnished on the drawings are correct and that the requirements of other disciplines have been taken care of. The names and complete signatures of the Contractor's personnel responsible for the drawings shall be contained on each drawing. Any drawing which does not contain the above names and signatures shall be summarily returned to the Contractor and treated as not having been submitted.
- b) The drawings submitted for approval shall be in any one of the standard sizes - AO, A1, A2, A3 or A4, in accordance with Indian standards.
- c) All drawings shall show the following particulars in the lower right-hand corner in addition to the Contractor's name.
 - i. Project Title
 - ii. Name of the Employer
 - iii. Name of Consultant
 - iv. Contract No.
 - v. Title of Drawing.

- vi. Scale
 - vii. Date of Drawing.
 - viii. Contractor's Drawing Number.
 - ix. Space for the Engineer's drawing number.
 - x. Name of the Engineer.
 - xi. Name of Review Consultant.
 - xii. This drawing is based on Drawing No. (s).
 - xiii. Further detail is given on Drawing No. (s).
- d) Each drawing shall carry a revision number, date of revision and brief details of revisions carried out. Whenever any revision is carried out, the revision number must be updated. The revisions carried out on the drawing shall be clearly marked by clouding and each cloud revision numbered by marking the revision number in triangle.
- e) All dimensions on drawings shall be metric units, unless otherwise specified. However, all levels shall be in meters.
- f) A template with the above information shall be got approved from K-RIDE before start of the work.
- g) All shop drawings shall be prepared on CAD using AUTO-CAD Version 2010 or higher.
- Shop drawings shall be prepared for the following works:
- i. Reinforcing bar bending schedules
 - ii. Working drawings for placing of reinforcement
 - iii. All form works, Shuttering and Scaffoldings
 - iv. Shop/Fabrication drawings for structural steel for PEB
 - v. Metal work (ferrous and non-ferrous) for inserts, structural work in built up sections etc.
 - vi. Seismic joints
 - vii. Expansion joints
 - viii. Construction joints
 - ix. Waterproofing
- h) Drawing Management at Site
- i) The Contractor shall ensure that all drawings (to be laminated at contractors' cost) meant for further engineering, fabrication, erection and field work are issued to his personnel in a controlled manner - a proper record shall be maintained to show to whom the drawing is issued and to ensure that the latest revisions of the drawing is being followed for further work. All superseded drawings shall be promptly withdrawn from the personnel to whom

they are issued and stamped "SUPERSEDED" in RED. The Contractor shall maintain a register of drawings, with their revision/issue number, as received from the Engineer and a record of their distribution to the designated personnel within their organization. A certificate to that effect along with list of drawings withdrawn during the month will be incorporated in the monthly progress report.

- j) The Contractor shall maintain at Site a set of the drawings issued by the Engineer on which changes shall be progressively marked and initialed by the Engineer so that "As-Built" drawings can be made correctly and expeditiously at the end of their Work at Site.
- k) Revision of Approved Drawings for Temporary/ Ancillary and Shop Drawings If, at any time before the completion of the Work, changes are made necessitating revision of approved Shop drawings/ drawings for Temporary/ Ancillary works, the Contractor shall make such revisions and proceed in the same manner and observe procedure for obtaining approval of the Engineer as for the approval of the original drawings.

l) Documents by Contractor

The contractor shall submit to the Engineer, for approval, Quality Assurance plans, design calculations, material specifications for each item and system, samples, as may be called for in the Specifications or as the Engineer may reasonably require. Wherever necessary the Contractor shall provide as built dimensions to facilitate proper Good for Construction drawings being prepared for various construction detailing.

- m) Number of Copies of Drawings for Temporary/ Ancillary works/ Shop drawings and Documents

All Shop drawings / drawings for Temporary and Ancillary works, Documents, Schedules etc. and revisions thereof shall be submitted by the Contractor to the Engineer in 6 copies. Copies required in excess of these shall also be borne by the Contractor at his own cost.

d) Completion Drawings

On completion of the work in all respects the contractor shall submit the following

- i. Two sets of "As Built Drawings" in the standard sizes of A0, A1 each containing complete set of drawings for every component of work on approved scale indicating the work "As Built". Each set shall also contain technical literature.
- ii. These drawings shall be prepared on CAD using Auto-Cad version (latest/as directed by Engineer) and shall be recorded on writable CDs and one set of these CDs shall also be submitted.
- iii. Four sets of catalogues of all manufactured materials with the name and addresses of the manufacturers for all equipment are provided by him.
- iv. The Contractor shall also submit one set of original "As Built" drawings on polyester film or as directed by Engineer of quality as approved by Engineer/ Engineer's Representative.

The Certificate of Completion of Works as per the provisions in the General Conditions of Contract shall not be issued by the Engineer in the event of Contractor's failure to furnish aforesaid "As Built" drawings for the entire works.

e) Plans and Drawings for Layout of Plant and Equipment

The Contractor shall submit the following information, in triplicate, to the Engineer, for approval, within the time stipulated against each item given below:

- i. A general layout plan for construction plant and equipment required for execution of work, within thirty days from the date of issue of "Letter of Acceptance".
- ii. Drawings or prints showing the locations of major facilities which he proposes to put up at site, at least fourteen days prior to the commencement of the respective work; and
- iii. Any other details and drawings as required under the contract, within the time as specified in the contract.

Cost of all the above activities shall be deemed to be included in the quoted rates of various items of the Price schedule and nothing extra shall be paid for on this account.

12. TRAFFIC MANAGEMENT

- 12.1 The Contractor shall make the detailed traffic diversion plans in consultation with Bengaluru Traffic Police. The work is to be executed with proper liaison with Bengaluru Traffic Police. Necessary assistance will be given by K-RIDE. The scheme should be such that minimum of two lane of traffic on each direction of the road should be available for the smooth flow of traffic. The Contractor should inspect the site.
- 12.2 The permanent traffic diversions will be carried out in consultation with traffic police. Contractor has to provide traffic diversion proposals, traffic marshals, cones, traffic diversion boards etc., as desired by Traffic Police.
- 12.3 Traffic barricade with reflective tapes, traffic signage's, traffic sign board, signals, road delineator reflective lights, traffic cones, deployment of adequate man power for 8hrs shift day and night management and other necessary provision should be provide wherever required so that safety is ensured during day and night continuously. Temporary traffic diversion for smooth flow of traffic during construction including necessary traffic signs, repairs to the diverted routes/service lanes.
- 12.4 It includes but not limited to Diversion to other adjoining parallel roads or other suitable roads including strengthening of the same and all provision and maintaining the flow of traffic towards the diverted route with minimal inconvenience to the flow of affected traffic and close liaison with Traffic Department of Bengaluru.
- 12.5 The Contractor shall take necessary and adequate measures to ensure uninterrupted traffic flow within the work area during the currency of the work. It shall be the responsibility of the Contractor to provide suitable and acceptable diversions for the passage of the traffic. Contractor shall ensure that at no time, his construction equipment interrupts the movement of the traffic on the road and IR Track.

- 12.6 The Contractor shall prepare a comprehensive Traffic Management Plan. The contractor shall also draw a phased program for traffic arrangements / diversions and get it approved from the Engineer and Traffic Police well in advance with respect to every stage of construction.
- 12.7 If traffic diversions require construction of temporary roads and / or improvement of the existing roads, the design / drawings for the same including diversion of utilities etc. (if required) shall be prepared by the Contractor using the specifications not inferior to that of the existing roads / utilities and get it approved from the Engineer/Employer and Traffic Police. Payment for the same shall be made under relevant item of PRICE SCHEDULE.
- 12.8 Before taking up the work in a particular stretch, all the traffic diversions plan applicable to that particular area shall be implemented as per the approved plans / drawings and trial runs carried out to the entire satisfaction of Engineer / Traffic Police. If during trial runs some modifications are suggested, the same shall be also being carried out before start of work.
- 12.9 The contractor shall take all necessary measures for safety of traffic during construction and provide, erect and maintain such barricades (as approved by Engineer) having marking with reflective paint, signs / sign boards, pavement markings, flags, lights, traffic marshals and flagmen as may be required and / or directed by the Engineer for guiding, information and protection of the traffic approaching or passing through the stretch. Red lanterns or flashing warning lights of suitable type spaced suitable intervals mounted on barricades along the diversions shall be provided and kept operational and maintained throughout from sunset to sunrise.
- 12.10 There could be locations where below the station structures, there is running traffic underneath which may not be stopped / diverted and will continue to move uninterrupted during construction and post -construction periods. In case of the pre-cast elements there could be locations where ground just below the launching area is not accessible or restricted due to traffic movement. The contractor should take care of these factors in to account while deciding the construction methodology / launching scheme for cast-in-situ / precast construction. Nothing extra will be paid for such eventualities.

13. LIGHTING AND FIRE PREVENTION

- a) Wherever night working is carried out by Contractor, temporary lighting arrangements as per approved layout shall be provided, installed, maintained for the duration of the contract and removed after completion of work by and at the expense of the Contractor.
- b) Flashing lights to warn the traffic on roads shall be used at all times on all obstructions.
- c) Contractor shall provide and maintain adequate firefighting equipment and take adequate fire precautions for the safety of all personnel, plant, and material including temporary and permanent works and shall take action to prevent damage to or destruction by fire of trees, shrubs and grasses.
- d) No extra payment will be made for the provision of temporary lighting, flashing lights and fire prevention measures and entire cost of all such work shall be deemed to have been included in the lumpsum cost of Price schedule.

14. UTILITIES

Necessary permanent diversion of utility services (Charted utilities) shall be undertaken by Employer through separate agency/contract. The Contractor will liaise with the Utility Diversion contractor for carrying out the work expeditiously wherever required so that works at particular locations are not delayed. In case he comes across any utilities (Uncharted utilities) also he will liaise with the agency concerned for necessary diversion; the cost of diversion shall be paid by Employer under the relevant item of Schedule-C of Price schedule. Contractor shall provide any temporary support for the utilities if called for, but at no extra cost.

All charted underground and overhead utilities will be shifted by K-RIDE, whether it is temporary or permanent diversion. However, during execution of work if any uncharted utilities are met, the contractor shall temporarily support or temporarily divert the same at his own cost. In case if this is not possible as decided by Engineer, then the same will be permanently diverted by the contractor and the payment will be made under respective item in the relevant payment schedule of Works under KPWD/BWSSB/BESCOM-SR 2019-20 (Schedule-C).

For the existing utilities owned by Railways, where the shifting thereof can take place only after certain works for its shifting have been completed by the Contractor, the Authority shall, undertake and complete its shifting.

The tender utilities drawings are only indicative. Contractor should make his own survey for identification of underground/above ground utilities;

New utilities: In the event the construction of any Works is affected by a new utility, the Contractor shall be entitled to a reasonable Time Extension in accordance with the provision of contract.

14.1 Damage to Utilities

The contractor shall be responsible for any theft, damage and / or protection of all the existing utilities within the site of work during currency of the Contract. In case of any theft/ damage occurring to these utilities while working or otherwise, the contractor shall immediately inform the Engineer's representative as well the utility owning agency and restore the same immediately to the entire satisfaction of the utility owning agency. Any damage due to working / negligence / fault of the Contractor (decision of Engineer in this regard shall be final and binding), the same shall be repaired / made good by the Contractor at his own cost. Any damage/ compensation / penalty etc. if charged by the utility owning agency in this regard shall also be payable by the Contractor and no claim in this regard shall be entertained by the Employer. Contractor shall always keep indemnified the Engineer / Employer against this.

15. BARRICADING OF SITE AND WORK AREAS

The contractor shall provide temporary barricade during construction at site, work areas (i.e., Construction Depot, store, site office, casting yard etc.) and locations where road vehicles / pedestrians are moving, along the at-grade section/ Viaduct / Stations / Construction sites as directed by Engineer. The above work shall be executed as per the technical specifications. The contractor shall provide & maintain barricading as per the drawings.

16. INTERFACE WORKS

In addition, the Contractor shall be required to carry out various interface works as per interfacing requirements. An Approved interfacing Manual will be supplied to the contractor, which needs to be followed by the contractor for all interfacing works.

The Scope of interface works for various interfacing Contracts E.g., Architectural finishes, MEP, Signaling & Telecommunication, Automatic Fare Collection, Traction Power & Power Supply, Track work, Rolling Stock, Noise barrier etc., shall be but not limited to as described below

- i. Architectural finishes
- ii. MEP works
- iii. Fixing arrangements for OHE for traction, Signaling post, Telecommunication structures, AFC, SCADA, Lifts, and Escalators etc.
- iv. ASS and TSS Room size and layout, openings in slab and viaduct beams, foundations and cable trays/ ducts/ hangers.
- v. Traction Power earthing arrangements- Grid earthing.
- vi. Layout of AFC Equipment in concourse, Raceways and cable trays/ power sockets required for AFC Equipment.
- vii. Rolling Stock- structure gauge/ schedule of dimensions etc. yellow line marking on platform.
- viii. Location and sizes of platform supervisory panels.
- ix. Location of rear-view mirror Train operation group,
- x. Location Layout, sizes, Shafts, walls, power supply for lifts and escalators
- xi. Construction of Utility Rooms
- xii. Cable ducts/cables/hangers/trays/raceways for routing all type of cables, cross- track cast in cable ducts, space cut-outs to the ceiling /wall finishes for mounting clocks, telephones, public address system equipment etc.
- xiii. Foundations for UPS unit, DG set and other equipment as required.
- xiv. Foundations for antenna mounting tower structure.
- xv. Space and mounting arrangement for work stations /control panels and other equipment.
- xvi. Earthing and lighting protection.
- xvii. The track supporting structure for elevated station will support ballast less track having long welded rails, which will be laid later on by another contractor. Arrangements required for provision of such ballast less track will have to be incorporated in the deck / track area within stations in consultation with the Engineer. On the portion where ballast less track concrete is to be laid, the top of the deck slab shall

be finished rough and dowel bars/shear connectors left in the deck slab, as directed by the Engineer, for proper keying up further concrete layers and/or casting blocks which will form part of Track Work to be done by another Contractor.

- xviii. The contractor to interface the work with station building contractor. The arrangements required for dowel bars/ shear connectors for beam, slab, column connection to be made by viaduct contractor as directed by Engineer. The lumpsum price is inclusive of same.

17. RESPONSIBILITIES OF CONTRACTOR

17.1 Casting Yard

The land for setting up two numbers of casting yard and stacking yard as required shall be arranged by the Contractor at his own cost. However, assistance can be provided by K-RIDE by giving recommendatory letters etc., to the concerned authorities. The desirable area for each casting yard shall be 7 to 8 acres. Casting yard shall have following minimum facilities.

- a. Casting beds as required.
- b. Sets of form work /moulds as required.
- c. All handling facilities for precast elements like over gantry, etc.
- d. Curing arrangements as required.
- e. Stacking arrangements for material and precast elements.
- f. Storing arrangement of materials.
- g. Proper drainage and all-weather approach roads.

17.2 The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, except for the items specified in the Price schedule and the cost being held to be included in the Contract lumpsum cost.

17.3 General works such as setting out, site clearance on completion of works. All weather approach roads to the site office should also be constructed and maintained in good condition.

17.4 All labor, materials, plant, equipment and temporary works, overhead charges as well as general liabilities, obligations, insurance and risks arising out of GCC, required completing and maintaining the works to the satisfaction of the Engineer.

17.5 Adequate lighting for night works, and also at other times whenever and wherever required by the Engineer.

17.6 All equipment, instruments, labor and materials required by the Engineer for checking alignment, levels, slopes and evenness of surfaces measurements and quality etc. Shall be arranged by the contractor

- 17.7 Design mixes and testing them as per relevant clauses of specifications giving proportion of ingredients, sources of aggregates and binder along with accompanying trial mixes. Test results to be submitted to the Engineer for his approval before adoption on works.
- 17.8 Method Statements, for each main activity of the work (temporary and permanent) to be executed detailing the purpose, scope, resources required, sequence / procedure of execution, persons responsible, time frame, safety requirements & measures, risk analysis, Inspections, and Test Procedures along with standard values / acceptable criteria etc. duly approved by the Engineer before start of that particular activity at site.
- 17.9 Contractor shall also prepare / approve and make available to the Site Engineer the work procedure for each sub-activity to be done at the site, detailing the procedure / process to be followed including work sequence, safety measures, to be followed, level of quality to be maintained, type of material to be used, type of finishing required and responsibility assigned etc.
- 17.10 Preparation and compliance with provision of a quality assurance control programme.
- 17.11 Prepare and submit Standard Quantities for the purpose of billing based on the approved drawings.
- 17.12 Safety measures and requirements of site safety plan
- i. The Contractor shall make adequate security arrangements for 24x7 protection of Temporary and permanent works and deployed resources.
 - ii. The Contractor shall be responsible for the security of the Site for the full time the Site is in its possession, except for the specific case after handover to the Employer. The contractor shall set up and operate a system whereby only those persons entitled to be on the Site can enter the Site. To this end, the Contractor shall with the consent of Engineer provide the specific points only at which entry through the security fence can be affected and shall provide gates and barriers at such points of entry and whereby maintain a twenty-four (24) hours security guard, and such other security personnel and patrols elsewhere as may be necessary to maintain security.
 - iii. The Contractor shall maintain all site boundary fences in good condition and shall so arrange site boundary fences at all access drainage points of work areas that it's use of such access points etc., are not restricted by the system or method of achieving the required security measures. Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.
 - iv. During the progress of the Works the Contractor shall maintain such additional security patrols over the areas of the Works as may be necessary to protect its own and its sub-contractor's work and equipment and shall co-ordinate and plan the security of both the work under this Contract and the work of others having access to and across the Site and the Works.
 - v. In order to operate such a security system, it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Site, and which may need to be separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system and the design of passes to suit the requirements of the foregoing and to suit the methods of work to be adopted by the Contractor. The Contractor

shall at all times ensure that the Engineer has an up-to-date list of all persons entitled to be on the Site at any time. The contractor shall also introduce a system of issue passes to any outsider or person/vehicles belonging to agencies other than employer/ Engineers who may have to visit the site in connection with work.

- vi. The Contractor shall liaise with the Designated Contractors and the contractors responsible for the adjacent and other interfacing contracts and ensure that coordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the Site and/or the adjacent sites in the latter periods of the Contract.
- vii. Security and checking arrangements as felt necessary shall be provided with advice and help of Police.

17.12.1 Safe guarding the environment.

17.12.2 The contractor shall carry out expeditiously and without delay the following works

- a. Identify and get approved the sources of various major construction materials.
- b. Material testing and mix designs of concrete as contemplated in the specifications.
- c. Setting up of fully fledged site laboratory as per the requirements.
- d. Setting up concrete batching & mixing plant.
- e. Contractor's site office setup.
- f. Casting yard with complete facilities.
- g. Any other pre-requisite items required for final execution.
- h. Any other items specified in other sections of contract.

18. ASSOCIATED WORKS DEEMED INCLUDED IN LUMP SUM COST OF PERMANENT WORKS

18.1 Contractor's Organization and Plant & Equipment

Project Organization Plan

- (1) The Contractor's Personnel shall be deployed & maintained in consultation with Engineer and as per the requirements. The Contractor's Superintendence shall be also properly deployed and maintained to carry out the construction activities as described in the relevant General Conditions of Contract (GCC) clause.
- (2) The Contractor shall submit an updated Project Organization Plan which includes complete project organization chart during the Construction Phase adding functions and personnel necessary to perform the Works during the Construction Phase in accordance with the conditions of the Contract. This plan shall be updated and resubmitted whenever there are changes to the staff and / or the organizational structure. The plan shall show the management structure and state clearly the duties, responsibilities and authority of key staff member.

- (3) The contractor shall deploy the key personnel of requisite qualification and experiences. In case Engineer instructs (in writing) the Contractor to remove a person of his work force stating the reasons, the Contractor shall ensure that the person leaves the Work Area within seven days and shall have no further connection with the Works in the Contract. The Engineer shall also seek prior consent of the Employer in this regard.
- (4) During the Construction Phase, the Contractor shall maintain the Design Team in his organization independent of the Construction Team to deal with Preliminary design, definitive design and working drawings.
- (5) The minimum requirements for man-power are attached as **Appendix 4 [Organization charts and key positions]** to the Employer's Requirement.

Plant and Equipment

- a) The minimum Plant and equipment as shall be maintained in consultation with Engineer and as per the requirements.
- b) The minimum requirements for plant & equipment are attached as **Appendix 5 [Plant and Equipment]** to the Employer's Requirement.

19. PENALTY FOR NON-COMPLIANCE

Notwithstanding the provisions elsewhere in the bid documents, the Contractor shall be penalized as detailed below:

- a) Correction of Defects

If the Engineer determines that any item or part of it was constructed with bad workmanship and / or using sub-standard construction materials,

Sl. No.	Nature of Defects (Indicative only)	Penalty (Rs.)
1.	Not maintaining plumb line, level in concrete works / observing honey combs on the finished surface of concrete	1,00,000/- each case
2.	Usage of unapproved / sub-standard materials	2,00,000/- each case

The above said penalty is envisaged to act as deterrent against bad workmanship and usage of sub-standard construction materials by the Contractor and shall be imposed for every occurrence. These penalties are non-refundable.

Appendix 01

1. PROGRAMME REQUIREMENTS

1.1 General

1.1.1 Construction programme and project monitoring

- I. The contractor shall propose and submit his detailed construction program separately and as per the procedure detailed in the scope of work. Contractor may be asked to schedule and complete the work block wise / area wise in a phased manner fixing priorities to different stretches of the work to give access to other interfacing contracts as mentioned in the Bid documents.

- II. The tentative construction program shall be submitted within the period as specified in the Bid document for approval of the Engineer as 'Baseline Program'. The base line program shall clearly reflect interface and access dates for other civil/ system-wide contracts. The basis of the time schedule for each activity such as productivity of man and machines and time cycle of each activity and resource planning shall be submitted along with the base line program.
 1. After the work has started, the Contractor shall deliver in the first week of every month to the Engineer an update of the Construction Program showing changes, if any, in planning or progress scheduling and reflecting the progress of all the activities of the network and the project status as at the end of previous month.
 2. If the Contractor falls behind the approved Construction Program by more than one month, he shall, within fourteen days of the date of such information, submit for approval, a revision of the construction program showing the proposed measures, including augmentation of plant, labor and material resources to complete the works on time.
 3. Whenever the Contractor proposes to change the construction program, he shall immediately advise the Engineer in writing and, if the Engineer considers the change a major one, the Contractor shall submit a revised program for approval.
 4. Detailed Network Plan (Works Program): Detailed Network Plan shall be prepared by the Contractor for each and every activity within the same time frame and in the same sequence. Activity at this level shall not be more than 15 days' duration, except for summary items like procurement/ mobilization etc.

- III. The Contractor shall select a PC-based broad planning and control software (licensed version of Primavera, M.S. Projects etc.). The two networks shall be implemented on works as detailed in the Scope of work. The Contractor shall supply one original licensed copy of the software selected including manuals and any subsequent versions thereof at no extra cost along with the Baseline program network and detailed network plan and load it on the PC system of the Engineer so that uniform monitoring of the project is done and any slippages are identified well in time and corrective action taken. The contractor shall also arrange suitable training of the personnel of Engineer on the selected software, if required, at no extra cost.

- IV. The following reports, in agreed formats and frequency, shall be submitted by the Contractor at his own cost:
 - i. Progress Reports

- ii. Material Status Reports
 - iii. Equipment and Manpower Deployment Reports
 - iv. Any other Report desired by the Employer or the Engineer
- V. The Engineer's monitoring team will have access to all the data/information of the Contractor, required for the assessment of the progress and monitoring. If necessary, the monitoring team will visit the Vendor/Contractor's works in order to assess the status of critical activities.
 - VI. Periodic Project Status Review Meetings will be held by the Employer or the Engineer. The Contractor shall depute his Engineers/Managers at appropriate level as decided by the Engineer to attend the Review Meetings.
 - VII. Progress photographs of the major events shall be submitted by the Contractor along with the Progress Reports. Video Recording of the progress of works shall be maintained from beginning till completion of work as directed by the Engineer.
 - VIII. The Contractor shall provide additional inputs whenever the PERT-CPM/ network diagram (Primavera/ MS Projects) indicates a possible slippage in the completion schedule. Such additional inputs may require supplementing of equipment, personnel, work in excess of the normal work per day, and work in excess of the normal work per week or other resources. Provisions in the relevant Clause of General Conditions of Contract will be applicable in cases of delays due to Contractor.

1.1.2 Purpose of Program

- a) The purpose for the requirement of Program (Scheduling) information described in this document is to provide the Engineer with status reports for managing, monitoring and coordinating the awarded contract during the execution within the overall multi-contract project schedule. It describes a series of reports to be submitted by the Contractor to the Engineer during the execution of the contract, following the award of Contract.
- b) The Bidder/ Contractor shall program his work at all times to meet the Key Dates and the Works Area Hand-over Dates specified in the bid documents and the specified interface periods for the design and installation of the Works with those of the Designated Contractors and shall during the progress of the Works constantly monitor his progress against the programs described below.
- c) The Bidder/ Contractor shall include in all programs his work obligations towards shared access, shared Site areas and other coincident or adjacent Works Areas.
- d) The Works Program, and all more detailed or revised versions, shall be submitted to the Engineer for his consent.

1.2 Methodology

- 1.2.1 The computerized MSP / Primavera network using the Precedence Diagramming Method (PDM) has been selected by the Employer as the technique for contract management system and in coordinating the multi-contract project. This technique shall also be employed by the Bidder in preparing their Bid submissions and by the Contractor in their Construction Stage submissions.
- 1.2.2 Unless otherwise agreed by the Engineer, all programs submitted by the Contractor shall be produced

using computerized MSP / Primavera Networks developed implementing the Precedence Diagramming Method (PDM) with Resource Loaded Charts and Tables.

- 1.2.3 The Contractor shall implement and use throughout the duration of the Contract, a computerized system to plan, execute, maintain and manage the planning, design, pre-construction, construction, and sub-contracts in executing the MSP / Primavera scheduling by PDM. The reports, documents and data shall be provided monthly and shall be an accurate representation of the current status of the Works and of the work remaining to be accomplished; work planned to be taken up during next month, shall provide a sound basis for identifying problems, deviations from the planned works, and for making decisions; and shall enable timely preparation of the same for presentation to the Engineer.

1.3 Programme management software

MSP / Primavera programming software used shall be Primavera-v P 6 or any other latest version of software's Scheduling software.

1.4 Submissions

- 1.4.1 The Contractor shall develop his Program into the Initial Works Program including an outline Narrative Statement and submit within 28 days of the date of receipt of Letter of acceptance and its more detailed version within 15 days of receiving the Engineer's consent to the proposed Initial Works Program.
- 1.4.2 Activities in the initial works program should be arranged as per the Works Break down Structure (WBS) of the work. The WBS of the work would be developed by the contractor in consultation with the Engineer. Contractor would get the WBS approved by the Engineer and the program expert.
- 1.4.3 The first Three Month Rolling Program shall also be submitted along with Initial Works Program within 28 days of the date of receipt of Letter of Acceptance and all subsequent editions shall accompany the Monthly Progress Report. The Monthly Progress Reports shall also include a Program Update as described below. These programs shall subsequently be updated as described below.
- 1.4.4 Following the Engineer's consent to Contractor's Initial Works Program submission, the contractor shall make submissions of the Detailed Works **Program** suitably amended to take into account the programs of Designated Contracts. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to review, revise and finalize his Initial Work Program so as not to affect the progress of Works/ and or the works of the Interfacing Contractors. The resubmitted program when approved by the Engineer and the program expert shall form the **Baseline Program** against which actual progress of the Contract shall be reckoned. As the work progresses, it may be necessary to update/ revise the Baseline program but such updating shall only be carried out with the prior consent of the Engineer or when directed by them.
- 1.4.5 For Initial & Detail Work Program submission, one (1) original and six (6) copies each (along with electronic copy) of the following Programs and Reports shall be submitted to the Engineer:
- a) Program: Baseline MSP / Primavera Network
 - b) Program: Baseline Milestone based Cost Activity Schedule
 - c) Baseline Schedule Report
 - d) Narrative
 - e) Baseline Physical Progress 'S' curve
 - f) Baseline Resource Charts (with Resource leveling)
 - g) Detailed Method Statement

- 1.4.6 The Engineer shall review and comment on the Contractor's programs and information submitted. The Engineer will confirm his consent or otherwise of the submissions.
- 1.4.7 The Engineer shall require the Contractor to re-submit within fifteen (15) calendar days if he is of the opinion that the programs and information submitted by the Contractor is unlikely to meet the Contract key dates.
- 1.4.8 If in the opinion of the Engineer, any of the Contractor's revised programs or Baseline Schedule Report is not acceptable, it shall be construed as a failure of the Contractor to meet a Milestone.
- 1.4.9 Notwithstanding the above, the Engineer may at any time during the course of the Contract require the Contractor to reproduce the computer-generated Baseline Schedule Report described above to reflect actual activity dates and generate schedules based upon "what if" statements. The initial computer-generated report after receiving the Engineer's consent will serve as the base against which the contract progress will be measured. Any changes to the Report reflected in subsequent Baseline Schedule Reports shall also require the Engineer's consent.
- 1.4.10 Failure to include any element of work required for performance of the Contract shall not relieve the Contractor from completing all works required under the Contract to achieve the original or any extended key completion date.

1.5 Works Programme

- 1.5.1 The Works Programme shall show the Contractor's plan for organizing and carrying out whole of the Works.
- 1.5.2 The Works Programme shall be a computerized MSP / Primavera network developed using the Precedence Diagramming Method (PDM) and shall be present in bar chart and time-scaled network diagram format to a weekly time scale.
- 1.5.3 Tasks in the Works Programme shall be sufficiently detailed to describe activities and events that include, but are not limited to, the following:
- (a) Key Dates, and Works Area Hand-over Dates and Interface dates.
 - (b) All physical work to be undertaken in the performance of the Contract obligations, including Temporary Works,
 - (c) The requested date for issue of any drawings or information by the Engineer,
 - (d) Procurement of major materials and the delivery and/or partial delivery date on-Site of principal items of Contractor's Equipment,
 - (e) Commissioning date of Contractor's major equipment
 - (f) Any off-site work such as production or pre-fabrication of components,
 - (g) Installation of temporary construction facilities,
 - (h) Interface periods with Designated Contractors or utility undertakings,
 - (i) Design, supply and/or construction activities of sub-contractors,
 - (j) Any outside influence which will or may affect the Works.
- 1.5.4 The Works Programme shall show achievement of all Key Dates, Interface dates and Works Area Hand-over Dates. The Works Program shall also show all Milestones, but the Milestones shall not be taken as imposing any constraints that in any way affect the logic or limit any other dates in the program.

- 1.5.5 Activity descriptions shall be unique, describing discrete elements of work. Any activity creating an imposed time or other constraint shall be fully defined by the Contractor.
- 1.5.6 The Works Programme shall be organized in a logical work-breakdown-structure including work stages and phases, and shall clearly indicate the critical path(s).
- 1.5.7 Activity duration shall not exceed 15 days, unless otherwise consented to by the Engineer, except non-construction activities such as submittals, submittal reviews, procurement and delivery of materials or equipment and concrete curing. The Contractor shall submit a Program/Project Calendar cross reference clearly indicating the allowance for holidays.
- 1.5.8 The Works Program, in each submission, shall be accompanied by an Activity Report and a Narrative Statement as described below in both electronic and hard copy format (time scale logic diagrams in A1/A3 size, reports in A4 size).
- 1.5.9 **Activity Report** shall list all activities, and events in the Works Program, sorted by activity identification number.

The Activity Report shall include the following for each activity and event:

- i. Activity identification number and description,
- ii. Duration expressed in Days,
- iii. Early and late start & early and late finish dates. Planned start and finish dates,
- iv. Calculated total float and free float,
- v. Predecessor and successor(s), accompanying relationships and lead/lag duration,
- vi. Imposed time or date constraints,
- vii. Calendar.

1.5.10 Narrative Statement

The Narrative shall be a comprehensive statement of the Contractor's plan and approach for the execution of the Works and the achievement of key dates, handover dates, submission dates and any intermediate dates. It shall incorporate outline method statements in respect of major items of work including construction sequences, launching scheme, resources required including primary item of plant, Construction Equipment required, person responsible, quality checks, inspection and test procedures, tolerances, Temporary Works and the like, risk analysis, etc. for carrying out that activity. It shall fully explain the reasons for the main logic links in the Program and include particulars of how activity duration is established. This shall include estimated quantities, production rates, hours per shift, work days per week and a listing of the major items of Construction Equipment planned for use on the project. Activities, which may be expedited by use of overtime or additional shifts, shall be identified and explained. A listing of holidays, and other special non-work days being used for the computer reports shall be included.

1.5.11 Baseline Physical Progress 'S' Curve

The Contractor shall also submit a forecast Cumulative Physical Progress 'S' curve based on the time-phased distribution of cost in the MSP / Primavera Network Logic Diagram, expressed in percentage terms. This 'S' curve shall be generated from the computerized MSP / Primavera Network Logic Diagram.

1.5.12 Baseline Resource Charts

The Contractor shall also submit a Resource Charts, generated from the Contractor's MSP / Primavera Network Diagram, showing the anticipated manpower and main Construction Equipment usage during the execution of the Project. The Resources shall be properly leveled using primavera VP6 software.

All submissions of proposed Works Programs subsequently, after approval of the Initial Works Program, shall include the actual physical progress of work and forecast of the remaining work. Actual progress shall be stated in percent complete, remaining duration, and actual start and finish dates for each activity in the Works Program.

1.6 Initial Works Programme

- 1.6.1 The Initial Works Programme submitted as under Clause 1.4.1 need not include the full details given under Clause 1.5 above. It should be a condensed version with combined activities of longer duration but must show clearly how the requirements of the Contract are to be achieved. Activities in the initial works program should be arranged as per the Works Break down Structure (WBS) of the work. The WBS of the work would be developed by the contractor in consultation with the Engineer. Contractor would get the WBS approved by the Engineer. The outline Narrative Statement shall be in sufficient detail to clearly show the Contractor's intention.
- 1.6.2 Within 15 days of the Engineer's consent to the Initial Works Program, the Contractor shall submit to the Engineer an expanded and more detailed version of the Initial Works Program containing all of the information and detail required under Clause 1.4 and 1.5 above.
- 1.6.3 Such submission shall make use of the Program submitted earlier but refined to include the best estimates of dates for the work of Designated Contracts which has impact on the Contractor's program. Such programs shall be amended subsequently to incorporate the actual dates/ schedule of the affecting contracts. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to finalize the Initial Program, without affecting progress of the work.

1.7 Works Programme Revisions

- 1.7.1 The Contractor shall immediately notify the Engineer in writing of the need for any changes in the Works Program, whether due to a change of intention or of circumstances or for any other reason. Where such proposed change affects timely completion of the Works or any other Key Date the Contractor shall within fourteen (14) days of the date of notifying the Engineer submit for the Engineer's consent its proposed revised Works Program and accompanying Narrative Statement. The proposed revised Works Program shall show the sequence of operations of any and all works related to the change and the impact of changed work or changed conditions.
- 1.7.2 If at any time the Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Program, he may request the Contractor to submit a proposed revised Program which together with an accompanying Activity Report and Narrative Statement, shall be submitted by the Contractor within fourteen (14) days after the Engineer's instruction. The proposed revised Works Program shall show the sequence of operations of any and all work related to the change and the impact of changed work or changed conditions. Revisions should not affect the overall completion of the project.
- 1.7.3 All activities that have negative float must be analyzed by the Contractor to identify the impact on the timely completion of the Works or on the achievement of Key Dates.

1.8 Three-Month Rolling Programme

- 1.8.1 The Three-Month Rolling Programme shall be an expansion of the Detailed Works Program, covering sequential periods of three months. The Three-Month Rolling Program shall provide more detail of the Contractor's plan, organization and execution of the work within these periods. In particular, the Contractor shall expand each activity planned to occur during the next three (3) month period, if necessary, to a daily level of detail.
- 1.8.2 The Three-Month Rolling Program shall be developed as an MSP / Primavera network, and shall be presented in bar chart and time-scaled network diagram format. Bar charts shall be presented on an A4 and time-scaled networks diagrams on an A3 size reproducible media. Tasks in the program shall be derivatives of and directly related to tasks in the approved Works Program.
- 1.8.3 The Contractor shall describe the discrete work elements and work element inter-relationships necessary to complete all works and any separable parts thereof including work assigned to sub-contractors within the contract period.
- 1.8.4 Activity duration shall not exceed two (2) weeks unless and otherwise consent of Engineer is granted.
- 1.8.5 Each activity in the Three-Month Rolling Program shall be coded, or described so as clearly to indicate the corresponding activity in the Works Program.

1.9 Three-Month Rolling Programme Revisions and update

- 1.9.1 The Three-Month Rolling Programme shall be extended forward each month as described under Clause 1.8.1 above. Each submission of the Three-Month Rolling Program shall be accompanied by a Program Analysis Report, describing actual progress to date, and the forecast for activities occurring over the next three-month period in order to achieve progress as per the approved Works Program.
- 1.9.2 If the Three-Month Rolling Program is at variance with the Works Program, the Program Analysis Report shall be accompanied by a supporting Narrative Statement describing the Contractor's plan for the execution of the activities to be undertaken over the three-month period, including program assumptions and methods to be employed in achieving timely completion.
- 1.9.3 The Contractor shall revise the Three-Month Rolling Program or propose revisions of the Works Program, or both, on a monthly basis to ensure consistency between them.
- 1.9.4 Three-Month Rolling Program (revised) to be submitted on a monthly basis by 5th of every month with respect to the progress achieved by the last day of the previous month. A penalty of Rs. 100,000/- (Rupees One Lakh) per instance will become applicable to the contractor for non-submission of the revised Three-monthly rolling program as per above clauses, irrespective of the causes lead to variances if any and the penalty will be deducted in the subsequent IPC which will be non-refundable.

1.10 Weekly review

Once a week, on a day mutually agreed to by the Engineer and the Contractor, a meeting will be held to assess progress by the Contractor during the previous week, progress review which will also be attended by the programs Expert and the Contractor's Program Engineer. The Contractor shall submit a construction schedule listing activity completed and in-progress from the previous week and the activities scheduled for

the succeeding two weeks based on the detailed Works Program. Copies of the schedule shall be submitted on A3 sized papers.

1.11 **Project Calendar**

For the Project, the Contractor shall adopt 7 days a week calendar, identical calendar for the purpose of programming and Execution of Works. Official documents shall be transacted during 6 days' week – Monday through Saturday. For Project purposes, a week begins at 0001 hours on a Monday and ends at 2359 hours on a Sunday. The completion of an activity or the achievement of an event when given a week number shall be taken to mean midnight on the Sunday at the end of the numbered week. An access date or activity start date when given as a week number shall be taken to mean 0001 hours on a Monday of the Numbered week.

1.12 **Programming Personnel**

The Contractor shall submit, as part of its Staff Organization Plan, the names and required information for the staff to be employed on Works Programming. The principal Works Programmer shall hold reputable professional qualifications acceptable to the Engineer including at least five (5) years relevant experience in programming civil engineering works. Others in the group shall have at least three (3) years' experiences in such work. The programmers shall be employed by the Contractor full time on the Contract until the completion or such earlier time the Engineer may give his consent.

1.13 **Programme and Report Submission Format**

The Contractor shall submit one (1) original and six (6) copies and one (1) reproducible (for Programs) of all submissions to the Engineer. All submissions shall be in A0, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Engineer. In addition, the computerized program and report shall be submitted in compatible discs. The format for all Program and Report submissions shall be strictly in accordance with the format as stated herein or as requested by the Engineer.

2. MONTHLY PROGRESS REPORTS

2.1 General

The Contractor shall submit to the Engineer, a Monthly Progress Report. This Report shall be submitted by the end of each calendar month and shall account for all work actually performed from 26th day of the last month and up to and including the twenty-fifth (25th) day of the month of the submission. It shall be submitted in a format to which the Engineer shall have given his consent and shall contain sections/sub-sections for, but not be limited to, the topics listed in clauses below.

2.2 Physical Process

- a) It shall describe the status of work performed, significant accomplishments, including critical items and problem areas, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues, problems and resolutions.
- b) It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Program.

2.3 Programme Update (For Entire Project)

Programme updating shall include

- (a) The monthly Program Update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the twenty-fifth (25th) of the month together with estimates of remaining duration and expected activity completion based on current progress. The Program Update shall be accompanied by an Activity Report and a Narrative Statement. The Narrative Statement shall explain the basis of the Contractor's submittal:
 - (i) Early Work and Baseline Submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in the Contract.
 - (ii) Updated Detail Program Submittals – state in narrative the Works actually completed and reflected along Critical Path in terms of days ahead or behind allowable dates. Specific requirements of narrative are:
 1. If the Updated Detailed Work Programme indicates an actual or potential delay to Contract Completion date or Key Dates, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Dates or mitigate potential delays. Identify deviation from previous month's critical path.
 2. Identify by activity number and description, activities in progress and activities scheduled to be completed.
 3. Discuss Variation Order Work Items, if any.
- (b) The Program Status which shall: -
 - (i) Show Works Program status up to and including the current report period, display Cumulative

progress to date and a forecast of remaining work.

(ii) Be presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings;

(c) The Activity Variance Analysis which shall analyze activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Program.

2.4 Three Month Rolling Program

The monthly issue of the Three-Month Rolling Program.

2.5 Financial Status

It should include following

- a) A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.
- b) A spread sheet indicating the status of all payments due and made.
- c) A status report on status of extra items, if any

2.6 Status of Claims

A report on of the status on any claims outstanding. The report shall in particular provide interim updated accounts of continuing claims.

2.7 Milestones/Key Dates Status

A report on the status of all milestones/ key dates due to have been achieved during the month and forecasts of achievement of any non-achieved key dates and those due in the next month

2.8 Resources Status

2.8.1 The Contractor shall submit to the Engineer each month a detailed list by trade classification, of manpower employed during the report period, stock of all major construction materials as also a list of all serviceable major items of construction plant and equipment on site including those which are proposed to be mobilized during the next month.

2.8.2 A report on the status of deployment of all key personnel and other manpower by trade Vis – a - Vis their deployment schedule and explaining constraints if any.

2.8.3 Status of stock of all the major construction material vis -a- vis its requirements for next month.

2.8.4 Status of all serviceable major construction plant and equipment at site.

2.9 Procurement Report

2.9.1 A summary of all significant procurement activities during the month, including reasons of delay (if any) and action taken to overcome problems.

2.9.2 A report listing major items of plant and materials which will be incorporated into the Works. The items shall be segregated by type as listed in the Specifications and the report should show as a minimum the following activities:

- (a) purchase Order Date – Scheduled/ Actual,
- (b) manufacturer/ Supplier and Origin,
- (c) letter of Credit Issued Date,
- (d) manufacturer/ Supplier Ship Date – Scheduled/ Actual,
- (e) method of Shipment,
- (f) Arrival Date in India – Scheduled/ Actual.
- (g) Arrival date at site and commissioning date

The report should also explain the delays (if any) in arrivals of the major equipment at site and the actions taken by the Contractor to expedite the same and the measures proposed to makeup the time loss.

2.10 **Production and testing**

It should include following:

- (a) A review of all production and manufacturing activities during the month.
- (b) Summaries of all production and manufacturing outputs during the month together with forecasts for the next month.
- (c) Review of all testing activities (both at site and at the manufacturer's premises) during the month.

2.11 **Safety**

A review of all safety aspects during the month including safety inspections / audits, reports on all accidents and actions proposed to prevent further occurrence.

2.12 **Environment**

A review of all environmental issues during past month shall include all monitoring reports, mitigation measures undertaken, and activities to control environmental impacts.

2.13 In case of failure of the Contractor to make submissions as per section 1.4 herein above, the Employer/ Engineer shall retain 5% of the due progress payment till the submissions. For non-submission of Monthly Update and Progress Reports as per Clause 2 herein above, the Employer/ Engineer shall retain 5% of

the due progress payment in each case, which shall be released upon submission of the same. In case the submissions are not made in the month it is due, the retained payment would be released only in the next Monthly Running Bill.

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Appendix-02

METHOD OF MEASUREMENTS FOR PERMANENT WORKS

1. INTRODUCTION

- 1.1 The detailed procedure to be followed for the recording of measurements and for the preparation and passing of Contractors Bills for permanent works is set out in the following paragraphs.

2. MEASUREMENT OF WORKS

2.1 General

- 2.1.1 Measurements shall be taken at such intervals as are found necessary or convenient. Generally, one bill will be preferred in a month or as specified in the contract.
- 2.1.2 Entries should be made only in ink, and no entry should be erased or defaced so as to make it illegible. Correction of mistake, if any, shall be made by neatly crossing out the incorrect entry and rewriting and correct words or figures. All such corrections should be initialed by the Contractor's Engineer as well as by the Engineer's Representative at site.
- 2.1.3 Format of Record of Measurements sheets and procedure for issue of these measurement sheets shall be as decided by Engineer / Employer.
- 2.1.4 Before starting the earth work for embankment, cutting, bridge excavations etc., the initial ground levels shall be taken jointly along with engineer.

2.2 Items for which Good-for-Construction GFC Drawing is issued

- 2.2.1 As soon as the Good-For-Construction GFC drawing for a work is issued, the Contractor will calculate the details of quantities of various items of PRICE SCHEDULE involved, in a format approved by Engineer, and submit the calculations and schedule of quantities to the Engineer / Engineer's Representative and get them approved for the drawing.
- 2.2.2 Once the schedule of quantities is thus approved, the Contractor will submit five copies of the approved schedule to Engineer's Representative in an approved format.
- 2.2.3 The Contractor will submit his payment claims based on the approved schedule of quantities along with certification of actual work done as per specifications, drawings and contract conditions and within the tolerances as specified. Measurement will be entered in Record of Measurement Sheet duly signed jointly on each page by Contractor's authorized qualified engineer and Engineer's Representative.
- 2.2.4 Abstract of measurement will be prepared by the contractor in the approved form based upon these measurements.

2.3 **Items for which Good-For-Construction GFC Drawing is not issued**

- 2.3.1 For all such works, whose measurement cannot be calculated from any Good-For-Construction (GFC) drawing, all measurements will be taken by the Contractor's authorized qualified Engineer in the presence of the Engineer's Representative at site. These measurements will be recorded on approved form of Record Measurement Sheet and signed jointly by contractor and Engineer's Representative.
- 2.3.2 Contractor will ensure that a properly qualified Engineer is deputed for taking measurements and also that all the measurements taken are witnessed and signed by the Engineer's Representative.
- 2.3.3 All measurements should be recorded at site on the Record of Measurement Sheet in the presence of the Engineer's Representative.
- 2.3.4 Each Measurement Sheet should be signed by the Contractor's Engineer as well as by the witnessing Engineer's Representative.
- 2.3.5 Based on the recorded measurement contractor will prepare abstract of quantities in the approved format.

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Appendix-03

1. QUALITY ASSURANCE

1.1 General

The Contractor shall implement a Project Quality Management Plan in accordance with ISO-9001 “Quality System – Model for Quality Assurance in Design/Development, Production, Installation and Servicing” or any other system as approved by Engineer to ensure that all materials, workmanship, plant and equipment supplied and work done under the contract meets the requirements of the contract. This plan shall apply to all activities related to the quality of items, including designing, purchasing, inspecting, handling, assembling, testing, storing, and shipping of materials and equipment and different elements of construction work and installations of system components.

The Quality Plan to be prepared by the Contractor and submitted to the Engineer shall follow the requirements of ISO 9001 and address each element therein. This Quality Plan / QA manual, specific to this work must be submitted within one month of award of contract.

Running on account payment will be released after the following milestones are achieved and Engineer has issued a ‘Notice of No Objection’ or a Notice of No Objection subject to (specifying the condition)’.

- a. Release of on-account payment after two months of signing the contract agreement – On submittal of QA Manual duly approved by Engineer. Otherwise, 10% of the running bill be withheld till compliance.
- b. Closure of Non-conformance Report – Action taken on non-compliance and its closure to be ensured within 15 days of issue of non-conformance report. In case of non-closure of report, running on-account bill will be withheld @ 1 % of amount for every non closure, till the same are closed satisfactorily.
- c. Release of on-account payment after four months and thereafter every 3 months from the date of start of work – On submittal of Internal Quality Audit Report duly reviewed by Engineer and Action Taken Report. Otherwise, 10% of the running bill be withheld till compliance.
- d. Release of Final bill
 - ii) Closure of all non-conformance Report
 - iii) Submittal of all quality documented record pertaining to monitoring and accountability including QA Manual & Procedures

Registration of the Contractor’s organization, or subcontractors or sub-consultants is not required for this Project but the Project Quality Management Plan as submitted shall meet the intent of the ISO 9001 requirement in that there is a comprehensive and documented approach to achieving the project quality requirements.

1.2 Quality Assurance Management Plan

The Project Quality Management Plan (PQMP) shall as a minimum address the quality system elements as required by ISO 9001, generally noting the applicability to the Contractor’s Works Program for the Project. Procedures or Quality Plans to be prepared by others (Suppliers, Subcontractors, and Sub-

consultants) and their incorporation in the overall PQMP shall be identified.

The Contractor shall provide and maintain a Quality Assurance Plan (QA) to regulate methods, procedures, and processes to ensure compliance with the Contract requirements. The QA Plan, including QA written procedures, shall be submitted to the Engineer for his review.

Adequate records shall be maintained in a readily retrievable manner to provide documented evidence of quality monitoring and accountability. These records shall be available to Employer at all times during the term of the Contract and during the Defects Liability Period and for a five-year period thereafter.

The Plan shall identify:

- a. Design Process: that control, check and verify the accuracy, completeness and integration of the design shall be performed by certified personnel and in accordance with documented procedure that have the written consent of the Engineer.
- b. Special Processes: that control or verify quality shall be performed by certified personnel and in accordance with documented procedures that have the written consent of the Engineer;
- c. Inspection and Test: Inspection and testing instructions shall provide for reporting non-conformances or questionable conditions to the Engineer; Inspection shall occur at appropriate points in the installation sequence to ensure compliance with drawings, test specifications, process specifications, and quality standards. The Engineer shall designate, if necessary, inspection hold points into installation or inspection planning procedures;
- d. Receiving Inspection: These procedures shall be used to preclude the use of non-conforming materials and to ensure that only correct and accepted items are used and installed;
- e. Identification and Inspection Status: a system for identifying the progressive inspection status of equipment, materials, components, subassemblies, and assemblies as to their acceptance, rejection, or non-inspection shall be maintained;
- f. Identification and Control of Items: an item identification and tractability control shall be provided;
- g. Handling, Storage, and Delivery: provide for adequate work, surveillance and inspection instructions.
- h. The Plan shall ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, and defects in materials and equipment shall be promptly identified and corrected.
- i. The Plan shall provide for establishing, and maintaining an effective and positive system for controlling non-conforming material including procedures for the identification, segregation, and disposal of all non-conforming material. Dispositions for the use or repair of non-conforming materials shall require the Engineers consent.

1.3 Plan Implementation and Verification

The Plan shall clearly define the QA Organization. Management responsibility for the QA shall be set forth on the Contractor's policy and organization chart. The Plan shall define the requirements for QA personnel, their skills and training. Records of personnel certifications shall be maintained and monitored by the QA

personnel. These records shall be made available to the Engineer for review, upon request.

The QA operations shall be subject to the Engineers, Employer or Employer's authorized representative's verification at any time, including: surveillance of the operations to determine that practices, methods and procedures of the plan are being properly applied; inspection to measure quality of items to be offered for acceptance; and audits to ensure compliance with the Contract documents.

The contractor's Quality Audit Schedule shall be submitted to the Engineer for consent every three months or more frequently as required.

The results of Quality Audits shall be summarized in the Contractor's monthly reports.

The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer to carry out on-site and off-site surveillance of Quality Assurance Audits to verify that the quality system which has the consent of the Engineer is being implemented fully and properly.

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Appendix-04

ORGANISATION CHART AND KEY POSITIONS

The Contractor shall provide the following organization chart for the Works as follows:

Head office Organization Chart

One organization chart shall be provided for the Contractor head office indicating the management and staff structure, with responsible personnel/departments described for all aspects of the work.

Site organization Chart

The Contractor shall provide the proposed site organization indicating the proposed structure, staff partners and positions necessary to adequately manage and control the Works.

The Contractor shall have a competent team of Managers, Engineers, Technical staff etc. so as to complete the work satisfactorily as per various requirements of the contract.

The Key Positions not limited to and corresponding qualification and experience are as under:

Sl. No	DESIGNATION	QUALIFICATION	EXPERIENCE LEVEL (FOR SIMILAR WORKS)	MIN. NO. REQUIRED
1	Project Manager (Team Leader)	Bachelor's Degree/Post Graduate Degree in Civil Engineer	Minimum 18 years total experience and 5-year experience in the role of Project Manager in the execution of similar type of work	1
2	Deputy Project Manager/ Construction Manager	Bachelor's Degree in Civil Engineer	Minimum 12 years total experience and 5-year experience in the role of Construction Manager in the execution of similar type of work.	8
3	Design manager	Post Graduate Degree/ Bachelor's Degree in Structural Engineer	Minimum 15 years total experience and 10-year experience in the role of Design Manager in the execution of similar type of work	2
4	Deputy Project Manager/ Construction Manager for Mechanical & Electrical	Bachelor's Degree in Mechanical Engineer	Minimum 12 years total experience and 8-year experience in execution of similar type of work.	2
5	QA & QC Manager.	Bachelor's Degree in Civil Engineer	Minimum 12 years total experience and 8-year experience in the role of QA&QC Manager in the execution of similar type of work.	2

Section 8A: EMPLOYER'S REQUIREMENT – GENERAL INFORMATION AND SCOPE OF WORK

Sl. No	DESIGNATION	QUALIFICATION	EXPERIENCE LEVEL (FOR SIMILAR WORKS)	MIN. NO. REQUIRED
6	Chief Safety and Health Manager	Bachelor's Degree in Civil Engineer & Diploma in Safety Course.	Minimum 10 years total experience and 8-year experience in the role of Chief Safety and Health Manager in the execution of similar type of work.	4
7	Traffic Coordinator	Bachelor's Degree in Civil/Transportation Engineer	Minimum 10 years total experience and 5-year experience in the role of Traffic Coordinator in the execution of similar type of work.	4
8	Interface manager	Bachelor's Degree in Civil/Mechanical /Electrical Engineer	Minimum 10 years total experience and 5-year experience in the role of Interface manager in the execution of similar type of work.	2
9	Planning Manager.	Bachelor's Degree in Civil Engineer with Knowledge of M.S Project Software	Minimum 12 years total experience and 5-year experience in the role of Planning Engineer in the execution of similar type of work.	2
10	Geotechnical Engineer	Bachelor's Degree in Civil/ Geotechnical Engineer	Minimum 8 years total experience and 3-year experience in the role of Geotechnical Engineer in the execution of similar type of work.	2
11	Billing Engineer/ Quantity Surveyor.	Graduate/ Diploma in Civil Engineering	Total minimum experience of 5 years with knowledge of computer applications for Degree and 8 years for Diploma with knowledge of Computer applications.	2
12	Procurement Specialist	Graduate/ Diploma in Civil Engineering	Minimum 5 years in relevant field.	2
13	Senior Civil Engineer	Bachelor's Degree in Civil Engineer	Total minimum 7 Years for graduate & 10 years for Diploma in relevant field.	15
14	Civil Engineer	Bachelor's Degree in Civil Engineering	Total minimum experience 5 Years	25
15	Electrical and Mechanical Engineer	Bachelor's Degree in Electrical and Mechanical Engineering	Total minimum experience 5 Years	05
16	Junior Civil Engineer	Diploma in Civil Engineering	Total minimum experience 4 Years	45
17	JE (Electrical and Mechanical)	Diploma in Electrical and Mechanical Engineering	Total minimum experience 4 Years	05
18	Safety Engineer/ Officers	Bachelor's Degree in Civil Engineer & Diploma in Safety Course	Total minimum experience 5 Years	10

NOTES:

1. The above categories of key positions shall be minimum required for successful completion of the work which shall be deployed at different points of time as per the progress and requirement of work and may not be required to deploy simultaneously and continuously. However, these personnel shall be deployed at site in advance as per requirement and as directed by the Engineer and the decision of Engineer in this regard shall be final and binding. **The above Manpower deployment plan** shall be submitted by the contractor within the 14 days of award of work and shall be approved by Engineer in charge / Employer.
2. The Contractor shall submit the CVs of the above key positions to Engineer for his approval within 28 days of issue of letter of Acceptance (LOA).
3. The contractor shall deploy resources as per the above-mentioned minimum requirement and also confirm to deploy manpower over and above the minimum numbers indicated above, if the work requires so.
4. The performance of project personnel deployed will be evaluated periodically by Employer during the contract period. In case the performance of any of the project personnel is not satisfactory, the Contractor shall replace them with better or equivalent personnel immediately as per directions of the Engineer.
5. Tenderer may propose any number of names of Personnel for each Key Position. Any of the proposed personnel as approved by the Employer for each key position have to be mandatorily deployed in case of award of work.
6. Non-deployment of the Key personnel as per approved personnel for Sl.no 1,2,6 &10 as per approved manpower plan leads to imposition of Penalty of Rs 2,00,000 /- Per Key personnel per month. For other personnel, a penalty of Rs. 50,000/- per person per month shall be levied.
7. The proposed Key personnel are not to be changed till the completion of the work. Under emergent circumstances, in case they are required to be changed, the new incumbent should have similar or better experience and qualification than as required above. These changes are permitted only with the approval of the Employer. Change in key personnel for one time without penalty is permitted. However, for subsequent changes there will be Penalty at Rs 2,00,000 /- Per Key personnel for Sl.no 1,2,6 &10.
8. All Key Personnel must be permanently stationed at Bangalore till the completion of the work.
9. The penalties imposed are non-refundable.

Appendix-05

PLANT AND EQUIPMENT

Sl. No.	Type of equipment required for the work	Proposed to be deployed (Minimum)	Remarks
1.	Piling Equipment Rotary Rig/Hydraulic Rig for soil boring and rock boring including diamond bits and core barrels for rock boring.	8 Nos	
2.	Piling rig (Tripod) with conventional winch	16 Nos	
3.	Fully Automatic and Computerized Batching Plant -2 Nos. (1 of 60 Cum/h and other one of 45 Cum/h) minimum or equivalent capacity in different configuration at casting yard with a RO of suitable capacity for proper quality of water.	2 Nos	
4.	Concrete boom placers	4 Nos	
5.	Concrete pumps with sufficient pipes	6 Nos	
6.	Transit Mixtures	20 Nos	
7.	Pile cap Shutters	18 sets	
8.	Pier and pier cap Shutter, staging and supporting arrangement for all type of Piers	18 Sets	
9.	Pre cast Post tension shutter staging support for Casting of Pier caps	2 Beds with Shutters	
10.	Pre cast post-tension I Girder Beds along with necessary shutter and support arrangements	2 Beds with Shutters	
11.	Portal shuttering & staging of required capacity in Viaduct	13 Nos	
12.	Minimum number of pre-casting beds for Box/U girders along with shutters and supporting for straight and curved spans.	12 Nos of long line and 12 Nos for S1 segments.	
13.	Launching Girder to Launch Box segments as per site requirements (Maximum permissible age in years is 10 Years)	4 Nos	
14.	The suitable launcher for U-girder launching fully automatic, capable of negotiating 200m radius curve and 4% gradient, speed of trolley carrying U-girder for launching with load 2km/hr. and without load 3km/hr. to be mobilized. The minimum of two numbers of LG for launching of U-girders with motorized bogies for handling and transportation of U-girders to be mobilized.)	2 Nos	

15.	250 MT or more capacity suitable cranes for erection of I Girders / RCC Portals, super structures of Viaduct work	4 Nos	
16	Crane of suitable capacity for Erection of LG girders, /U Girders.	4 Nos	
17	Cranes in casting yard/site of suitable capacity	4 Nos	
18.	Gantry of suitable capacity in casting yard	6 Nos	
19..	Trolley to transport U Girder of 200 Mt weight over the erected span	4 Nos	
20.	Trailers for carrying U Girder/Box segments of Suitable capacity as per site requirement including MAV (Multi axial vehicle)	4 Nos	
21.	Trailers for carrying I Girders/Pier caps and other Precast elements of Suitable capacity as per site requirement	2 Nos	
22.	Gantry for parapet erection	3 sets	
23.	Man-lift for adequate height	10	
24.	Crash Barriers & Friction slab Shutters	8 Sets	
	Road work, Embankment and cutting works.		
25.	Hydraulic excavator (1 cum bucket)	4 Nos	
26.	Tippers/trucks (10 cum capacity)	20 Nos	
27.	Dozer of suitable capacity	3 Nos	
28.	Front end loader with suitable capacity	3 Nos	
29.	Crane 5 MT capacity	2 Nos	
30.	Crane 35 MT capacity	2 Nos	
31.	Generators 125 KVA	4 Nos	
32.	Vibratory roller 8-ton capacity	2 Nos	
33.	Smooth wheeled roller 8-ton capacity	2 Nos	
34.	Pneumatic road roller	1 No	
35.	Tandem road roller	1 No	

36.	Water tanker of 6000 lit capacity	4 Nos	
37.	Grader	2 Nos	
38.	Back hoe loader of suitable capacity	3 Nos	
39	Plate Vibratory Roller	2 Nos	
40	Slope Compactor Roller	2 Nos	
41	Survey equipment's: Total stations and auto level	3 sets	

NOTES:

1. The above type of plant and equipment (but not limited to) may be required for execution of the work. The contractor shall submit the details of plant & equipment to be deployed in the above table within 28 days of issue of LOA to the Engineer for approval.
2. Plant and Equipment indicated above is minimum to be deployed at appropriate stage of the work. However, depending on the requirement to complete the work in the stipulated completion period, the tenderer should deploy additional machinery as circumstances warrant at no extra cost.
3. Plant and equipment to be mobilized for the work shall be in good serviceable condition.

Appendix-06

OFFICE ACCOMMODATION AND EQUIPMENS

1.0 Accommodation for the Engineer/Employer.

1.1 The contractor has to provide the following

- Office accommodation of approx. 300 sqm (with approx.30% area as air-Conditioned) for the Engineer as per enclosed drawings x 3 nos.
- Site Office in the casting yard(s) measuring 80 sqm for site engineers x 2 nos.

The Contractor has to design the office by considering the following parameters, Design and Build Pre-Fabricated office consists of super structure made of Steel sections and profiles incorporating columns, wall frames, trusses, purlins, bracings, ties etc. The foundation will be made by the contractor where the anchor bolt made of M.S. round 12mmdia. And 18" length (opening at the bottom) will be grouted to hold the building strongly.

Car sheds for parking of 9 nos. Car Pre-coated profile rust proof GI Corrugated sheets conforming to IS: 2096: 1992.

Outer wall cladding:

Material: High Density Fiber-Reinforced Cement Boards Conforming to: IS: 14862:2004/ IS: 5476:2004
Size: 2.44mtr x 1.22mtr, 12mm/10mm thick Resistant to: Heat, moisture and fire.

Inner wall cladding:

Material: High Density Fiber - Reinforced Cement Boards Conforming to: 14862: 2004 Size: 2.44mtr x 1.22mtr, 10mm thick Resistant to: Heat, moisture and fire.

False Ceiling:

GI-powder coated (T & L) grid system and high-density fiber reinforced Cement board size (1200 x 1200) mm, 6mm thick are having density of 1250 Kg/m³ conforming to ASTM-E84, ISI 14862-2004, respectively.

Door:

7X3.5 Teak wood door – (Main Door). Brass Fittings. PVC Doors for bathroom. Glass door for cabins

Windows:

Aluminum windows 2 track Sliding windows with M.S grill

Tiles:

Vitrified tiles (Scratch Proof)
Bath rooms Floors-Antiskid tiles

Plumbing:

CPVC Pipes for internal work and PVC for outer walls.2.5" PVC SWR Pipes. All Fittings to be of ISI standards. Ceramic Fixture Hardware.

Electrical Wiring:

Concealed wiring with fire proof cables with switches and fans and office ceiling lights fluorescent lamp (LED/CFL)

Painting:

Inside: primer one coat +2coats of emulsion paint. Outside:1coatprimer+2 coats of weather proof Bathroom Fittings with overhead water tank and septic tank, Washbasin, EWC and pipe fittings.

Networking:

Wiring with CAT6E cable with switches and router connector point as per the approved Plan.

Arranging the office accommodation on hired/lease basis as per requirement throughout the project period.

Instead of constructing new project office contractor can arrange Hire /Lease basis office space as provided in PRICE SCHEDULE. In case contractor provides project office on hire basis the payment will be made on pro rate basis during the contract period.

- 1.2 The Contractor has to provide the following furniture/facilities for engineers at his own cost.
The contractor has to provide the following furniture/facilities **at each project office and site office.**
- a. Manager's Table: size 5'x3' L-table with side cadenza complete with laminate finish 5 Nos. (4 Nos. at project office and 01 Nos. at site office in casting yard)
 - b. Executive Table: size 4'x3' table with side cadenza complete with laminate finish 6 Nos. (4 Nos. at project office and 02 Nos. at casting yard)
 - c. Conference Table: 14-person seating (12'x4') -01 No (at project office)
 - d. Workstations: size 4'x5'. Modular workstations green ply makes with merino Laminate and storage cabinets-12 Nos (10 Nos. at project office and 02 Nos. at site office in casting yard)
 - e. Workstations: Modular size 4'x3' straight workstation with partition and storage. Cabinets under the working counter as per the approved plan-10 Nos (10 Nos. at project office)
 - f. Chairs: High back revolving manager's chair with fabric finish- 3Nos (02 Nos. for Project Office & 01 Nos. for Site Office).
 - g. Medium back revolving chairs with FRP finish- 17 Nos. (14 Nos. for Project Office & 03 Nos. for Site Office).
 - h. Low back revolving chairs with FRP finish- 24 Nos (For Project office only)
 - i. Three-seater steel waiting chair- 4 nos.
 - j. White magnetic boards and pin boards in each room/work stations and one projector with screen for conference room (For Project Office only).
 - k. Racks & shelves as per requirement in all chambers and office use.

- I. Supplying, erection, testing and commissioning of Off-Line UPS system suitable for operation with all accessories on sufficient power back up (with minimum backup time of 2 hours) including 12 V DC, AH Batteries in polypropylene container for UPS low maintenance tubular batteries, to meet the sufficient power load in case of power disruption (for project office)
- m. Split A/C- 1.0 Tone. Capacity with required voltage stabilizer – 03 Nos (02 Nos. at project office and 01 Nos. at site office in casting yard) and 1.5 Tone capacity- 04 Nos in project office

In addition, Contractor shall provide the following for Project Office:

- a. Telephone & Broad band Connection -2 P & T line + 10-line intercom with instruments & Broad Band Connection.
- b. Digital Photocopy Machine (Up to A3 size)- 01 No
- c. Refrigerator (290 Liter) -01 No
- d. Hot case – 02 No
- e. Drinking Water Dispenser (Hot & Cold) - 01 No
- f. Tea/Coffee Dispenser -01 No
- g. Standby DG Power-As required to run and maintain both the officers
- h. Safety Helmets, Boots and any other safety device-As per Requirement

Furniture's

- i. Side units with table - 8 sets
- ii. Filing cabinet (36 lockers) – 8 No.
- iii. Lockers cabinet (36 lockers) – 02 No.
- iv. Steel Cupboard - 05 No.
- v. Fax Machine - 02 No.
- vi. Digital Camera – 01 No.

- 1.3 The Contractor is required to maintain the offices throughout the contract period and provide the following, but not limited to;
 - i. Pay all electricity, phone & water charges and Broad band.
 - ii. Provide all stationery items and consumables for office use
 - iii. Carry out necessary repairs to office and equipment as and when required
 - iv. Bottled water.
 - v. Tea and Coffee
 - vi. Crockery including cups and saucers for office use
- 1.4 Fire extinguishers shall be provided in accordance with the recommendations of the Bangalore City Fire Brigade.
- 1.5 The Contractor shall provide erect and maintain appropriate name boards as specified for each of the offices. The wording on each name board and its location shall be agreed by the Engineer before it is erected.
- 1.6 The Contractor shall supply the following personnel as required for the use of Employer's representative.

• Office Assistants / Secretary	02 No's
• CAD Operator	02 No's

- Watchman Round the clock

2.0 Equipment for the use of Engineer/Employer.

The Contractor shall provide new equipment and software at each office as listed and maintain them for the exclusive use of the Employer and the Engineer.

(a) Computers (with computer table) – 02 No's, the computers shall be Intel core i7 or its latest generic descendent or higher, running at a clock rate of not less than 3.4 GHz. (Hyper technology) with no wait state, If the Central Processing Unit has no floating-point arithmetic capabilities, a math-coprocessor shall be installed.

A minimum of 256 megabytes with software configurable into extended memory and expanded memory. The expanded memory shall be one combo drive (DVD, R/CD RW), Hard disk size min 500GB (7200 RPM) 22" color monitor – 04 nos. and 18" color monitor – 02 nos.

(b) Lap Top Computer – 01 nos.

1. Processor: Intel core i7 or higher, 5.0 GHz (hyper technology) with in-built LAN, Modem, AGP card, Audio Card, and Wi-Fi Internet Card.
 - i. Cache Memory: 512 KB L2 cache
 - ii. Memory: 4GB DDR RAM Expandable up to 8GB
 - iii. Hard Disk: 500 GB
2. Display: 22" TFT at 1920X1080 resolutions, S3 VIRGE MX 3D Graphics Controller Chip, 64 Bit Graphics Accelerator, Bit BLT hardware
3. Pointing Device: 102 multimedia Keyboard Acupoint Point Device
4. Ports: 1 Parallel, 1 Serial, 2USB Port, PS/2 Mouse/Keyboard, SVGA Video Port, Line in Jack, Headphone & External Microphone Jack, 1 Serial Infrared Port, USB port with Wi-Fi LAN.
5. Card Bus: 2 x PCMC1A Slots (Type II) or 1 x PCMC1A Slot (Type III) Card Bus ready.
6. Battery / Power: AC Adaptor/Li-Lon rechargeable battery with built in battery charger & Software Power Management.
7. OS/Software: Pre-installed Windows X professional with Service Pack 2, latest version of MS office, Windows Utilities, Mediamatics Arcade Pak, Diagnostic Utilities, Ring Central, MS Internet Explorer, Norton Anti-Virus, Speech activated typing software, latest version of MS Project /primavera.
8. Communication: 56 Kbps Integrated Fix / data Modem with V.90 support.
9. Carrying Case: Notebook / Laptop carrying case

(c) Printer – 03 nos. (A4 size – 02 No. and A3 size – 01 No.)
One Printer each of A3 & A4 size shall be Color.

(d) Languages:

(i) Python (latest version), Java and any other language as directed by the Engineer.

(e) Application Software:

- Microsoft office, latest release,
- A database management package to be selected by the Employer / Engineer.
- Latest version of AUTOCAD Civil 3-D, for 05 users.
 - ❖ Project Management Package (Microsoft Project) or Primavera V. P6-2 licenses (1 Core Module and 1 Web based Module)
 - ❖ Multimedia

(f) UPS system with sufficient power backup (with minimum backup time of 1 hr.) to meet the sufficient power load in case of power disruption.

(g) Surge Protection Devices (one for each computer and printer as given above) Power supply for the systems is to be AC 240 volts, 50 Hz from normal building wiring circuit mains, Power regulator, stabilizer or transformer should be supplied by the Contractor for the computer systems such that the systems can function efficiently.

Note: These items under Clause 2.0 above will be retained by contractor except 2.0 (e)-Application Software.

3.0 Documentation

3.1 A complete set of documentation will be supplied with each System. The documentation should be self-tutorial in nature and be readily understood by non-computer personnel.

The following manuals will be supplied with the system:

- a. Manual on how to operate the equipment; and
- b. Manual on how to use the facilities and software provided by the supplier.
(Including languages and utilities)

4.0 Auto CAD Operator:-

The contractor shall provide one experienced Auto CAD operator exclusively for the Office of the Engineer till six months beyond the date of completion of contract.

APPENDIX 7:
DOCUMENT SUBMISSION AND RESPONSE PROCEDURE

1. PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

The Contractor shall utilise a PMIS integrating with BIM software such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer office at site and the Employer's Office by the Contractor.

IFC format (Industry foundation Classes)

IFC list format is a platform neutral format. Hence all/any BIM program used by tenderer should provide files in IFC format for interoperability between different BIM programs.

2. SUBMISSIONS TO THE ENGINEER

The general requirements are as follows:

2.1 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

- 1) The Employer shall provide a web-based information management system of transmittal for formal project correspondence, documents and information to ensure efficient information management on the Project. Where it is necessary to transmit original signed documents, these shall be acceptable forms of correspondence only when they have been issued via the system first.
- 2) The Employer shall provide the Project-wide use of the system during the Design and Construction Phases and also the Defects Notification Periods.
- 3) The system shall be capable of issuing a list of outstanding responses from the Engineer 7 days before the due date of the response.

2.2 DRAWING AND SPECIFICATION REGISTER

The Contractor shall submit drawings and specifications register to the Engineer in electronic copy and hard copy with each submission of drawings and at an interval agreed by the Engineer. The drawings and specifications register shall be in a format submitted for review and agreed without objection by the Engineer and shall include each document reference number, version, date, title and data-file name.

3. RECORDS AND REPORTS

3.1 FORMAT

Reports and records are to be submitted via the system to the Engineer and shall be in a format agreed by the Engineer. Reports and records shall be signed prior to submission by the Contractor's agent or by a representative authorized by the Contractor.

3.2 PROJECT DOCUMENT CONTROL PROCEDURE

Within twenty-eight (28) days after Commencement Date, the Contractor shall submit via the system a Project document control procedure to the Engineer for review, which shall include but not be limited to the following:

- 1) a document approval system which shall specify the level of authority for approval of all documents and material before submission to the Engineer;
- 2) a system of issuing documents to ensure that pertinent documents are issued to all appropriate locations;
- 3) a document change or re-issue system to ensure that only the latest revision of a document can be used; and
- 4) a submission identification system that identifies each submission uniquely by the following:
 - a) contract number;
 - b) discipline;
 - c) submission number; and
 - d) revision indicator.

3.3 PROJECT RECORD

Project records will eventually be used by the Employer to manage, operate and maintain the Works after the completion of the Project under construction and for future reference.

3.4 ADEQUACY OF THE PROJECT RECORD

The Contractor shall submit the documents as required by the Engineer as Project records in full and on time. The Engineer shall determine the adequacy of the Project record.

4. SUBMISSION AND RESPONSE PROCEDURE

4.1 GENERAL

Except where specific procedures are given for certain items, all submissions shall be submitted and reviewed according to the procedure laid down in the following clauses.

4.2 PROPOSAL

Each submission shall be accompanied by a brief introduction to explain which sub-system, part or section of the Works to which the submission refers, listing the documents enclosed with the submission, and describing in outline how all relevant requirements of the Employer's Requirements are achieved by the proposals.

4.3 SUBMISSION RESPONSE REQUEST

For each stage of submittal, the Contractor shall prepare a Submission Response Request (SRR) carrying the date of submission, the submission reference number as defined in Clause 2.2 (4) above, the submission title, the stage of submission (e.g., Technical Design, etc.), and the authorized signature of the Contractor's responsible engineer to confirm that, in the opinion of the Contractor, the submission:

- 1) complies with all relevant requirements of the Employer's Requirements;

- 2) conforms to all interface requirements;
- 3) contains, or is based on auditable and proven or verified calculations or design criteria;
- 4) has been properly reviewed by the Contractor, according to the Contractor's Quality Assurance System, to confirm its completeness, accuracy, adequacy and validity; and
- 5) has taken account of all requirements for approval by statutory bodies or similar organizations, and that where required, such approvals have been granted.
- 6) contains 2 (two) properly signed copies of Independent Design Checker Certificate (Form IDCC) and 2 (two) properly signed copies of the Construction Design Pack Certificate (Form CDPC).

4.4 THE ENGINEER'S RESPONSE

The Engineer's response to the submission from the Contractor will be made within 21 calendar days of receipt of the submission. If the submission is made later on the Design Submissions Programme, the Engineer may extend the review period depending on the amount of documentation accompanying the submission.

4.5 MONTHLY DESIGN REVIEW MEETINGS

Throughout each Design Stage, the Contractor shall attend monthly design review meetings with the Engineer. At these Engineer's review meetings, the Contractor shall present information, drawings and other documents to the Engineer in respect of all submissions programmed to occur during the following five-week period. The Contractor's presentations shall be in sufficient depth to enable the Engineer to obtain a clear understanding of the Contractor's proposals and to discuss the methodology and process used in reaching the proposed design solutions.

4.6 THE ENGINEER'S OBSERVATIONS

The Contractor shall record all of the Engineer's observations and any agreed actions resulting from the Engineer's review meeting and shall address each of these fully before submission of the respective documents for formal review.

4.7 NOTIFICATION

If, in the Engineer's opinion, following receipt of a submission there is benefit to be gained from a meeting with the Contractor to clarify or discuss any of the contents of the submission, he will notify the Contractor accordingly with not less than 3 days advance notice, and the Contractor shall attend at the time and place appointed by the Engineer

4.8 NOTICE OF NO OBJECTION

The Contractor in respect of the Works or any sub-system, part or section may make no submission thereof unless a Notice of No Objection of No Objection with Comments has been received for the previous stage of the same Works or any sub-system, part or section thereof.

5.0 RESPONDED PROCEDURE

5.1 RESPONDED PROCEDURES

The Engineer will respond in one of the following three ways:

- 1) "Notice of Rejection" (with "A" Comments)
- 2) "Notice of No Objection"
- 3) "Notice of No Objection with Comments" (with "B" or/and "C" Comments)

5.2 RESPONSE DEFINITION

Definition of the Engineer's response:

- 1) "Notice of Rejection" (with "A" Comments) if following his review of the submission, the Engineer discovers major non-compliance, discrepancies or omissions etc. that in his opinion are of a critical nature, the Engineer will issue a "Notice of Rejection" (NOR) with type "A" comments. The Contractor shall revise and reissue the submission within 21 calendar days of receipt of "Notice of Rejection" from the Engineer addressing the Engineer's comments. Subsequently the Engineer shall respond within 21 calendar days of receipt of the resubmission. Following the issue of a NOR by the Engineer the Contractor is not entitled to proceed to the next programmed stage for that section of the work until all of the Engineer's comments have been fully addressed and a NONO issued.
- 2) "Notice of No Objection" if following his review of the submission the Engineer has not discovered any non-compliance with the contract the Engineer will issue to the Contractor a formal "Notice of No Objection (NONO). A NONO from the Engineer irrespective of with or without comments does not in any way imply the Engineer's consent of the submission nor does it remove any responsibility from the Contractor for complying with the Contract. Issue of a NONO from the Engineer entitles the Contractor to proceed to the next stage of the programmed work.
- 3) "Notice of No Objection" (With Comments) if following his review of the submission the Engineer discovers discrepancies or omissions etc. that in his opinion are not of a critical nature the Engineer may issue a "Notice of No Objection" with Comments, (NONOC) the comments will be of either type B or type C as defined below. The Contractor shall respond to the comments in accordance with the requirements of Clause 4.3. Following the issue of a NONOC by the Engineer the Contractor is entitled to proceed to the next stage of the programmed work subject to the inclusion of amendments necessary to address the comments.

6.0 The Contractor shall respond to Type B and C comments and get the Engineer agreement and closure prior to full inclusion in the Final Design.

6.1 THE ENGINEER'S COMMENTS

Definition of the Engineer's comments:

- 1) Type "A" Comments are of a critical nature that renders the submission non-compliant with the Contract, the submission shall be corrected and resubmitted.
- 2) Type "B" Comments are of an intermediate nature that shall be responded, agreed and incorporated.
- 3) Type "C" Comments are of a minor nature or may affect future submissions.

7.0 RECORDS

The Contractor shall establish and maintain a place for the storage and archiving of all the documents relating to the Works and are not required to be submitted to the Engineer under Clause 2.

8.0 IMPLEMENTATION OF BIM SYSTEM

- (i) Civil Contractor shall implement BIM system for executing and delivering the services set out in this Agreement. Building Information Modelling (BIM) uses computing power and systems to create 3D models of all kind of buildings and infrastructure, with information about its design, operation and current condition. At the planning and design stage it enables designers, owners and users to work together to produce the best possible designs and to test them virtually before they are constructed. During construction, it enables Employer, contractors and suppliers to integrate all components cutting out waste and reducing the risk of errors. In operation it provides users with real-time information about available services and facility managers with accurate assessments of the condition of assets.
- (ii) All station structure designs as well as viaduct designs/proof checking shall be done using BIM modelling. Civil Contractor shall implement the necessary hardware, software and human resources towards this end. 3D Coordination between all disciplines shall be achieved by incorporating them in a single model.
- (iii) Contractor shall be required to produce, update and present to Employer on a fortnightly basis an integrated 3D BIM model incorporating rail track (Viaduct), topography, architecture, structure, plumbing and all other building services and system wide requirements in design review meetings. These models shall be 3D rendered and shall help in design visualization and clash detection of elements as well as finalization of design.

In addition, Contractor shall also provide following individual models: -

1. Rail alignment Modelling
 2. Structure design modelling
 3. Terrain modelling
 4. Quantity take-off from BIM model wherever required
 5. Visualization and Animated Walkthrough
 6. Clash detection
- (iv) Final coordinated GFC drawings of all disciplines shall only be generated from the BIM model.
 - (v) The contractor shall develop as built" BIM Model up to LOD 500 level and submit the same to Employer at the time of completion of the project. Schedule of BIM implementation Plan and standards to be adhered to, shall be provided after award of contract.
 - (vi) **IFC format (Industry foundation Classes)**

IFC list format is a platform neutral format. Hence all/any BIM program used by tenderer should provide files in IFC format for interoperability between different BIM programs.

ANNEXURE 1

The Contractor shall prepare and submit his detailed Programme of Work so as to achieve key dates of various activities on time. The Contractor shall complete the work in a phased manner by fixing priorities to different stretches of work to give access to the other interfacing contractors as per the requirement of project from time to time and as per the key dates (mile stones) indicated below:

Name of Work:

“Design and Construction of Elevated Viaduct of Length 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 km) including ramps and Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade Section of Length 17.551 km (CH:-0.964 Km to CH:-0.675 Km, CH: -0.050 km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other Related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding Station Buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.

I. FOR 'ELEVATED' PORTION

Key Dates No.	Description of stage	Period from the date of issue of notice to proceed with the work	Liquidity Damages for non-achieving the key dates
KD 1	Completion of 1 st working pile	90	0.001% of total contract price per day of delay for the key date
KD 2	Start of casting of Box girder segments	110	0.001% of total contract price per day of delay for the key date
KD-3	Casting of first pier after approval of mark up	120	0.001% of total contract price per day of delay for the key date
KD 4	Start of Erection of box girder/ U girder	190	0.001% of total contract price per day of delay for the key date
KD 5	Partial access of Viaduct (for a minimum length of 3 km) to track contractor for laying track	400	0.007% of total contract price per day of delay for the key date
KD 6	Partial access of viaduct (for a minimum length of 3 km) to S&T and Electrical contractors for their respective works	450	0.007% of total contract price per day of delay for the key date
KD 7	Access of viaduct in entire length to track contractor for laying track.	630	0.007% of total contract price per day of delay for the key date
KD 8	Access of viaduct in entire length to S&T and Electrical contractors for their respective works.	730	0.007% of total contract price per day of delay for the key date
KD 9 (Taking over date)	Completion of Entire Work as per the contract	825 Days (27 months)	0.036% of total contract price per day of delay for the key date

II. FOR 'AT-GRADE' PORTION

Key Dates No.	Description of stage	Period from the date of issue of notice to proceed with the work	Liquidity Damages for non-achieving the key dates
KD 1	Start of earthwork in embankment /cutting	60	0.001% of total contract price per day of delay for the key date
KD 2	Completion of 2 km of embankment /cutting	130	0.001% of total contract price per day of delay for the key date
KD-3	Start of one minor bridge	80	0.001% of total contract price per day of delay for the key date
KD 4	Completion of 15 minor bridges	270	0.001% of total contract price per day of delay for the key date
KD 5	Partial access of section (for a minimum length of 4 km) to track contractor for laying track	470	0.007% of total contract price per day of delay for the key date
KD 6	Partial access of section (for a minimum length of 4 km) to S&T and Electrical contractors for their respective works	550	0.007% of total contract price per day of delay for the key date
KD 7	Access of section in entire length to track contractor for laying track.	630	0.007% of total contract price per day of delay for the key date
KD 8	Access of section in entire length to S&T and Electrical contractors for their respective works.	710	0.007% of total contract price per day of delay for the key date
KD 9 (Taking over date)	Completion of Entire Work as per the contract	825 Days (27 Months)	0.036% of total contract price per day of delay for the key date

NOTES:

1. For the Viaduct, the key dates KD 5, 6,7,8,9 is pertaining to the interface with other Contractors/Parties to be read in conjunction with the relevant clause of Contract Data.
2. For the at-grade, the key dates KD 5,6, 7, 8, 9 is pertaining to the interface with other Contractors/Parties to be read in conjunction with the relevant clause of Contract Data.

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SECTION 8A

PART-2

EMPLOYER'S REQUIREMENT – GENERAL INFORMATION AND SCOPE OF WORK

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SECTION 8A- PART-2**WORKS/EMPLOYER'S REQUIREMENTS****EPC TENDER.**

“NAME OF WORK: “DESIGN AND CONSTRUCTION OF ELEVATED VIADUCT OF LENGTH 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 Km) INCLUDING RAMPS AND FORMATION IN EMBANKMENTS /CUTTINGS INCLUDING BLANKETING, MAJOR BRIDGES, MINOR BRIDGES, RUB, ROB, ROR, RETAINING WALL, SACRIFICIAL RETAINING WALL AND DRAINS, UTILITY DIVERSIONS OF AT-GRADE SECTION OF LENGTH 17.551 Km (CH: -0.964 Km to CH:-0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) AND OTHER RELATED INFRASTRUCTURAL WORKS FROM BENNIGANAHALLI TO CHIKKABANAVARA, EXCLUDING STATION BUILDINGS, OF CORRIDOR - 2 OF BENGALURU SUBURBAN RAILWAY PROJECT (BSRP)”.

EMPLOYERS REQUIREMENT - SCOPE OF WORK**1. INTRODUCTION**

These Employer's Requirements are divided into four sections as follows:

- (a) General: these apply throughout the Contract.
- (b) Functional: these include the specific core requirements for the design and performance of the Works.
- (c) Design: these apply in respect of requirements relating to the design of the Permanent Works.
- (d) Construction: these apply in respect of other requirements relating to the construction of the Works.
- (e) General Planning Criteria

2. DEFINITIONS AND INTERPRETATIONS

In addition to the words and expressions defined in the General Conditions of Contract (GCC), further following words and expressions shall have the meaning assigned to them except where the context otherwise requires:

"As-Built Drawings": means those drawings produced by the Contractor and endorsed by him as true records of construction of the Permanent Works and which have been agreed with the Engineer.

"Combined Services Drawings" (CSD): means drawings showing the locations, layouts and sizes of all services including those of other contractors coordinated so as to eliminate all clashes.

"Construction Phase": has the meaning identified in Clause 4 of the Employer's Requirements - General.

"Good for Construction Drawings (GFC)": means those drawings referred to in Clause 2(8) of the

Employer's Requirements - Design in respect of which a Notice has been issued.

"GFC Drawings Submission": means the submission of GFC Drawings representing elements of the Permanent Works

"Construction Specification": means those parts of the Standard Outline Specification which relate to construction.

"Definitive Design Submission": means the submission of documents which comprise the whole or parts of the proposed Definitive Design and for which the Contractor seeks a Notice.

"Design Manual": means the manual to be prepared and submitted by The Contractor as part of the Definitive Design and as described in the Employer's Requirements Design.

"Design Package": has the meaning identified in Clause 2(5) of the Employer's Requirements - Design.

"Design Phase": has the meaning identified in Clause 4 of the Employer's Requirements - General. "Design Criteria": means those parts of the Standard Outline Specification which relate to design.

"Final Design": has the meaning identified in Clause 3(5) of Employer's Requirements -Design. "Notice": means a Notice of No Objection.

"Particular Specification": means the combined specifications prepared by the Contractor in CSI format which combines the Employers Design Criteria, the Employer's Outline Construction Specifications and those parts of the Contractor's Technical Proposals which specify standards for design and construction which are developed during the Design Phase.

"Preliminary Design": means the submission of documents which comprise the initial stage of the design phase.

"Railway Envelope": means the zone or zones within the Works containing the track work and equipment necessary for the operation of the railway.

"Services, Electrical, Mechanical Drawings"(SEM): means those drawings produced by the contractor executing the service works showing the locations, sizes and details for openings in structural elements for mechanical and electrical facilities and other related contracts.

"Standard Outline Specification": means the Design Criteria and the Outline Construction Specifications that specify standards issued by the Employer for development by the Contractor for design and construction.

"Specification": has the meaning identified in Clause 5 of the Employer's Requirements -General. "Structure Gauge": means the profile related to the designed normal co-ordinated axis of the track into which no part of any structures or fixed equipment may penetrate.

"Working Drawings": comprise the GFC Drawings and such other drawings and documents, such as bar bending schedules and manufacturing drawings, as are necessary to amplify the GFC Drawings for construction purposes and endorsed as required by the Engineer.

3. **RELEVANT DOCUMENTS**

The Design Criteria shall be read in conjunction with the General Conditions of Contract (GCC), the Special Conditions of Contract (SCC), the Employer's Requirements, the Drawings and any other document forming part of the Contract.

In the event of a conflict between the Employer's Requirements and any Design Criteria, the Design criteria shall prevail.

In the event of a conflict between any Design Criteria and any other standards or specifications quoted, the requirement of the Design Criteria shall prevail.

Notwithstanding the precedence specified above the Contractor shall always immediately seek advice from the Engineer in the event of conflicts in Specifications among various standards. **The order of precedence is:**

- Design Criteria
- Employer's Requirements
- Indian and other International Standards referenced herein.
- Indian and other International Standards

4. **PHASES (DESIGN AND CONSTRUCTION)**

- (1) The Contractor shall execute the Works in two phases, the Design Phase and the Construction Phase.
- (2) The Design Phase shall commence upon the date of issue of Letter of Acceptance. This phase shall include the preparation and submission of:
 - (a) The Preliminary Design
 - (b) The Definitive Design; and
 - (c) The GFC Drawings.

The Design Phase will be complete upon the issue of a Notice in respect of the comprehensive and complete GFC Drawings Submission for the whole of the Permanent Works.

- (3) The requirements for the Preliminary Design, Definitive Design and GFC Drawings are stated in Employer's Requirements-Design.
- (4) The Construction Phase for the whole or a part of the Permanent Works shall commence immediately upon the issue of a Notice by the Engineer/Employer in respect of the relevant GFC Drawings Submission. Such Notice may be issued by the Engineer in respect of a GFC Drawing Submission covering a major and distinctive part of the Permanent Works. However, construction shall not be commenced until the original negatives of the appropriate Working Drawings have been endorsed:
 - (a) by the Contractor as "Good for Construction"; and

(b) by the Engineer that he has no objections to the drawing.

The Construction Phase shall include the completion and submission of the Final Design and the preparation and submission of the As Built Drawings and other records as specified.

- (5) Notwithstanding Clause 4(4) above, for those elements identified under Clause 2(6) of the Employer's Requirements - Design, the Construction Phase may commence immediately upon the issue of the Notice in respect of the Definitive Design Submission in respect of each such element subject to availability of the site in accordance with agreed programme.

5. SPECIFICATIONS

In accordance with the provisions of these Employer's Requirements, the Contract Specification contained in the Contract shall be developed during the design stage and submitted as part of the Definitive Design Submission. When the Specification has received a Notice of No Objection from the Engineer it shall become the Particular Specifications and shall take precedence over the other Specifications for construction purposes.

6. SPECIFICATIONS IN METRIC AND IMPERIAL UNITS

- (1) The Contract shall utilize the SI system of units. Codes and Standards in imperial units shall not be used unless the Engineer has given his consent.
- (2) Conversion between metric units and imperial units shall be in accordance with the relevant Indian Standards.

7. WORKS PROGRAMME

- (1) The Key Dates are defined in Annexure-I to these Employer's Requirements.
- (2) The Contractor shall prepare and submit its Works Programme and three month rolling programmes and the detailed requirements to these Employer's Requirements.
- (3) In compiling its Works Programme and in all subsequent updating and reporting, the Contractor shall make provision for the time required for coordinating and completing the design, testing, commissioning and integrated testing of the Works, including, inter alia, design co-ordination periods during which the Contractor shall co-ordinate its design with those of Designated Contractors, the review procedures, determining and complying with the requirements of all Government Departments and all others whose consent, permissions, authority or license is required prior to the execution of any work.
- (4) The Works Programme shall take full account of the Design Submission Programme.

8. MONITORING OF PROGRESS

- (1) The contractor shall submit to the site Engineer three copies of a Monthly-Progress Report (MPR), as described in Employer's requirements describing the progress and current status of the Works. The MPR shall address the matters set out in the Works Programme.
- (2) The MPR shall be submitted by the end of each calendar month. It shall account for all works actually

performed from twenty sixth day of the last month and up to twenty fifth day of the current month

- (3) The MPR shall be divided into two sections. The first section shall cover progress and current status relating to design and the second section shall cover progress and current status relating to construction.
- (4) A monthly meeting to monitor & review the progress of the project shall be convened by the Engineer. Contractor's site Representative & Designer Representative of Contractor and site agent of all interfacing contractors shall also attend the meeting. The Employer may also be present in the meeting.
- (5) The Engineer or Employer may also conduct progress review meetings on weekly /bi-weekly intervals depending upon the requirements or urgency of works. In these review meetings Engineer may call Contractor's Supplier/Sub-Contractor/Designer etc. as per the requirements.

9. QUALITY ASSURANCE

The Contractor shall establish and maintain a Quality Assurance System in accordance with Appendix-3 to these Employer's Requirements for design and construction procedures and the interfaces between them. This Quality Assurance system shall be applied without prejudice to, or without in any way limiting, any Quality Assurance Systems that the Contractor already maintains.

10. DIGITAL DELIVERY OF THE PROJECT AND SOFTWARE SUPPORT

(A) DIGITAL DELIVERY

K-RIDE envisages digitization of BIM (Building Information Model). The Designer Contractor and should be familiar with operations of a digital project platform enabling a fully integrated solution for employer & contractors.

The Contractor will be required to work on a digital delivery for built assets based on international standards and methodologies including:

- PAS 1192-2 2013 - "Specification for information management for the capital/delivery phase of construction projects using building information modeling"
- PAS 1192-3 2014 - "Specification for information management for the operational phase of assets using building information modeling"
- AIA Document E203TM–2013, Building Information Modeling and Digital Data Exhibit
- CIC BIM Protocol 2013
- BIM Forum LOD Specification 2013
- Software packages that may be considered to specify and integrate the system solution that will support the Digital Project Office may include Oracle, SAP, Microsoft Dynamics, CMiC, RiB AG, AutoDesk, Bentley, Trimble, Synchro etc.

(B) SOFTWARE SUPPORT

- (1) The Contractor shall provide full support to the Employer or Engineer for all computer programs provided by the Contractor under the Contract.
- (2) The Contractor shall submit a software support plan at least 90 days before commencement of software installation. This plan shall require the Contractor to provide all changes, bug fixes, updates, modifications, amendments, and new versions of the program as required by the Engineer.
- (3) The Contractor shall provide all tools, equipment, manuals and training necessary for the Employer / Engineer to maintain and re-configure all the software provided under the Contract.
- (4) The Contractor shall submit all new versions to the Engineer for review at least 2 weeks prior to their installation. New Versions of any program shall not result in any non-conformance with the Specification, or degrade the operation of the System. The Contractor shall:
 - Ensure that all new versions are fully tested and validated on the simulation and development system prior to installation.
 - Ensure that all new versions are fully tested and commissioned once installed on the Site.
 - Deliver to the Employer/Engineer any new version, together with the updated Operation and Maintenance Manuals.
- (5) The Engineer shall not be obliged to use any new version and -that: shall not relieve the Contractor of any of its obligations. Any effect upon the performance or operation of the computer controlled system that may be caused by a new version shall be brought to the Engineer attention including updating the files to suit new version.
- (6) Within 14 days of the installation of any software into the Permanent Works by the Contractor, the Contractor shall submit to the Engineer for retention by the Employer/Engineer two back up copies of the software, which shall include, without limitation:
 - All licenses in favour of Employer for their use.
 - all source and executable code;
 - all design documentation relating to the software; and
 - Any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.
- (7) When a fault is discovered within delivered software or documentation, the Contractor shall take necessary steps to rectify errors or faults at the earliest.
- (8) The Contractor shall provide written details as to the nature of the proposed correction to the Engineer.
- (9) The Contractor shall notify the Employer promptly of any fixes or patches that are available to correct or patch faults.
- (10) The Contractor shall detail any effect such fixes or patches are expected to have, upon the applications.
- (11) The Contractor shall provide training for the Employer's staff to enable the Employer to make proper use of any software and its new versions.

11. CO-ORDINATION WITH DESIGNATED AND OTHER CONTRACTORS**General**

- (1) The Contractor is responsible for detailed co-ordination of his design and construction activities with those of the Designated Contractors, Civil Contractors, Utility Agencies, Statutory Authorities, Private Service Providers, Developers, Consultants and other Contractors whether or not specifically mentioned in the contract, that may be working on or adjacent to the site for the purpose of the Project. For the purpose of this Specification, all of the above parties shall be referred to as Interfacing Contractors. The Contractor shall note that there are other contractors, consultants, etc. which the Employer will engage from time to time with whom the Contractor shall have to similarly co-ordinate. Such co-ordination responsibilities of the Contractor shall include the following:
- (a) To provide all information reasonably required by the Interfacing Contractors in a timely and professional manner to allow them to proceed with their design or construction activities, and specifically to meet their contractual obligations.
 - (b) To ensure that the Contractor's requirements are provided to all other Interfacing contractors before the cut-off dates to be identified in the Interface Management Plan (IMP).
 - (c) To obtain from the Interfacing Contractors information reasonably required to enable the Contractor to meet the design submission dates as identified in Annexure-I.
 - (d) Where the execution of the work of the Interfacing Contractors depends upon the site management or information to be given by the Contractor, the Contractor shall provide to such Interfacing Contractors the services or correct and accurate information required to enable them to meet their own programme or construct their work.
 - (e) To co-ordinate access and delivery routes, and to ensure that all provisions for access and delivery of Plant is coordinated with and reflected in the Interfacing Contractor's Delivery Route Drawings. The Interfacing Contractors shall ensure that all Plants are delivered at the time agreed to allow openings left in the structure for such delivery to be sealed in accordance with the Contractor's programme.
 - (f) To co-ordinate with the Interfacing Contractors on attendance.
 - (g) To attend regular co-ordination meetings convened by the Engineer with the Interfacing Contractors. The Contractor shall conduct separate meetings with the Interfacing Contractors as necessary to clarify particular aspects of the interfacing requirements of the Works. The party who convenes the meeting shall prepare minutes recording all matters discussed and agreed at the meeting.
 - (h) To ensure that copies of all correspondence, drawings, meeting, minutes, programmes, etc. relating to the Contractor's co-ordination with the Interfacing Contractors are issued to all concerned parties and four (4) copies issued to the Engineer no later than two (2) calendar days from the date of such correspondence and meetings.

- (2) The Contractor, shall in carrying out his co-ordination responsibilities, raise in good time and provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the interfacing Contractors as to the extent of services or information required to pass between them. If such disagreement cannot be resolved by the Contractor despite having taken all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.
- (3) Where an Interfacing Contract is yet to be awarded the Contractor shall proceed with the coordination activities with the Engineer until such time when the Interfacing Contractor is available. The Contractor shall provide the Interfacing Contractor with all information necessary to enable the Interfacing Contractor to follow-on and proceed with their coordination.
- (4) The Contractor shall note that the information exchange is an iterative process requiring the exchange and update of information at the earliest opportunity and shall be carried out on a regular and progressive basis so that the process is completed for each design stage by the cut-off dates.
- (5) The Contractor shall co-ordinate with the Engineer on all matters relating to works that may affect the Operation & Maintenance of the already operational Section corridor of the Employer in general. Such work shall be subject to the rules and regulations imposed by the Employer.

12.0 Dedicated co-ordination team

- (6) The Contractor shall establish a dedicated co-ordination team, led by a Chief Co-ordinator in Bangalore reporting to the Contractor's Site Agent (Team Leader). The primary function of the team is to provide a vital link between the Contractor's design and construction teams and the Interfacing Contractors.
- (7) The Chief Co-ordinator shall assess the progress of the co-ordination with Interfacing Contractors by establishing lines of communications as indicated in the co-ordination model shown in Figure 1 and promote regular exchange and updating of information so as to maintain the Contractor's programme.
- (8) The complexity of the Project and the importance of ensuring that work is executed within time limitations require detailed programming and monitoring of progress so that early programme adjustments can be made in order to minimise the effects of potential delays.
- (9) The Chief Co-ordinator in conjunction with the Interfacing Contractors shall identify necessary provisions in the Works for plant, equipment and facilities of the Interfacing Contractors. These provisions shall be allowed by the Contractor in his design of the Works.
- (10) During the course of the contract, information will be obtained in a number of ways. These may include direct inspection, regular site meetings, the obtaining of progress reports and the use of turn round document to obtain design and programme data. Turn round document shall be issued to the Interfacing Contractors to be returned giving the current positions on their programme.

13.0 Design & Construction Interface

- (11) The dates shown in Employer's Requirements Annexure-I are critical to the timely completion of the project. The Contractor shall commence design interface with the Interfacing Contractors as soon as he has been notified by the Engineer that such Interfacing Contract has been awarded. In the case of utility agencies and other statutory boards, interface shall commence as soon as it is practicable. Where no design interface date has been established because the Interfacing Contractors have not been identified or for whatever reason, the Contractor shall liaise with such Interfacing Contractor/s as soon as they have been awarded.
- (12) The Contractor shall immediately upon award of the Contract gather all necessary information and develop his design to a level where meaningful interaction can take place as soon as the Interfacing Contracts are available. The Contractor shall submit together with each of his Design Submissions a joint statement from the Contractor and the relevant Interfacing Contractor confirming that design co-ordination has been completed and that they have jointly reviewed the appropriate document to ensure that a consistent design is being presented.
- (13) The design interface is an iterative process requiring regular exchange and update of interfacing information. The Contractor shall ensure that the information he requires from the Interfacing Contractors is made known at the outset of each design interface and vice versa so that the information can be provided in time for the Contractor and the Interfacing Contractors to complete their design to meet their various design submission stages.

Construction Interface

- (15) Construction interface will be necessary throughout the duration of the Works commencing from the time the Contractor mobilizes to the Site to the completion of the Works. Construction interface will overlap design interface, involving cast-in and buried items such as pipes for electrical and mechanical services, supports, brackets, plinths, ducts, service buildings if arising, openings, cableways, trenches etc. that are to be incorporated at the early stage of the construction up to provision of attendance during the testing and commissioning stage.
- (16) The Contractor shall ensure that there is no interference with the Works of the Interfacing Contractors and shall maintain close co-ordination with them to ensure that his work progresses in a smooth and orderly manner. The Contractor shall carry out and complete the Works, or any part thereof, in such order as may be agreed by the Engineer or in such revised order as may be requested by the Engineer from time to time. The Contractor shall, unless otherwise provided, be liable for and shall indemnify the Employer against all costs, charges, expenses and the like resulting from failure of the Contractor to co-ordinate the Works as specified.
- (17) For effective document/record control consisting Design reports and GFCDs to make the design interface more efficient.

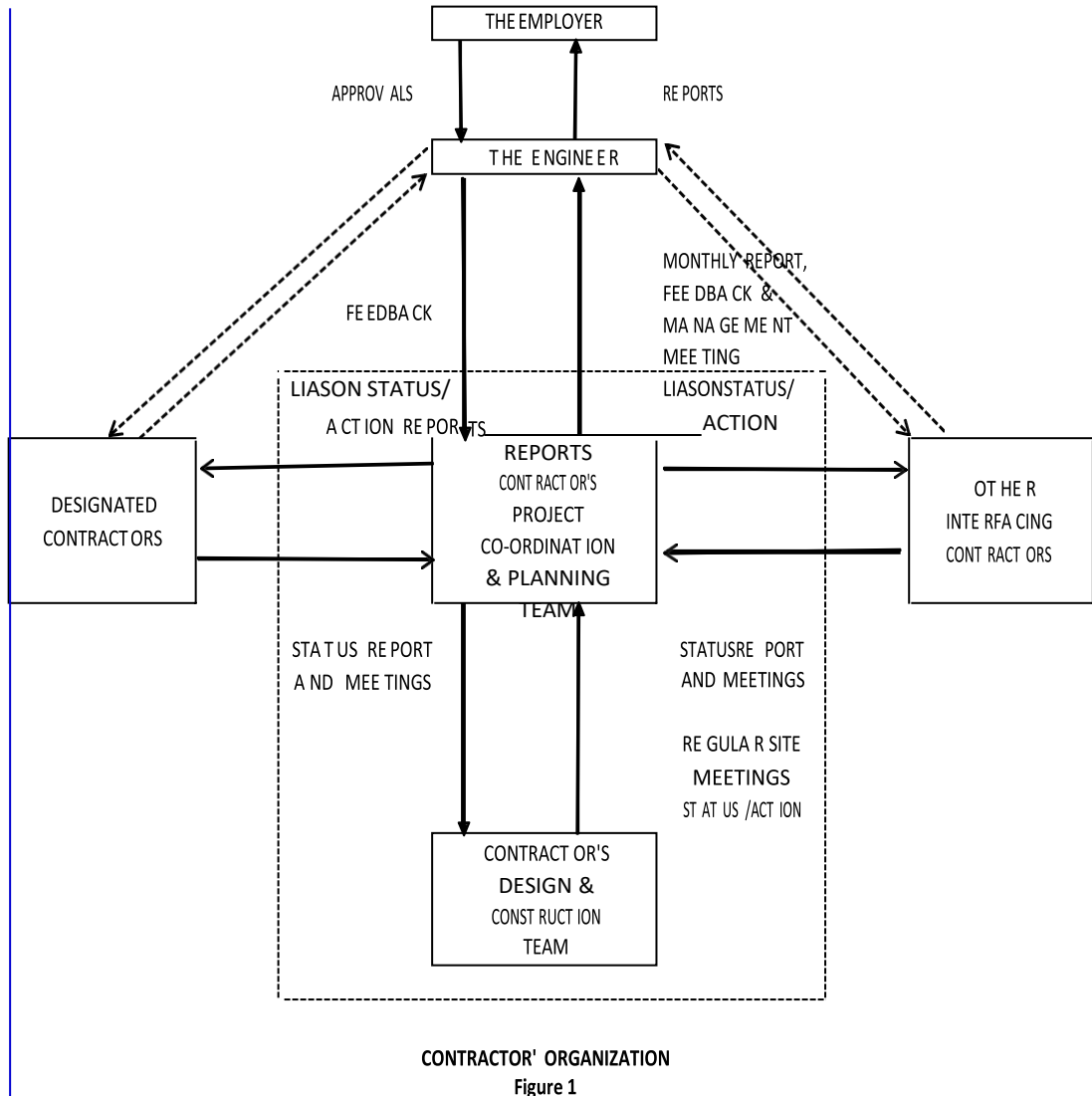


Figure 1

14. DELETED.**15. CONTRACTOR'S PROJECT ORGANISATION**

- (1) The Contractor shall have a competent team of Managers, Engineers, Technical staff etc so as to complete the work satisfactory as per various requirements of the contract.
- (2) A control room with round the clock radio communication or telephone switch board links with all safety offices, works sites, site offices, batching plants, casting yards, workshops, fabrication yard, off site offices, Engineers site office, Resident Engineer's office, testing labs etc shall be maintained and manned round the clock. Residences of all senior project team members shall also be linked with the control room. Vehicles for emergency use should be on stand-by at the control room around the clock.
- (3) The designations of the various project organizations team members shall be got approved by the Engineer before adoption so as to avoid any duplication of the designations with those of the Employer or the Engineer.

16. TECHNOLOGY TRANSFER

- (1) The Contractor shall ensure that all local contractors and sub-contractors engaged in the works are given training, guidance and the necessary opportunity for transfer of technology in various areas of construction such as instrumentation, safety, quality assurance, viaduct etc.

17. MAINTENANCE REPORT

- (1) The Maintenance Report shall be submitted as part of the Definitive Design and shall include full details of the long term inspection and maintenance operations for each major component of viaduct.
- (2) Deleted
- (3) For each area an inspection checklist shall be supplied giving inspection frequency, items to be inspected, criteria for acceptance, criteria for remedial works and details of the remedial works, including proposed materials and method statements. The recommended regular maintenance regime of each area shall also be given including cleaning methods and frequency for different Surfaces; removal of leakage borne salts from concrete surfaces; cleaning of drainage channels, sumps and pipes; repainting of metallic items;
- (4) A long term monitoring regime shall also be included covering items such as
 - Viaduct

- Differential movement at viaduct / station junctions or other areas identified in the design.
 - Loss of prestress in the girders with passage of time.
- (5) All instruments necessary to carry out the inspections and monitoring that are identified in thereport shall be provided by the Contractor within the lump sum tender price.

18. DELETED

SECTION B**EMPLOYER'S REQUIREMENTS – FUNCTIONAL****Objective**

The objective of the contract is, construction, completion, testing and commissioning of the permanent works by the Contractor (including without limitation, construction and removal of the Temporary Works) and the rectification of defects appearing in Permanent Works in the manner and to the standards and within the time stipulated by the Contract. In full recognition of this objective, and with full acceptance of the obligations, liabilities and risks which may be involved, the Contractor shall undertake the execution of the Works.

1. GENERAL

- 1 The design and performance of the Permanent Works shall comply with the specific core requirements contained in these Employers's Requirements-Functional.
- 2 The design of the Permanent Works shall be developed in accordance with these Employer's Requirements - Functional, the Contractor's Technical Proposals and the other requirements of the Contract.
- 3 The Permanent Works shall be designed and constructed to the highest standards available using proven up-to-date good Engineering practices. The Specification shall in any case not specify standards which, in the Engineer's opinion, are less than or inferior to those described in the Design Basis Report (Design Criteria) and Technical/Construction Specifications contained in the Tender Documents. Construction shall be carried out employing the procedures established by the Contractor in his Quality, Safety Health and Environmental management plans.
4. The Contractor shall be responsible for obtaining all necessary approvals from the relevant Public/Government/Local/Statutory or any agencies in the construction of the works.

2.1 Co-ordination/co-operation with other Contractors & Agencies (External/Internal)

- i. In addition, the Contractor shall be required to carry out various miscellaneous works as per interfacing requirements. The contractor shall carry out necessary co-ordination with various system contractors pertaining to traction power supply, signaling, telecommunication etc. for keeping provisions pertaining to cut outs, shafts, concealed conduits, other conduits, fixtures, inserts clearances etc. all complete.
- ii. Earthing and lightning protection measures wherever required.
- iii. The track supporting structure will support ballast less track (long welded rail) which will be laid later by a separate contractor. Arrangements required for provision of such ballast less track will have to be incorporated in the deck, in consultation with the Engineer. Where the ballast less track concrete is to be laid on the top of the deck slab, as directed by the Engineer, contractor will make suitable arrangements for proper keying up further concrete layers /or casting blocks which will form part of track work to be done by a separate contractor.
- iv. The contractor shall cooperate with the other contractors appointed by the employer so that the work proceeds smoothly to the specifications of the Engineer. The contractor shall plan & execute the works with proper intimation to the other contractors.
- v. NOC & Approval of schemes of diversion of utilities from the concerned regulatory/statutory/local authority is the responsibility of the contractor.
- vi. The contractor shall attend regular coordination meetings convened by the employer/engineer for interface and adhere to the decisions taken in the meeting.
- vii. Access will be provided to the staff of the other Contractor appointed by the employer for carrying out their works and bringing materials and equipment at the site. However, the security of materials and Equipments brought at the site will be the responsibility of the respective Contractors.
- viii. The contractor shall, in carrying out his coordination responsibility, raise in good time and provide sufficient information for the employer to decide on any disagreement with other contractor. If the contractor despite having taken all reasonable efforts cannot resolve such disagreement then the decision of the Engineer shall be final and binding on the contractor.

2.1.1 TRAFFIC MANAGEMENT

The Contractor shall make the detailed traffic diversion plans in consultation with Bangalore Traffic Police. The work is to be executed with proper liaison with Bangalore Traffic Police. Necessary assistance will be given by K-RIDE. The scheme should be such that preferably two lanes limiting to minimum of one lane of traffic in each direction of the road should be available for the smooth flow of traffic. The Contractor should inspect the site. The Contractor shall also strengthen the road where the diversions are planned by widening, repairing to the road surface etc.

- 2.1.2 Any other item of work as may be required to be carried out for completing the construction of elevated structure of specified length including all necessary interfaces works with station and system Contractors in all respects in accordance with the provisions of the Contract and/or to ensure the structural stability and safety during and after construction are included in lumpsum price.

2.2 Structures

The construction of structures will have to be planned in such a manner that they do not obstruct or interfere with the existing roads/railways and other utilities. Where work is required to be carried out at locations adjacent to such roads/railways, utilities, structures, monuments etc. suitable safety and protection arrangements will have to be ensured for which nothing extra will be payable. It should be ensured that no damage is caused to any such elements and engineer/employer shall be indemnified against such damage at no extra cost.

2.3 Design criteria (Viaduct)

Design shall be carried out as per design basis report enclosed. Indicative parameters for designing of viaduct are given below:

A Spacing of tracks.

Since the U- Girders are preferred in superstructure, the spacing of the tracks to be considered accordingly. The track spacing on viaduct of minimum 4.725m to be considered for Box girder/I-Girder with slab and 5.2m for U-Girders.

If independent girders carry each track, then the Structure gauge on each track will determine the spacing of tracks when there is a structure between tracks. Ex: parapet wall, web of girder in case of trough type girder, etc. Since end evacuation is adopted in BSRP, Tenderers may note that side walkways are not a must in the viaduct and this may be taken note of while designing the girders for the viaducts".

B The Girder deck shall carry in addition to the Two tracks,

- i) Rail plinths (since the track is ballast less track), Two numbers supporting the two rails of each track, totaling to four plinths ('L' shaped). The rail plinths are also called 'derailment up stands'.
- ii) Dowels for rail plinth are covered in the scope of the work.
- iii) **(Deleted)**
- iv) All cable for signaling etc. shall be supported by four rows of hangers fixed at inside face of parapet wall/through cable ducts.

Note: Design of rail plinth is independent of provision of walkway.

C. Deleted

D. **Deleted**

- E. Since power cables and S&T cables will be close to each other, to prevent induction, etc a Minimum clearance shall be kept between them.

Note: B to E above will have to be additionally considered by the tenderer while fixing the Deck width of the girder. It may be noted that the tenderer cannot have any claim for minor changes which may be required to be made after award of contract. **The final parameters/dimensions shall be given to the successful tenderer after award of contract.** Neither the tenderer be awarded any compensation for execution/construction arising on account of above minor changes.

Engineer's decision will be final and binding on the tenderer in this respect. Inserts/Fixtures/Supports/Hangers for system contractors shall be supplied and installed at no extra cost, by the contractor.

2.4 Reference to the Standard Codes of Practice

All Standards, Technical Specifications and Codes of practice referred to shall be latest editions including all applicable official amendments and revisions. The Contractor shall make available at site all relevant Indian Standard Codes of practice and IRS & IRC Codes as applicable.

241 Wherever Indian Standards do not cover some particular aspect of design/ construction, relevant British/German Standards will be referred to. The Contractor shall make available at site such standard codes of practice.

242 In case of discrepancy among Standard codes of practice, Technical Specifications and provisions in sub clauses of NIT, the order of precedence will be as below:

- i) Provision in ITT and Employers Requirements
- ii) Technical Specifications provided in the tender doc , (Order of priority IRS,IRC,IScodes)
- iii) MORTH Specification for road & Bridges
- iv) CPWD specifications
- v) Standard Codes of Practice

In case of discrepancy among Standard Codes of Practice, the order of precedence will be IRS, IRC, IS, BS, DIN

2.5 Dimensions

251 As regards errors, omissions and discrepancies in Specifications and Drawings, relevant clause of Particular Conditions of Contract will apply.

252 The levels, measurements and other information concerning the existing site as shown on the conceptual / layout drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or strata turning out different from what is shown on the drawings.

2.6 Associated Works

Works to be performed shall also include all general works preparatory to the construction and works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and meaning of the drawings adopted and technical specifications, to best Engineering standards and orders that may be issued by the Engineer from time to time, compliance by the agency with all Conditions of Contract, supply of all materials, apparatus, plants, equipment, tools, fuel, water, strutting, timbering, transport, offices, stores, workshop, staff, labour and the provision of proper and sufficient protective works, diversion, temporary fencing, lighting and watching required for the safety of the public and protection of works on adjoining land; first -aid equipment, sanitary accommodation for the staff and workmen, effecting and maintenance of all insurances, the payment of all wages, salaries, fees, royalties, duties or the other charges arising out of the erection of works and the regular clearance of rubbish, clearing up, leaving the site perfect and tidy on completion.

2.7 CONSTRUCTION DEPOT & DUMPING YARD.

No land for casting yard or offices/laboratories etc. will be provided by the employer. However, the employer will give the necessary assistance required for seeking permissions but without any responsibility for the same. Contractor should make his arrangements at his own cost which is deemed to be included in Lump sum price in Schedule-A.

Satisfactory tyre washing arrangements of each and every vehicle shall have to be made by the contractor for the vehicles leaving the depot to avoid the spillage on the connecting roads.

2.8 TIME SCHEDULE & MONITORING OF PROGRESS

- (i) The agency shall submit with the tender "Time Schedule" for completion of various portions of works. This schedule is to be within the overall completion period of 27 months. The detailed programme in the form of a quantified bar chart or CPM network shall include all activities starting from design to completion.
- (ii) In compiling its Works Programme and in all subsequent updating and reporting, the contractor shall make provision for the time required for co-coordinating- and completing the design, testing, commissioning and integrated testing of the Works, including, inter alia, design co- ordination periods during which the Contractor shall co-ordinate its design with those of Designated Contractors, the review procedures, determining and complying with the requirements of all Government Departments and all others whose consent, permissions, authority or license is required prior to the execution of any work.
- (iii) The Contractor shall submit to the Engineer Four copies of a Monthly Progress Report (MPR), describing the progress and current status of the Works. The MPR shall address the matters set out in the Works Programme.
- (iv) The MPR shall be submitted by the end of each calendar month. It shall account for all works actually performed from twenty sixth day of the last month and up to twenty fifth day of the current

month.

- (v) A monthly / biweekly meeting to monitor the progress of the project shall be convened by the Engineer, Contractor's site agent and site agent of all interfacing contractors shall attend the meeting. The Employer may also be present in the meeting.

2.9 Deleted

2.10 UTILITIES

Utility identification at foundation locations will be done by the contractor and in case utility (ies) is encountered or obligatory requirement is to be met out; the contractor shall modify the span configuration at such location to save the utility (ies) or to meet obligatory requirements within the accepted price. Shifting of utility (ies) would be done by K-RIDE only in exceptional cases where in the opinion of the Engineer no other option is available. No payment shall however be made for supporting the utilities during course of work. Any other utilities shifted by the contractor as directed by Engineer/Employer, will be paid separately under Schedule-C SSR items.

The utilities are to be diverted with proper liaison and approval of the utility owning agencies. The utilities which are not be diverted but require supporting, proper supporting is be done so that they are not damaged along their branches. Precautions to be taken while handling the utilities are mentioned as under;

- (i) Utilities must not be damaged at any cost. If due to some reason or the other, mishap occurs, it should be rectified immediately by the Contractor at his own cost under intimation of K-RIDE.
- (ii) Till rectification of the damaged trunk sewers, the Contractor shall arrange substitute arrangement for sewage pumping and its disposal as per directions of Engineer. Similar arrangement is to be done for other utilities.
- (iii) The manholes of Trunk/Sewers should not be covered under the foundation as these may create hindrances to the annual de-silting/cleaning of sewer lines.
- (iv) Sufficient distance of foundation from outer edge of Trunk / Sewers is kept in view of further maintenance/Safety of Trunk/Sewers.
- (v) The covers of manholes be saved from heavy machinery movement to avoid any accident/Slippage of malba in manholes etc into the Trunk /Sewers which may cause blockage of lines. In case of damage of manhole cover & frame the same shall be replaced immediately by the Contractor at his own cost.
- (vi) Manholes of the trunk sewer should be kept freely accessible for cleaning and removal of blockages and malba should not be dumped over these manholes.
- (vii) Branch sewer connections which are connected with the trunk sewers should also be taken care of. If the same are damaged, the same should be restored immediately on priority.

- (viii) NOC & Approval of schemes of Diversion of Utilities from the concerned regulatory / statutory /Local Authority will be got done by contractor. However, necessary assistance will be provided by K-RIDE.

These are only indicative for one of the utilities only. Similarly, necessary precautions which are specified from time to time by the utility owning agencies shall also be followed. The Central verge/footpath furnishings which are to be dismantled be handed over to the concerned department in their stores at contractor's own cost.

2.11 INSPECTION

K-RIDE may appoint an independent agency to ensure the quality checking of design, supply, fabrication, erection and construction of all the work under 'scope of work'. The contractor shall ensure complete co-operation with the agencies to perform their work satisfactorily. In addition, K-RIDE also reserves the right to undertake quality check and inspection directly by itself.

2.12 DELETED

3. ALIGNMENT OF TRACKWAYS

- (1) The alignment shall be as shown in the tender drawings. The alignment has been developed by the Employer to meet operational and technical criteria. The Contractor is not required to evaluate the alignment for compliance with these criteria, but shall review it with respect to his own design and construction proposals and shall satisfy himself that there is no conflict with existing structures which are to be preserved.
- (2) The Contractor is permitted to propose minor deviations in alignment to suit his construction proposals, but he must demonstrate that any such deviations shall comply with good design practice and the alignment requirement of the Design Criteria. Such deviations shall require prior approval of the Employer subject to following conditions: -
 - i. There is no extra cost to the employer
 - ii. Changes proposed are essentially required to suit the contractor's specific design
 - iii. There is no change at the contract boundaries or if there is any, the same is agreed by the contractor of the adjoining section without any extra cost to the employer.

4. CLEARANCES

- (1) The Permanent Works shall not infringe the Structure Gauge. Extra clearances shall be provided on curved alignment as per the Schedule of Dimensions (SOD)/Design Basis Report (DBR).
- (2) The Permanent Works shall provide for the installation by the Designated Contractors of operating equipment for the railway and without infringement of the Structure Gauge.
- (3) Railway clearances:
Various clearances shall be provided as per the schedule of dimensions approved for the K-RIDE.
- (4) Construction limits:
 - (a) The limits of land for the Works will be given to successful tenderer. The Contractor shall design

the Works to be contained totally within these limits, respecting the regulations concerning construction and property boundaries of the local authorities such as BDA, BBMP, SWR, BWSSB etc., In the event that the Contractor, having used its best endeavors, is unable to design the permanent works and utilities to be contained totally within these limits, then the Employer will obtain the necessary additional land or the Contractor may be required to redesign the structure as instructed by Engineer.

- (b) The limits of land will be given to successful tenderer but for general guidance it is 5 m on either side of the center line in Viaduct portion and limits of the land for At-Grade portion as per the Tender drawing. However, the permission for barricading etc. will be given depending upon the preparedness of the contractor, issues concerning traffic department etc. as is the usual practice. It may undergo changes after final survey and the Contractor shall make any adjustments necessary to the design to acknowledge the changes to the limits as then defined. Site will be made available progressively depending upon the requirement.
- (c) The approval for viaduct, major bridges, minor bridges, ROB's, RUB drawings from railway to be obtained by the contractor. The necessary assistance will be provided by K-RIDE.

5. DESIGN LIFE

The design life of all Permanent Works shall be 120 Years.

6. DURABILITY AND MAINTENANCE

- (1) The Permanent Works shall be designed and constructed such that, if maintained reasonably and in accordance with the Contractor's statement of maintainability contained in the Contract, they shall endure in a serviceable condition throughout their minimum lives
- (2) The permanent Works shall be designed and constructed so as to minimize the cost of tenancy whilst not compromising the performance characteristics and ride quality of the railway.
- (3) Restoration of roads, utilities and other services dislocated during construction is the responsibility of the contractor.
- (4) Survey, instrumentation, ground treatment, ground and building monitoring, risk analysis, settlement prediction, preventive and corrective actions is the responsibility of the contractor.
- (5) Traffic management along the worksite including works connected with traffic management is the responsibility of the contractor.
- (6) Reinstatement of services (such as street lighting, signaling system, bus stand, footpath including kerb stone, boundary wall, horticulture work and any other work to bring the site to original position) within barricading area as per current standards with new materials (except electrical/signal post which may be reused if they are usable).
- (7) The contractor shall be responsible for obtaining relevant certificates or clearance from local civic authorities.

- (8) The contractor shall be responsible for obtaining approval by all relevant civic authorities having jurisdictional authority wherever required.

7. OPERATIONAL REQUIREMENTS

- (1) The Permanent Works shall be designed to permit the BSRP to operate satisfactorily at a maximum design speed as described in Design Basis Report.
- (2) The vertical and horizontal alignments for the main line track work shall comply with the conditions laid in para (3) and (4) of this document.
- (3) Particular attention shall be paid to locations where flooding could damage the railway. In particular Construction of surface water drainage systems including plinths and ducts shall be avoided in the vicinity of traction substations to obviate any risk of flooding of electrical equipment areas.
- (4) During construction the contractor shall be responsible for providing and maintaining adequate flood protection to ensure protection of the works.

8. Deleted

9. ENVIRONMENTAL CONSIDERATIONS

All provisions and conditions contained in the conditions of contract on safety, health & environment and section-5 & 8c of the tender document shall be strictly complied with. Bidders should note that any stipulations specified by the funding agency in relation to environment, social, health and safety (eshs) shall have to be complied in all respect. Such stipulations will be uploaded along with as addendum in due course of bid process.

10. URBAN PLANNING FUNCTIONAL REQUIREMENTS

1. Deleted
2. Deleted
3. Deleted
4. Requests for temporary power supplies for the construction of the works must be submitted by the contractor to the concerned authorities. Alternatively separate power supplies may be arranged by the Contractor independent of concerned electricity distribution/ transmission authority subject to compliance with all necessary statutes.
5. In addition, a number of agencies are involved in the reinstatement works, permanent road accesses, temporary road accesses, refuse collection accesses, street lighting, traffic management and fire hydrant positions. The Contractor is responsible for obtaining the approvals for these other works
6. The Contractor is responsible for obtaining the approval of applications from the above authorities for the design and construction of works. The Employer may provide assistance in order to obtain any permission on clearances.

11. TRAFFIC MANAGEMENT

The Contractor shall carry out the Works so as to minimize disruption to road and pedestrian traffic. The Contractor shall prepare his traffic management plan based on his proposed construction methodology in co-ordination with Engineer and in conjunction with Bangalore Traffic Police. He shall comply strictly with the approved plan during construction of his works. The design shall provide for temporary road decking wherever necessary to provide minimum no. of traffic lanes as agreed with Bangalore Traffic Police.

12. MISCELLANEOUS

The Contractor shall note that the Commissioner for Railway Safety (CRS) will inspect the Works from time to time for the purpose of determining whether the Bangalore Suburban Rail Corridor Project complies in terms of operational and infrastructural safety in accordance with the Laws of India. The contractor shall note that CRS approval is mandatory for commissioning the system. Notwithstanding other provisions of the Contract, the Contractor shall ensure that the Works comply with the requirements of CRS in terms of construction to the drawings, and shall assist the representatives of CRS in carrying out their inspection duties and also comply with their instructions regarding rectifying any defects and making good any deficiencies.

13. STANDARDS

- (1) Equipment, materials and systems shall be designed, manufactured and tested in accordance with the latest issue of International and/or National codes and standards. The Contractor submit hard copies in original to the Engineer of all codes and standards used for the work.
- (2) Reference to standards or to materials and equipment of a particular manufacturer shall be regarded as followed by the words "or equivalent". The Contractor may propose alternative standard materials, or equipment that shall be equal to or better than those specified. If the Contractor for any reason proposes alternatives to or deviations from the specified standards or desires to use materials or equipment not covered by the specified standards, the Contractor shall apply for the consent of the Engineer. The Contractor shall state the exact nature of the change, the reason for making the change and relevant specifications of the materials and equipment in the English language. The decision of the Engineer in the matter of quality will be final. No compensation or extra money shall be paid.

SECTION C**EMPLOYER'S REQUIREMENTS –DESIGN****1. INTRODUCTION**

- (1) The Employer's Requirements - Design, specifies the procedural requirements for the preparation of the design of the Permanent Works. These requirements are subdivided into those that are to occur during the Design Phase, those that are to occur during the Construction Phase, and those that are of general application.
- (2) Obligations prior to commencement of Works relating to Design and Construction.

Within 20 (twenty) days of the LOA, the Contractor shall:

- (a) appoint its representative, duly authorized to deal with the Authority in respect of all matters under or arising out of or relating to this Agreement;
 - (b) appoint a Design Director who will head the Contractor's design unit and shall be responsible for surveys, investigations, collection of data, and preparation of preliminary and detailed designs;
 - (c) undertake and perform all such acts, deeds and things as may be necessary or required before commencement of Works under and in accordance with this Agreement, Applicable Laws and Applicable Permits; and
 - (d) make its own arrangements for quarrying and procurement of materials needed for the Railway Project under and in accordance with Applicable Laws and Applicable Permits.
- (3) **Design and Drawings**

Design and Drawings shall be developed in conformity with the Specifications and Standards set forth in Schedules and Employers Requirement and scope of work. In the event, the Contractor requires any relaxation in design standards due to restricted Right of Way in any section, the alternative design criteria for such section shall be provided for review of the Authority's Engineer.

The Contractor shall appoint a proof check consultant (the "Proof Consultant") after proposing to the Authority a panel of 3 (three) names of qualified and experienced firms and Authority will select 1 Proof Consultant from panel. The Parties agree that no firm or person having any conflict of interest shall be engaged hereunder.

The Proof Consultant shall:

- a) evolve a systems approach with the Design Director so as to minimise the time required for final designs and construction drawings; and
- b) proof check the detailed calculations, drawings and designs, which have been approved

by the Design Director.

- c) no review and/or observation of the Authority's Engineer and/or its failure to review and/or convey its observations on any Drawings shall relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Authority's Engineer or the Authority be liable for the same in any manner; and if errors, omissions, ambiguities, inconsistencies, inadequacies or other Defects are found in the Drawings, they shall, along with the affected Works, be corrected at the Contractor's cost.
 - d) The Contractor shall be responsible for delays in submitting the Drawings, caused by reason of delays in surveys and field investigations, and shall not be entitled to seek any relief in respect thereof from the Authority; and
 - e) the Contractor warrants that its designers, including any third parties engaged by it, shall have the required experience and capability in accordance with Good Industry Practice and it shall indemnify the Authority against any damage, expense, liability, loss or claim, which the Authority might incur, sustain or be subject to arising from any breach of the Contractor's design responsibility and/or warranty as set out in this Clause.
 - f) Any cost or delay in construction arising from review by the Authority's Engineer shall be borne by the Contractor.
 - g) The Contractor shall appoint a safety consultant, the Safety Consultant. shall:
 - (i) evolve a system approach for undertaking a safety audit of the Railway Project during construction phase; and
 - (ii) proof check the detailed safety plan covering all aspects of including safety of Users, workers and equipment
- (4) Construction of the BSRP Project

The Contractor shall construct the Railway Project as specified in Schedules, and in conformity with the Specifications and Standards. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works. For works involving existing yards, the non-interlocking programme for each year shall be drawn by the Authority's Engineer and provided to the Contractor. The Contractor and the Authority's Engineer, within a period of 30 days, will discuss the same and issue a jointly agreed NI programme. The execution of work during the non-interlocking period will be the responsibility of the Contractor. The work during non-interlocking period in yards will be executed directly under the supervision of K-RIDE/Railways, however, the timely completion of NI working will be the responsibility of the Contractor and the Contractor agrees and undertakes that the construction shall be completed on or before the Scheduled Completion Date, including any extension thereof, in which case the Scheduled Completion Date will be the extended date as per the time extension granted.

- (5) In addition to the express requirements herein, the Contractor shall, whenever the Engineer so requests, provide information and participate in discussions that relate to design matters.

- (6) The Contractor shall engage the Designer who shall undertake and prepare the design of the Permanent Works and Temporary Works. The Contractor shall establish an office for his core design team at the Site in Bangalore. The core design team shall function from this office and all meetings and discussions relating to design shall be held in this office.
- (7) The Contractor shall ensure that the Designer continues to be represented in Bangalore at all times by staff whose seniority and experience are to the satisfaction of the Engineer and whose representative is available on the Site as necessary or as required by the Engineer.
- (8) The Contractor shall submit his Quality Assurance Plan as required at Appendix 6 for the design required by the Contract.

2. REQUIREMENTS DURING DESIGN PHASE

- (1) The principal requirements of the Design Phase are the production of the Preliminary Design, the Definitive Design and Good for Construction Drawings (GFC).

- (2) Preliminary Design

The Preliminary Design shall incorporate guidelines provided in tender documents and conceptual arrangements submitted. In addition, general construction methods and documentation needed to develop the Definitive Design shall be submitted.

- (3) Definitive Design shall accord with and incorporate the Contractor's Technical Proposals and shall be the design developed to the stage at which all elements of the structures are fully defined and specified and in particular:

- (a) Calculation and analysis are complete;

- (b) All main and all other significant elements are delineated;

- (c) All tests and trials and all selection of materials and equipment are complete;

- (d) Shall take full account of the effect on the Permanent Works of the proposed methods of construction and of the Temporary Works.

- (4) During the preparation of the Definitive Design, the Contractor shall complete all surveys investigations and testing necessary to complete the design of the Permanent Works.

- (5) The Contractor shall sub-divide the proposed Definitive Design into Design Packages to be submitted in advance of the Definitive Design Submission and to be identified in the Design submission Programme. The Design Packages are to relate to the significant and clearly identifiable parts of the proposed Definitive Design and shall address the design requirements as described herein. The Design Packages shall facilitate the review and understanding of the definitive Design as a whole and shall be produced and submitted in an orderly sequential and progressive manner.

- (6) Separate Definitive Design Submissions may be prepared for those major elements to be

procured by sub-contract and which sub-contracts include design. Where such work is to be procured by the Contractor on the basis of outline design, design briefs and performance specifications, such documents may be submitted as Definitive Design Submissions.

- (7) Upon issue of the Notice in respect of the Definitive Design Submission, the Contractor shall complete the design in all respects and produce the GFC Drawings, the purpose of which is to illustrate all the Permanent Works and to be the drawings governing construction.
- (8) GFC Drawings shall fully detail for the construction of the elements covered by the Definitive Design and shall show in full the works to be constructed.

3. REQUIREMENTS DURING CONSTRUCTION PHASE

- (1) The principal requirements relating to design during the Construction Phase are the production of Working Drawings, the preparation of technical submissions as required under the Contract, the compilation of the Final Design and the production of the As-Built Drawings.
- (2) Working Drawings shall be prepared as required under the Contract. They shall be endorsed by the Contractor as being in accordance with the GFC Drawings.
- (3) The Contractor shall endorse the submissions required under the contract that "all effects of the design comprising the submission on the design of adjacent or other parts of the works have been fully taken into account in the design of these parts"
- (4) At least 3 months but not more than 6 months prior to the anticipated date of substantial completion of the Works, the Contractor shall submit the Final Design to the Engineer.
- (5) The Final Design is the design of the Permanent Works embodied in:
 - (a) The latest revisions of the documents comprised in the Definitive Design, taking account of comments in the schedules appended to Notices of No Objection
 - (b) The latest revisions of the GFC Drawings;
 - (c) The calculations (see Clause 11 herein); and
 - (d) Such other documents as may be submitted by the Contractor at the request of the Engineer to illustrate and describe the Permanent Works and for which a Notice has been issued.
- (6) The Contractor shall maintain all records necessary for the preparation of the As-Built Drawings.

Upon completion of the Works or at such time as agreed to or required by the Engineer, the Contractor shall prepare drawings which, subject to the Engineer's agreement, shall become the As-Built Drawings. All such drawings shall be endorsed by the Contractor as true records of the construction of the Permanent Works and of all temporary works that are to remain on the site. The Contractor shall also show the locations of utilities exposed and retained as directed.

4. DESIGN INTERFACES WITH DESIGNATED CONTRACTOR

The Contractor shall coordinate all design and installation works with the various Designated contractors and establish the Co-ordinate Installation Plan (CIP). The co-ordinated installation Plan (CIP) shall be developed by the contractor in a format acceptable to the Engineer. The Contractor shall co-ordinate with all interfacing designated contractors to produce a detailed programme of access dates, equipment delivery routes and occupation periods for each room and area inside the station envelope. The CIP shall be signed off by each Designated Contractor and Submitted to the Engineer not later than **3 (Three) months** before basic structure is completed as described in Annexure-1.

5. DESIGN SUBMISSIONS

5.1 PRELIMINARY DESIGN SUBMISSION

GENERAL

The preliminary design shall provide initial design documents for review and shall be sufficiently detailed to show the element of the design main and documents required for preparation of the definitive design. It shall also include:

- a) The quality assurance plan for design
- b) A review of the outline design criteria
- c) The submission of design manuals
- d) The submission of proposed software
- e) The preliminary equipment layouts and details
- f) The preliminary maintenance analysis
- g) The preliminary off site testing recommendation
- h) Deleted
- i) The submission of specifications proposed for the work
- j) The identification of design codes and standards
- k) The CAD procedures
 - l) preliminary station sizing (Wherever applicable)
- m) Preliminary viaduct sizing
- n) An alignment reviews
- o) The preliminary construction methodology
- p) The design submission programme (update)

- q) The utility diversion plan
- r) Proposed site surveys and other field surveys
- s) A review of permanent land requirement
- t) The preliminary ground treatment and building protection proposal.
- u) The preliminary reinstatement drawings.

5.2 Deleted

5.3 DEFINITIVE DESIGN SUBMISSION

1. GENERAL

The Definitive Design Submission shall be a coherent and complete set of documents properly consolidated and indexed and shall fully describe the proposed Definitive Design. In particular, and where appropriate, it shall define:

- (a) The dimensions of all major features, structural elements and members;
- (b) All materials;
- (c) Potential forces and movements due to all possible loadings and actions on the structures, and their accommodation;
- (d) All second order effects;
- (e) The layout and typical details of reinforcement in structural concrete members;
- (f) The locations and nature of all relevant joints and connections and details thereof;
- (g) Standard details;
- (h) Location, geometry and setting-out of all main elements and features;
- (i) Electrical and mechanical services and equipment and their interaction with the structures;
- (j) Provisions and proposals for construction interfacing with the Designated Contractors;
- (k) Deleted;
- (l) Utilities to be diverted/supported;
- (m) DELETED
- (n) DELETED
- (o) Traffic or other civic service affected.
- (p) DELETED.
- (q) DELETED.

2. DRAWINGS

The Definitive Design Submission shall include drawings that shall illustrate the proposed Definitive Design and in particular shall include, without limitation:

- (i) General arrangements;
- (ii) DELETED
- (iii) Layouts and details of structural elements;
- (iv) Associated fittings;
- (v) DELETED
- (vi) Structural and surface drainage
- (vii) DELETED
- (viii) DELETED
- (ix) DELETED
- (x) DELETED
- (xi) DELETED
- (xii) Existing and proposed utilities;
- (xiii) Road works and works related to traffic management including decking.
- (xiv) DELETED
- (xv) DELETED
- (xvi) DELETED

3. CONTRACT SPECIFICATION

The Specification included in the tender documents together with the Outline Design Specification and Outline Construction Specifications shall be amplified so as to specify comprehensively the design and construction of the Permanent Works.

DESIGN MANUAL

The Design Manual shall incorporate all design requirements, standards, codes, loading cases, permissible movements and deflections, limit states, design-stresses and strains, material properties and all other documents or matters which are relevant to and govern the design. The Design Manual shall refer to all materials, codes and standards used, making clear their specific

applications. The Design Manual shall be produced so that it can be used by those involved in the preparation or review of the design of the Permanent Works as a comprehensive reference text and efficient working document.

INTERFACE REPORT ON DESIGNATED CONTRACTS

This will include the following:

Details of the design and construction of the Works adjacent to other contracts. Details of provisions for the Designated Contractors, indicating arrangements for accesses, fixings, casting-in, openings, supports, decks, manholes, trenches and the like; updated interface management plan relating to design integration and co-ordination.

TESTING AND COMMISSIONING REPORT

Details of proposals for testing and commissioning procedures for all relevant elements and equipment contained in the Permanent Works.

MAINTENANCE REPORT

A report updating the Statement of Maintainability in the tender documents and Detailing maintenance routines necessary for the achievement of the required lives of the various elements of the Works.

AESTHETICS REPORT:

Bridge Aesthetics:

Bridge structures are important landmarks and play a significant part in the collective experience of the built environment. Hence there is a clear need for these structures to be, put in simple words, good looking & aesthetically pleasing.

1. The general arrangement shall have good proportions, of harmonic proportions between length and height, between span clearance and depth, between the supporting and the supported structures
2. The product, or the structure, must be shaped in a way to allow easy fabrication or construction. This means that the material used has an influence on the design. The final shape should also express special qualities of the material, for instance high strength should lead to slenderness or gracefulness.
3. All sharp edges shall preferably rounded with minimum 50 mm radius curves.
4. All surfaces beyond 1 m width shall be provided with aesthetically designed grooves, as approved by K Ride. Grooves, wherever provided shall be with vertical plane to avoid accumulation of dust.

The following bridge aesthetic aspects shall be considered in design:

5. Bridges shall have a minimum structural depth consistent with their spans and method of construction.

6. The design of bridges shall address the slenderness aspects of the structure and consider the effects of the parapets and all other elements of the structure in the determination of the apparent visual slenderness.
7. All structures shall present smooth, clean lines and continuous lines.
8. Bridge proportions shall represent spanning and supporting requirements and shall respond to the context of the individual bridge localities.
9. Length of spans shall be maximised where practical, within the context of the necessary bridge length.
10. Bridge structural elements such as piers, sill beams and abutments shall be aesthetically integrated.
11. The bridge deck, kerb and barriers shall extend beyond the deck units to prevent water staining of the units and for aesthetics.
12. All the elements of superstructure and substructure shall be gracefully harmonized (angles, curbs, shapes, geometry, etc.) to ensure aesthetics.
13. Drip moulds / Drip Courses shall be provided monolithically with the structural concrete.
14. Form Finishes: All exposed surfaces shall be necessarily form finished to category Finish F4. To meet with requirements for F4 finish, forms shall be manufactured in a skilful, workmanlike manner, accurately to dimensions. There should be no visible offsets, bulges or misalignment of concrete. At construction joints, the forms shall be rightly set and securely anchored close to the joint. Abrupt and gradual irregularities shall not exceed 3mm. All joints or any infirmities in the surfaces shall be made good to be absolutely uniform, at no extra cost.

SPECIFICATION FOR FORMWORK

1.0 Formwork for Exposed Concrete Surfaces

The facing formwork shall be specifically approved by the Engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure:

- 1.1 Plain slab soffit, and sides of beams, girders, joists and ribs and side of walls, fins, parapets, pardis, sun-breakers, etc shall be made with Steel plates not less than 4mm thick of specified sizes stiffened with a suitable structural framework and fabricated true to plane.
- 1.2 Bottoms of beams, girders and ribs, sides of columns shall be made with steel plates not less than 5mm thick of specified sizes stiffened with a suitable structural framework, and fabricated true to plane.
- 1.3 For Precast segments, piers, pier heads, portals etc. suitable steel form work is to be used unless otherwise specified by Engineer.

2.0 Formwork for Sloped Surfaces

- 2.1 Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration, inspection and finishing of the concrete, as approved by Engineer In-Charge.

- 2.2 The formwork shall be built in such a way so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 2 horizontals: 1 vertical shall be formed as required herein.
- 2.3 All construction joints shall be harmoniously treated, as per the directions of Engineer In-Charge, at no extra cost

3.0 Formwork for Curved Surfaces

- 3.1 The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form lumber shall be built up of laminated splices cut to make tight, smooth form surfaces.
- 3.2 After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature, as directed by the Engineer In-Charge

4.0 Aesthetic Finishes

Special approved aesthetic finishes like grooves, logos, engravings/projections in inset and out set as per the approved design shall be provided by fixing monolithic rubber forms or any other approved material fixed on the entire surface of the form work. The shore hardness of the rubber shall ensure strength, flexibility and elasticity. The rubber shall be cold cured (preferably polyurethane based) and fixed to the formwork under controlled conditions in shade and air temperature.

The form liners should be shrinkage free, solvent free and should be impervious to abrasion by Concrete, resistant to concrete pressure and heat resistant upto 700 degree centigrade dry heat. Formwork liner fixation should be factory made under close tolerances and stage inspections.

If proprietary system of formwork is used, detailed information as given below herein shall be furnished to Engineer for approval before use.

4.1. General

- a. The information which the manufacturer is required to supply shall be in such detail as to obviate unsafe erection and use of equipment due to the intention of the manufacturer not having been made clear or due to wrong assumptions on the part of the Contractor.
- b. The Contractor shall refer unusual problems of erection/assembly not in keeping with intended use of equipment, to the manufacturer of the equipment.

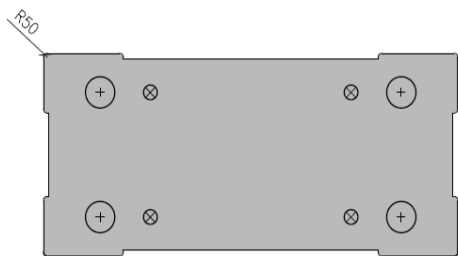
4.2. The manufacturers of proprietary systems shall supply the following information;

- a. Description of basic functions of equipment.
- b. List of items of equipment available, giving range of sizes, spans and such like, with manufacturer's identification number or other references.
- c. The basis on which safe working loads have been determined and whether the factor of safety given applies to collapse or yield.
- d. Whether the supplier's data are based on calculations or tests. This shall be clearly stated as there may be wide variations between results obtained by either method.

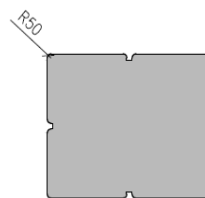
- e. Instructions for use and maintenance, including any points which require special attention during erection, especially where safety is concerned.
- f. Detailed dimensional information, as follows:
- i. Overall dimensions, depths and widths of members.
 - ii. Line drawings including perspectives and photographs showing normal uses.
 - iii. Self-weight.
 - iv. Full dimensions of connections and any special positioning and supporting arrangements.
 - v. Sizes of members, including tube diameters and thicknesses of material.
 - vi. Any permanent camber built into the equipment.
 - vii. Sizes of holes and dimensions giving their positions.
 - viii. Manner of fixing including arrangements for sealing joints.
 - ix. Method of de-stripping, storing & shifting.

g. Data relating to strength of equipment as follows:

- i. Average failure loads as determined by tests.
- ii. Recommended maximum working loads for various conditions of use.
- iii. Working resistance moments derived from tests.
- iv. Working shear capacities derived from tests.
- v. Recommended factors of safety used in assessing recommended loads and deflections based on test results.
- vi. Deflections under load together with recommended pre-camber and limiting deflections.
- vii. If working loads depend on calculations, working stresses should be tested. If deflections depend on theoretical moments of inertia or equivalent moments of inertia rather than tests, this should be noted.
- viii. Information on the design of sway bracing against wind and other horizontal loadings.
- ix. Allowable loading relating maximum extension of bases and/or heads.
- x. Any restrictions regarding usage of any component or full assembly with regard to spans, heights and loading conditions.



PLAN AT PIER CAP TOP LEVEL



PLAN AT PIER BOTTOM LEVEL

STATION PLANNING REPORT – DELETED**4. SUPPORTING DOCUMENTS**

The Definitive Design Submission shall be accompanied by the following documents, which will be considered by the Engineer in his review of the Definitive Design Submission. Where relevant or required, these documents shall be accompanied by a design note stating clearly how information has been used in the design of the Permanent Works.

GEOTECHNICAL INTERPRETATIVE REPORT

A report including site investigation results and covering the geotechnical interpretation of site investigation work including that undertaken by the Contractor in sufficient detail to confirm and justify parameters used in the foundation and geotechnical designs. The report shall include the full logs and descriptions of confirmatory boreholes drilled by the Contractor.

SURVEY REPORT

A report on all survey work undertaken by the Contractor, including checks on mapping, survey stations, co-ordinates and setting-out. Updated topographical and survey drawings shall also be included.

UTILITIES REPORT

A report giving details of arrangements and working methods in respect of the existing utilities, including protection measures, diversions, reinstatements and programme allowances.

TEMPORARY WORKS DESIGN REPORT

A report which provides sufficient information on the design of the Temporary Works to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

CONSTRUCTION / INSTALLATION ANALYSIS REPORT

A report containing a stage-by-stage construction / installation sequence for all structures / equipment.

CONSTRUCTION METHOD STATEMENT

A report which provides sufficient information on the methods of construction, execution and launching systems proposed and Contractor's Equipment to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

PROJECT SCHEDULE REVIEW

- (vi) The Contractor shall, prior to submitting the Definitive Design Submission, review the Project Schedule against the current version of the Design Submission Programme.
- (vii) In the event that the Contractor considers that there are any discrepancies or inconsistencies between the Design Submission Programme and the Project Schedule, the Contractor shall submit with the Definitive Design Submission its proposed revisions to the Project Schedule such that the discrepancies or inconsistencies are removed.
- (viii) The Contractor shall provide details of submissions of the proposed Working Drawings and their anticipated timing during the Construction Phase and shall identify information required from or actions to be undertaken by the Employer or others which are necessary to permit the completion of the design of the Permanent Works and the Working Drawings. Desired Dates for the receipt required by the Contractor of such information or for the completion of such actions shall be included with appropriate justification.

REPORT ON THE USE OF WORKS AREAS

A report updating the proposals from those contained in the Contractor's Technical Proposals for the use of Works Areas and their reinstatement and accesses facilities.

5. NOTICES ON DEFINITIVE DESIGN SUBMISSION

The Contractor may make Definitive Design Submissions and seek separate Notices in respect of:

- (a) The temporary works for construction of the viaduct & Station works (Wherever required).
- (b) All works related to the viaduct & At-Grade sections.
- (c) Major elements as identified under Clause 2(6) herein.

The issue of such separate Notices under (a) and (b) above shall be conditional upon the Contractor having demonstrated, to the satisfaction of the Engineer, that the effect of each structure on other structures, utilities, etc., has been fully accommodated in the design.

5.1 Submission of Design Data

In the case of submissions subsequent to the Definitive Design, the Design Data shall be in accordance with Employer's Requirements and the Definitive Design.

The Contractor shall submit to the Engineer all Design Data, together with the relevant Design Certificates certified by the Contractor, on or before the respective dates for submission shown on the Design Submission Programme or, as the case may be, the Works Programme. In the event that a re-submission of Design Data is required, such re-submission shall be made as soon as practicable after the receipt of the relevant statement of objections. All submissions of Design Data shall include the copies as stipulated in the Employer's Requirements.

Following receipt of a submission of Design Data the Engineer shall, within 28 days, return one copy of the Design Data to the Contractor, together with either a Notice of No-Objection, or a statement of objections which shall identify the aspects of the Design Data which do not conform to the above requirements. If the Engineer returns any Design Data with a Notice of No Objection, the Contractor shall proceed with the Works in accordance with the Contract

If the Engineer provides that revisions to a submission of Design Data/ are appropriate but that such revisions are of minor design significance, the Engineer may issue a Notice of No Objection subject to an appended schedule of comments identifying the relevant revisions. The Contractor shall revise such Design Data in accordance with such comments but shall not be obliged to re-submit such Design Data solely on account of such revisions.

If the Engineer returns any Design Data with a statement of objections the Contractor shall revise the Design Data to take account of the stated objections and re-submit such Design Data to the Engineer, together with new Design Certificates signed by the Designer and the Contractor.

The issue of a Notice of No Objection in relation to any submission of Design Data shall be entirely without prejudice to the review of subsequent submissions of Design Data or to any subsequent request for a Contractor's Variation, and shall not bind or fetter the Engineer in any manner whatsoever when deciding whether or not to raise objections in relation to any subsequent submission of Design Data or when dealing with a subsequent request for a Contractor's Variation.

Neither an objection raised to the Design Data nor revisions of minor design significance under this Clause will, under any circumstances, constitute an Employer's Variation.

6. DESIGN SUBMISSIONS - GFC DRAWINGS SUBMISSIONS

- (1) The GFC Drawings shall be derived directly from the Definitive Design and shall detail and illustrate in full the Permanent Works. The Construction' Reference Drawings shall form part of the Working Drawings to be used for construction purposes.
- (2) Prior to any GFC Drawings Submission, the Contractor shall prepare a full list of GFC Drawings in order to demonstrate, to the satisfaction of the Engineer, that such GFC Drawings will be sufficient in extent to cover the construction of the whole of the Permanent Works.
- (3) Unless otherwise required by the Engineer, the GFC Drawings need not include bar bending schedules, bar reference drawings, fabrication or shop drawings as well as other schedules or erection drawings which are to be provided by the Contractor during the Construction Phase.

7. DESIGN SUBMISSIONS – CONSTRUCTION PHASE

- (1) On the issue of a Notice in respect of the GFC Drawings the Contractor shall produce the proposed Working Drawings. These- shall either be identical to the GFC Drawings or shall be further drawings developed in accordance with the GFC Drawings such as site sketches, bar bending schedules, bar reference drawings, fabrication and shop drawings, construction erection sequences and the like. All such drawings shall comply with the requirements of the Contract.

- (2) Prior to submission of the proposed Working Drawings, the Contractor shall endorse the appropriate original paper drawings as "Good for Construction". If the Engineer so requires, the endorsed original shall be submitted to the Engineer who shall, if he has no objection to the contents of the submission, further endorse the original by stating that he has no objection to the proposed Working Drawings. On the endorsement by the Engineer, the original forthwith be returned to the Contractor as the Working Drawings.
- (3) Only the Working Drawings endorsed as in 7(2) above or those that the Engineer has expressly stated as not requiring his endorsement shall be issued to the Site. The construction of the Works shall be strictly in accordance with these Working Drawings.
- (4) The contractor shall finalize details of the proposed method of construction and submit such finalised details to the Engineer for review. The proposed method shall have no adverse effects on the partially completed Permanent Works and shall ensure the Works are statically and, if appropriate, aerodynamically stable.
- (5) The Contractor shall undertake and submit a stage by stage construction sequence and the effect of any Temporary Works and the Contractor's Equipment on the Permanent Works. This analysis shall be in sufficient detail to demonstrate that the Contractor's proposals are safe and have no adverse effects upon any parts of the Permanent Works.
- (6) As-Built Drawings, endorsed by the Contractor shall be submitted to the Engineer for agreement.

8. DESIGN SUBMISSIONS - REVIEW PROCEDURES

- (1) Submissions of Design Data shall be made and reviewed by the Engineer. The form and detail of the review shall be as determined by the Engineer and will not release or remove the contractor's responsibility for the design under the contract.
- (2) The issue of a Notice shall be without prejudice to the issue of any future Notices.
- (3) The Contractor shall, prior to the submission of the Design Data, obtain all required and/or statutory approvals that relate to that submission including, where appropriate, the approval of the Concerned Government Authorities and utility undertakings, and demonstrate that all required approvals have been obtained.
- (4) All submissions shall be accompanied by two original copies of a 'Design Certificate' as set out in Attachment - D1 hereto and signed by the Contractor and the Designer.

9. DESIGN SUBMISSION PROGRAMME

- (1) The Contractor shall prepare the Design Submission Programme which is to set out fully the Contractor's anticipated programme for the preparation, submission and review of the Design Packages, the Definitive Design Submission and the GFC Drawings Submissions and for the issue of Notices in relation thereto.
- (2) The Design Submission Programme shall:

- (a) Be consistent with and its principal features integrated into the Works Programme, and show all relevant Key Dates;
 - (b) Identify dates and subjects by which the Engineer's decisions should be made;
 - (c) Make adequate allowance for periods of time for review by the Engineer and other review bodies;
 - (d) Make adequate allowance for the design and development of specialist works;
 - (e) Include a schedule identifying, describing, cross-referencing and explaining the Design Packages into which the Contractor intends to divide the Definitive Design and GFC Drawings; and
 - (f) Indicate the Design Interface and Co-ordination periods for each Designated Contractor.
- (3) The Contractor shall submit the Design Submission Programme to the Engineer within thirty (30) days of the date of Notice to Proceed, and thereafter up-dated versions thereof at intervals of not more than one (1) month throughout the Design Phase.

10. PROGRAMME FOR SUBMISSIONS DURING CONSTRUCTION PHASE

In accordance with Clause 4 of the employer requirements – General, the contractor shall identify submissions required during the construction phase.

11. CALCULATIONS

- (1) Unless otherwise required by the Engineer, calculations relevant to the Definitive Design and GFC Drawings shall be submitted for review with the respective Design Packages or Submissions. The Engineer may require the submission of applicable software including in house software programmes/ worksheets developed by the Contractor, computer input and programme logic for its review prior to the acceptance of the computer output.
- (2) The Contractor shall prepare and submit a comprehensive set of calculations for the Definitive Design in a form acceptable to the Engineer. Should the design of the Permanent Works be revised thereafter and such revision renders the calculations as submitted obsolete or inaccurate, the Contractor shall prepare and submit the revised calculations
- (3) Similarly, the Contractor shall submit such further calculations as have been prepared in connection with the GFC Drawings.
- (4) Calculations to be included as part of the submission herein shall comprise the up-to-date calculations in respect of the Definitive Design, the GFC Drawings and such further calculations which the Contractor has prepared during the production of Working Drawings.
- (5) The Contractor shall submit all calculations necessary to support proposals relating to the construction methods.

12. DOCUMENTS REQUIREMENTS

- (1) Drawings shall be prepared generally to A1 size, but to ISO A0 size where appropriate. Appendix 7 defines the Drawings and CAD Standards required for drawing preparation and submittal.
- (2) The Contractor shall submit 6 copies of his design and/or drawings for review by the Engineer. After receipt of "No Objection" from the Engineer's Representative, the Contractor shall submit 6 copies of design and/or drawing for the use of the Engineer.
- (3) The submission of drawings may be by CAD Media files and Appendix 7 specifies the drawing submission requirements for CAD Media files.

13. Liability for review of Documents and Drawings

Except to the extent expressly provided in this Agreement:

- (a) no review, comment or approval by the Authority or the Authority's Engineer of any Document or Drawing submitted by the Contractor nor any observation or inspection of the construction of the Railway Project nor the failure to review, approve, comment, observe or inspect hereunder shall relieve or absolve the Contractor from its obligations, duties and liabilities under this Agreement, Applicable Laws and Applicable Permits; and
- (b) the Authority shall not be liable to the Contractor by reason of any review, comment, approval, observation or inspection referred to in Sub-clause (a) above.

ATTACHMENT D 1

DESIGN CERTIFICATE

This design Certificate refers to design submission nowhich comprises of Definitive Design submission / GFC Drawings submission, working drawing submission scheduled in the attached transmittal, in respect of:

(Description of Permanent Works to which the submission refers)

DESIGNER'S STATEMENT:

We certify that:

- a) The outline designs, design briefs and performance specifications of those elements of the Permanent works as illustrated and described in the documents scheduled in the attached transmittal, complies with the design basis criteria and other contract provisions.
- b) An in-house check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Permanent Works as illustrated and described in the documents scheduled in the attached transmittal.
- c) All necessary and required approval relating to the design of the Permanent Works, as illustrated and described in the documents listed in the attached transmittal, have been obtained.
- d) All effects of the design comprising the submission on the design of adjacent or other parts of the works have been fully taken into account in the design of those parts.

Signed by Designer's Authorized Representative Name :
 Position :
 Date :

CONTRACTOR'S CERTIFICATE:

The Certifies that all design has been performed utilizing the skill and care to be expected of a professionally qualified and competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us and the design proposed by the designer has been accepted by us

Signed by Contractor's authorized representative

Name :
 Position :
 Date :

Note 1

The Contractor shall insert one of the following, as applicable:

- (i) The Contractor's Technical Proposals
- (ii) The Contractor's Technical Proposals and Design Packages Nos for which a Notice of No Objection has been issued.
- (iii) Design Packages Nos for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.

(iv) The Definitive Design.

SAMPLE DRAWING TEMPLATE(a) Design Quality Assurance' by designer & contractor:

DESIGN QUALITY ASSURANCE			
The responsibility of control, Check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the design consultants and the contractor.			
By Designer			By Contractor
Sig:	Sig:	Sig:	Sig:
<u>Date:</u>	<u>Date:</u>	<u>Date:</u>	<u>Date:</u>
<u>Name:</u>	<u>Name:</u>	<u>Name:</u>	<u>Name:</u>
<u>Designed By</u>	<u>Checked by</u>	<u>Approved by</u>	<u>Accepted by</u>

(b) Notice of 'No Objection' from Employer's representatives:

Notice of 'No Objections' from Employer			
	Remarks	Date	Signature
DGM (Design)	Reviewed		
GM (Design)	Reviewed & comments as marked on drawing		
GM (Construction)	Reviewed & No objection issued with comments as marked on Drawing		

Section C

[Contractor to attach copies of necessary and required approvals]

SECTION D
EMPLOYER'S REQUIREMENTS - CONSTRUCTION

1. CONTRACTORS SUPERINTENDENCE

- (1) The Contractor shall submit a Staff Organization Plan in accordance with the ITT/Employer's Requirement. This plan shall be updated and resubmitted whenever there are changes to the staff. The plan shall show the management structure and state clearly the duties, responsibilities and authority of each staff member.
- (2) The site agent and his associates/supervisors shall have experience and qualification appropriate to the type and magnitude of the Works. Full details shall be submitted of the qualifications and experience of all proposed staff to the Engineer for his approval.
- (3) **DELETED**

2. CHECKING OF THE CONTRACTOR'S TEMPORARY WORKS DESIGN

The Contractor shall, prior to commencing the construction of the Temporary Works, submit a certificate to the Engineer signed by him certifying that the Temporary Works have been properly and safely designed and checked and that the Contractor has checked the effect of the Temporary Works on the Permanent Works and has found this to be satisfactory. The contractor to obtain the approval for designs and drawings of temporary structures from Railways and CRS. The necessary assistance will be given by K-RIDE.

3. THE SITE

- (1) Works Areas are those areas identified in Appendix-2A to these Employer's Requirements and on the Drawings.

No land shall be made available by the employer for casting yard, site offices, and site laboratories. Contractor shall make his own arrangements at his own cost. In case the Railway land is arranged adjacent to near to railway track for casting of U-Girders & for initial erection and launching activity temporarily, the necessary land rent /lease charges shall be levied as per Railway guidelines /K-RIDE norms and the same will deducted from RA bills of the Contractor.

USE OF THE SITE

- (2) The Site or Contractor's Equipment shall not be used by the Contractor for any purpose other than for carrying out the Works in the scope of this contract, except that, with the consent in writing of the Engineer, the Site or Contractor's Equipment such as batching and mixing plants for concrete and bituminous materials may be used for the work in connection with other contracts under the Employer.
- (3) Rock crushing plant shall not be used on the Site.
- (4) The location and size of each stockpile of materials, including excavated materials, within the Site shall be as permitted by the Engineer. Stockpiles shall be maintained at all times in a stable condition.

- (5) Entry to and exit from the Site shall be controlled and shall be only available at the locations for which the Engineer has given his consent.

ACCESS TO THE SITE

- (6) The Contractor shall make its own arrangements, subject to the consent of the Engineer, for any further access required to the Site.
- (7) In addition, the Contractor shall ensure that access to every portion of the Site is continually available to the Employer and Engineer.
- (8) Following the handover of the Railway Envelope, (as defined in the Employer's Requirements-General), to the Employer, the Employer will control the Railway Envelope and will be responsible for all matters relating to security and safety therein. Access to the Railway Envelope by the Contractor shall be in accordance with any procedures requirements and conditions.

ACCESS TO OUTSIDE THE SITE

- (9) The Contractor shall be responsible for ensuring that any access or egress through the Site boundaries are controlled such that no disturbance to residents or damage to public or private property occur as a result of the use of such access or egress by its employees and sub-contractors.

SURVEY OF THE SITE

- (10) A survey shall be carried out of the Site to establish its precise boundaries and the existing ground levels within it. This survey shall include a photographic survey sufficient to provide a full record of the state of the Site before commencing the work with particular attention paid to those areas where reinstatement will be carried out later on. The survey shall be carried out before the site clearance wherever possible and in any case prior to the commencement of work in any Works Area. The survey shall be carried out by the Contractor and agreed with the Engineer.

BARRICADES AND SIGN BOARDS

- (11) The Contractor shall erect barricades and gates around its areas of operations to prevent entry by unauthorized persons to his Works Areas and necessary identity cards /permits should be issued to workers and staff by the contractor. The Contractor shall submit proposal for barricades of the complete perimeter of all works areas to the Engineer. The safety barricading as per Drawing No. K-RIDE/ BSRP/ SBAR/03/2021 with Contractor's material labour including foundation works are required adjacent to IR tracks along the alignment for ensuring the safety of running trains. The temporary barricades of 2m heights of line MS sheets 16 gauge as per K-RIDE drawing are required to be provided near to IR/BSRP boundary. Painting of the barricades shall be carried out to the design and colours as directed by the Engineer and the Contractor shall carry out re- painting of the entire barricades on an annual basis. No work shall be commenced in any Works Area until the Engineer has been satisfied that the barricades installed by the Contractor are sufficient to prevent, within reason, unauthorized entry.
- (12) Project signboards shall be erected within four (4) weeks, or such other period as the Engineer has given his consent, after the date of commencement of the Works. The types, sizes and locations of

project signboards shall be agreed with the Engineer before manufacture and erection. Other advertising signs shall not be erected on the Site. The cost of these signboards is included in quoted price.

- (13) The consent of the Engineer shall be obtained before hoardings, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in positions after the completion of the Works shall be repaired and repainted as instructed by the Engineer.
- (14) Hoardings, barricades, gates and signs shall be maintained in clean and good order by the Contractor until the completion of the Works, whether such hoardings, fences, gates and signs have been installed by the Contractor or by others and transferred to the Contractor during the period of the Works. All the fencing, hoardings, gates and signs etc. shall be mopped minimum once in a week and washed monthly.
- (15) All hoardings, barricades, gates and signs installed by the Contractor shall be removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.
- (16) Hoarding/ barricades can be reused after removing from one place to other locations / sites provided they are in good condition and approved by Engineer.
- (17) Damage/worn-out barricades /hoarding shall be replaced by contractor within 24 hours. Engineer's decision regarding need for replacement shall be final and binding and if no action is taken by contractor, the Engineer may get it repaired through other agency and the cost of any repairs will be deducted by the Engineer from any payment due to the contractor.

CLEARANCE OF THE SITE

- (18) All Temporary Works which are not to remain on the Site after the completion of the Works shall be removed prior to completion of the Works or at other times instructed by the Engineer. The Site shall be cleared and reinstated to the lines and levels and to the same condition as existed before the Works started except as otherwise stated in the Contract.

4. SURVEY

- (1) All along the length of the proposed benchmarks (Tentative) have been set up by the Employer at intervals of about a kilometer. The details of these bench marks along with their reduced levels have been marked on the design drawings indicating the plan and 'L' section which form a part of the tender. The contractor along with the Engineer should verify the details of these bench marks (with reference to nearby GTS benchmarks) in the first instance, soon after taking possession of the site. If any mistakes are detected in these details of these bench marks the same should be indicated to the Engineer. The mistakes detected should be corrected in consultation with the Engineer. These corrections should be got approved by the Engineer before starting of any other work.
- (2) The contractor shall then in presence of the Engineer establish working bench marks at short intervals, adequately connecting them to the reference bench marks set up by the Employer in the Project length. The working bench mark levels should be got approved from the Engineer. An up-to-date record of all bench marks including approved corrections if any, shall be maintained by the

contractor and also the Engineer.

- (3) All levels taken for making out the longitudinal section and cross section should be related only to these working bench marks.
- (4) While doing the above-mentioned work, the fact that similar work will have to be done once again on the completed earth work in formation for fixing up the longitudinal levels of the installed P. Way should be kept in view.
- (5) The Contractor to fix alignment reference points at regular intervals all along the alignment. The contractor along with the Engineer should verify the details of these alignment pillars. If any mistakes are detected in these details, the same should be indicated to the Engineer before starting any work. These detected mistakes should be corrected by the Contractor in consultation with the Engineer. These corrections should be got approved from the Engineer.
- (6) The Contractor shall relate the construction of the Works to the Site Grid. To facilitate this, survey reference points have to be established by the contractor and benchmarks in the vicinity of the Site.
- (7) Before the Contractor commences the setting out of the Works, the Contractor shall satisfy itself that there are no conflicts and shall establish and provide all subsidiary setting out points, monuments, towers and the like which may be necessary for the proper and accurate setting out and checking of the Works.
- (8) The Contractor shall carefully protect all the survey reference points, bench marks, setting out points, monuments, towers and the like from any damages and shall maintain them and promptly repair or replace any points damaged from any causes whatsoever. The Contractor shall regularly recheck the position of all setting out points, bench marks and the like to the satisfaction of the Engineer.
- (9) The survey reference points will become the responsibility of the Contractor. The Contractor shall, by annual or more frequent review, ensure that these survey points continue to remain consistent with the benchmarks.

5. SAFETY, HEALTH AND ENVIRONMENTAL REQUIREMENTS

The Contractor shall comply with in the conditions stipulated in the Conditions of contracts on Safety, Health & Environment (SHE) including ESMP plan attached with SHE manual.

5.1 Training of Contractor's Employees/Staff/Workers: -

Contractor shall provide a training/workshop on safety, Health & Environment (SHE) to all its workers/staff/employees/subcontractors of at least 2 weeks (96hrs.) at the time of induction. Before postings of any his workers/staff/employees/subcontractors, the contractor shall give a certificate that the said person had undergone the requisite SHE training. Non-compliance of the above will invoke penalties as per condition of contract on SHE, Section-8C of Tender document.

In case of any mishap/ accident causing death/injury to public or damage to public/private property or damage to public/private vehicles or damage to railway property, the employer, will impose a penalty

to the contractor as deemed fit and appropriate in addition to the cost of damage caused due to the mishap/accident.

5.2 Use of "Tractor Transmission type" Pick and Carry Hydra crane: -

"Tractor Transmission type" Pick and Carry Hydra crane - 1st Generation model is prohibited at BSRP works, Contractor shall mobilize "Truck Transmission type" pick and carry hydra crane - 2nd Generation model only.

6. OTHER SAFETY MEASURES

Site Safety, Health & Environment Plan

- (1) The Contractor shall, within 60 days of the date of Notice to Proceed, prepare and submit to the Engineer for review his proposed safety, Health and Environment plan which shall contain as a minimum those items set out in Conditions of Contract on Safety, Health & Environment Plan.

Fire Regulations and Safety

- (2) The Contractor shall provide and maintain all necessary temporary fire protection and firefighting facilities on the Site during the construction of the Works, and shall comply with all requirements of the Bangalore Fire Services Department. These facilities may include, without limitation, sprinkler systems and fire hose reels in temporary site buildings, raw water storage tanks and portable fire extinguishers suitable for the conditions on the Site and potential hazards.
- (3) The Contractor shall submit details of these facilities to the Engineer for review prior to commencement of work on the Site.
- (4) If, in the Engineer's opinion, the use of naked lights may cause a fire hazard, the Contractor shall take such additional precautions and provide such additional firefighting equipment (including breathing apparatus) as the Engineer considers necessary. The term "naked light" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.
- (5) Oxyacetylene burning equipment will not be permitted in any confined space; Burning equipment of the oxpropane type shall be used.

Hazard and Risk Assessments

- (6) The Contractor shall, prior to the commencement of any operation carry out a detailed hazard and risk assessment. The results of such assessments shall be recorded and the records kept for inspection by the Engineer.
- (7) The Contractor shall produce detailed method statements for all medium and high risk operations and shall submit them to the Engineer for his consent prior to commencement of any task to which they relate.
- (8) The Contractor shall produce and implement a Permit to Work system for all high risk operations. The

Permit to Work system shall be submitted to the Engineer for consent before application.

Explosives

- (9) Explosives shall not be used without prior written consent of the Engineer. Before consent to blasting is granted, the Contractor shall prepare a Specification as to the size of charge, the method of firing and any other restrictions that may be imposed from time to time.
- (10) Where the Engineer has consented to the use of explosives, the Contractor shall be responsible for obtaining the requisite licences and permits for complying with all statutory requirements for blasting.
- (11) The storage, transportation and use of explosives shall at all times be governed by the Explosives Acts and such other statutory regulations which may be applicable and as imposed by the Statutory Authority.

Launching Girder/ Launching Crane

- (12) No Launching Girder or Launching Crane shall be used without written consent of the Engineer.
- (13) The Contractor shall prepare a detailed specification for the operation of Launching Girder and submit it to the Engineer for review and approval.

Standby Equipment

- (14) The Contractor shall provide adequate stand-by equipment to ensure the safety of personnel, the Works and the public. These measures shall include as a minimum the following: -
 - (a) stand-by pumping and generating equipment for the control of water;
 - (b) stand-by equipment and spares for illumination of the Works; and
 - (c) Stand-by generating equipment and equipment for the lighting for the works.

Co-operation

- (15) The Contractor shall provide full co-operation and assistance in all safety surveillance carried out by the Engineer or the Employer. Any breaches of the Site Safety Plan or the statutory regulations or others disregard for the safety of any persons may be the reason for the Engineer to exercise his authority to require the site agent's removal from the Site.

7. CARE OF THE WORKS

- (1) Any error in the execution of work leading to redesign work shall be duly compensated by the contractor as per the decision of Engineer. Any error attributable to the construction including failure to locate underground utilities shall attract penalties.
- (2) Unless otherwise permitted by the Engineer all works shall be carried out in dry conditions.
- (3) The works, including materials for using in the works, shall be protected from damage due to water. Water on the site and water entering the site shall be promptly by temporary drainage or pumping

system or by other methods capable of keeping the works free of water. Silt and debris shall be removed by traps before the water is discharged and shall be disposed of at a location or locations to which the engineer has given his consent.

- (4) The discharge points of the temporary systems shall be as per the consent of the engineer. He contractor shall make all arrangements with and obtain the necessary approval from the relevant authorities for discharging water to drains, watercourses etc. The relevant work shall not be commenced until the approved arrangements for disposal of the water have been implemented.
- (5) The methods used for keeping the works free of water shall be such that settlement of, or damage to, new and existing structure does not occur. Measures shall be taken to prevent flotation of new and existing structures.

PROTECTION OF THE WORKS FROM WEATHER

- (6) Work shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.
- (7) Permanent Works, including materials for such Works, shall be protected from exposures of weather conditions that may adversely affect such Permanent Works or materials.
- (8) During construction of the Works storm restraint systems shall be provided where appropriate. These systems shall ensure the security of the partially completed and ongoing stages of construction and in all weather conditions. Such storm restraint systems shall be installed as soon as practicable and shall be compatible with the right of way or other access around or through- out the Site.
- (9) The contractor shall at all-time programme and order progress of the work and make all protective arrangements such that the works can be made safe in the event of storms.

PROTECTION OF THE FINISHEDWORKS

- (10) The finished works shall be protected from any damage that could arise from any activities on the adjacent site/ works.

8. DAMAGE AND INTERFERENCE

- (1) Work shall be carried out in such a manner that there is no damage to or interference with:
 - (a) watercourses or drainage systems; (b) utilities; (c) structures (including foundations), roads, including street furniture, or other properties; (d) public or private vehicular or pedestrian access; (e) monuments trees, graves or burial grounds other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works. Heritage structures shall not be damaged or disfigured on any account. The Contractor shall inform the Engineer as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers need to be removed or diverted to enable the Works to be carried out. Such items shall not be removed or diverted until the consent of the Engineer to such removal or diversion has been obtained.

- (2) Items which are damaged or interfered with as a result of the Works and items which are removed to unable work to be carried out shall be reinstated to the satisfaction of the Engineer and to at least the same condition as existed before the work started. Any claims by Utility Agencies due to damage of utilities by the Contractor shall be borne by the Contractor.

UTILITIES

- (3) Please refer Employer's Requirement –Functional

STRUCTURES, ROADS AND OTHER PROPERTIES

- (4) The Contractor shall immediately inform the Engineer of any damage to structures, roads or other properties.

ALTERNATIVE ACCESS

- (5) Alternative access shall be provided to all premises if interference with the existing access, public or private, is necessary to enable the Works to be carried out. The arrangements for the alternative access shall be as agreed by the Engineer and the concerned agency. Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed immediately as it is no longer required, and the ground surfaces reinstated to the satisfaction of the Engineer. Proper signage and guidance shall be provided for the traffic / users regarding diversions.
- (6) Deleted

REMOVAL OF GRAVES AND OTHER OBSTRUCTIONS

- (7) If any graves and other obstructions are required to be removed in order to execute the Works and such removal has not already been arranged for, the Contractor shall draw the Engineer's attention to them in good time to allow all necessary arrangements and authorizations for such removal, and it shall not itself remove them unless the Engineer has given consent.

PROTECTION OF THE ADJACENT STRUCTURES AND WORKS

- (8) The Contractor shall take all necessary precautions to protect the structures or works being carried out by others adjacent to and, for the time being, within the Site from the effects of vibrations, undermining and any other earth movements or the diversion of water flow arising from its work.

9. WORK ON ROADS

(1) Traffic Management Plan

The Contractor shall develop a detailed Traffic Management Plan for the work under the contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighborhoods impacted by the construction activities. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract.

Principles for Traffic Management

The basis for the Plan shall take into consideration four principles:

- to minimize the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities;
- to ensure the safety of road users in the impacted area;
- to facilitate access to the construction site, and to maintain reasonable construction progress.
- to ensure traffic safety at each construction site.

Integrated Traffic Management Plan

The Contractor shall prepare an integrated plan showing the arrangements to be made for accommodating road and pedestrian traffic, at individual construction sites and continuously along the alignment, to smooth traffic operations and for the safety of both construction workers and road users.

The Plan shall consider different measures such as:

- Proper phasing and timing of traffic signals;
- Modifications to intersection geometry;
- Changes in lane usage;
- parking prohibitions;
- relocation of bus stops;
- reducing width of footpaths and median
- right turn prohibition;
- work site access management;
- minimizing the duration of any road closure;
- reversible lane operations;
- modification of roadway alignment affected by the construction, which shall be in conformance with the requirements and regulations defined by the relevant authorities; and may include widening of roads, Construction of temporarily new road etc.
- other traffic engineering measures as may be applicable.

(2) Mitigation of Traffic Disturbances

The Contractor shall manage the vehicular and pedestrian right of way during the period of construction. The Contractor shall take account of the need to maintain essential traffic requirements, as these may influence the construction process.

The Contractor shall include local traffic diversion routes and assess traffic impacts caused by the construction in the affected areas. Signage layout shall be included to ensure that adequate motorist information will be provided for traffic diversions.

Where it becomes necessary to close a road or intersection, or supplementary lanes are required to satisfy the traffic demands, traffic diversion schemes to adjacent roadways shall be developed with quantitative justifications. The Contractor shall co-ordinate with all relevant authorities.

Other considerations include:

- The minimum lane widths for fast traffic and mixed traffic shall follow the regulations of the different authorities.
- Any roads or intersections that have no alternative access shall not be fully closed for construction.
- Emergency access to all properties shall be maintained at all times.
- Access to business premises and property shall be maintained to the extent that normal activities are not seriously disrupted.
- Minimum footpath width shall be 1.5 m, unless otherwise indicated. The footpath shall be separated from vehicle traffic and not necessarily immediately adjacent to vehicle traffic;
- Where existing footbridges and underpasses are demolished or closed, provisions shall be made for pedestrian crossing to minimise the conflicts between a traffic lanes.
- Construction traffic shall be separated from other traffic wherever possible;
- Any traffic related facilities (bus stops, parking, etc.) which are affected by the construction works shall be maintained or relocated to appropriate locations;
- Motorists, pedestrians, workmen, plant and equipment shall be protected from accident at all times;
- Roadway designs, traffic management schemes, and installation of traffic control devices shall be in conformance with the requirements and regulations defined by the relevant authorities. And
- Where applicable, utility diversions shall be incorporated in the traffic management plan.

APPROVAL FOR TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL

- (3) The Contractor shall make all arrangements with and obtain the necessary approval from the transport authorities and the Police Department for temporary traffic arrangements and control on public roads. In the event that the Contractor, having used its best endeavors, fails to secure the necessary approval from the transport authorities and the Traffic Police Department for temporary traffic arrangements and control on public roads, then the Employer will use its best endeavors to assist the Contractor to secure such approval but without responsibility on the part of the Employer to do so.

TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL

- (4) Temporary traffic diversions and pedestrian routes shall be surfaced and shall be provided where work on roads or footpaths obstruct the existing vehicular or pedestrian access. The relevant work shall not be commenced until the approved temporary traffic arrangements and control have been implemented.
- (5) Temporary traffic arrangements and control for work on public roads and footpaths shall comply with the requirements of the Traffic Police. Copies of documents containing such requirements shall be kept on the Site at all times.
- (6) Temporary traffic signs, including road marking, posts, backing plates and faces, shall comply with the requirements the traffic police and should be in accordance with the requirements of Ministry of Surface Transport. All overhead traffic management signs that are fixed to bridges and gantries shall be illuminated at night. Pedestrian routes shall be illuminated at night to a lighting level of not less than 50 lux.
- (7) Adequate number of traffic guards, supervisors and in charge shall be deployed for smooth regulation of traffic.
- (8) Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night. Lights and signs shall be kept clean and legible. Equipment which are damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced promptly.

PARTICULARS OF TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL

- (9) The following particulars of the proposed temporary traffic arrangements and control on public roads shall be submitted to the Engineer for consent at least 28 days before the traffic arrangements and control are implemented:
 - (a) details of traffic diversions and pedestrian routes;
 - (b) details of lighting, signage, guarding and traffic control arrangements and equipment;
 - (c) any conditions or restrictions imposed by Traffic Police or any other relevant authorities, including copies of applications, correspondence and approval.
- (10) Where concrete barriers are used to separate flows of traffic, the barriers shall be in a continuous unbroken line. No gaps shall be left between any section of the barrier.
- (11) Site perimeter fencing and barriers along the roadway, shall have flashing amber lights positioned on the top of them every 50 meters apart and at every abrupt change in location. Directly below the flashing light shall be fixed, in the vertical position, a white fluorescent, with a waterproof cover.

USE OF ROADS AND FOOTPATHS

- (12) Public roads and footpaths on the Site in which the work is not being carried out shall be maintained in a clean and passable condition.
- (13) Measures shall be taken to prevent the excavated materials, silt or debris from entering gullies

onroads and footpaths, entry of water to the gullies shall not be obstructed.

- (14) Surfaced roads on the Site and leading to the Site shall not be used by tracked vehicles unless protection against damage is provided.
- (15) Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall be washed when necessary, before leaving the Site to avoid the deposition of mud and debris on the roads.

REINSTATEMENT OF PUBLIC ROADS AND FOOTPATHS

- (16) Temporary diversions, pedestrian access and lighting, signing, guarding and traffic control equipment shall be removed immediately when they are no longer required. Roads, footpaths and other items affected by temporary traffic arrangements and control shall be reinstated to the same condition as existed before the work started or as permitted by the Engineer immediately after the relevant work is complete or at other times permitted by the Engineer.
- (17) The contractor shall submit his design for the reinstatement to the relevant authorities and obtain their prior approval to carrying out the work. Reinstatement works shall include:
- Parking bays
 - Footpath and kerbs
 - Road Signage
 - Street Lighting
 - Landscaping
 - Traffic Lights and Control Cable
 - Road painting

10. SITE ESTABLISHMENT: SITE LABORATORIES

- (1) The Contractor shall provide, erect and maintain in a clean, stable and secure condition a laboratory, equipped for the routine testing of concrete, soil and rock samples and for the storage and curing of concrete cubes or cylinders only. This laboratory shall be located at the Contractor's principal work site or at a location agreed to by the Engineer. Detailed requirements for this laboratory are set out in Appendix 14 to these Employer's Requirements.
- (2) **CONTRACTOR'S SITE ACCOMMODATION**
The Contractor shall provide and maintain its own site accommodation at locations consented to by the Engineer. Offices, sheds, stores, mess rooms, garages, workshops, latrines and other accommodation on the Site shall be maintained in a clean, stable and secure condition. Living accommodation shall not be provided on the Site. The Contractor shall comply with the requirements of Appendix 8 to the Employer's Requirements.

(3) **LATRINES AND WASH PLACES**

The Contractor shall provide latrines and wash places for the use of its personnel and all persons who will be on the Site: The size and disposition of latrines and wash places shall accord with the

numbers and dispositions of persons entitled to be on the Site, which may necessitate their location on structures and, where necessary there shall be separate facilities for males and females. The capacities and layout shall be subject to approval of the Engineer. The Contractor shall arrange regular disposal of effluent and sludge in a manner that shall be in accordance with local laws/ regulations.

- (4) The Contractor shall be responsible for maintaining all latrines and wash places on the Site in a clean and sanitary condition and for ensuring that they do not pose a nuisance or a health threat. The Contractor shall also take such steps and make such provisions as may be necessary or directed by the Engineer to ensure that vermin, mosquito breeding etc. are at all times controlled.

SITE UTILITIES AND ACCESS

- (5) (a) The Contractor shall be responsible for providing water, electricity, telephone, sewerage and drainage facilities for contractor's site offices, structures and buildings and for all site laboratories in accordance with Appendix 14 to these Employer's Requirements and all such services that are necessary for satisfactory performance of the Works. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant civil and utility authorities for the facilities.
- (b) The contractor shall be responsible for provision of power supply for his works including for launching girder and the like. The Employer cannot guaranty provision of adequate, continuous power supply however assistance will be given in obtaining the necessary permissions for site generators and the like.
- (6) Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, acceptable and stable condition. For lengths of roadway longer than 100 m and heavy commercial vehicle are to ply the Contractor shall provide paved surfacing of adequate thickness and quality to the satisfaction the Engineer.

SUBMISSION OF PARTICULARS

- (7) The following particulars shall be submitted to the Engineer for his consent not more than thirty (30) days after the date of commencement of the Works:
- (a) drawings showing the formation works and the layout within earmarked area for the Contractor's offices, project signboards, principal access and other major facilities required early in the Contract, together with all service utilities;
- (b) drawings showing the details to be included on the project signboards and diversion boards.
- (8) Drawings showing location of stores, storage areas, concrete batching plants and other major facilities +and their access roads/paths shall be submitted to the Engineer for his consent as early as possible but in any case, not less than twenty-eight (28) days prior to when such fatties are intended to be constructed on the Site.

11. SECURITY

- (1) The Contractor shall be responsible for the security of the site for the full time the site is in its possession, except for the specific case of the Railway Envelope after handover to the Railway Operator It shall set up and operate a system whereby only those persons entitled to be on the Site can enter the Site. To this end, the Contractor shall with the consent of Engineer provide the specific points only at which entry through the security fence can be effected, and shall provide gates and barriers at such points of entry and whereby maintain a twenty four (24) hours security guard, and such other security personnel and patrols elsewhere as may be necessary to maintain security.
- (2) The Contractor shall maintain all site boundary fences in first class condition, and shall so arrange site boundary fences at all access drainage points of work areas that it's use of such access points etc., are not restricted by the system or method of achieving the required security measures. Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.
- (3) During the progress of the Works the Contractor shall maintain such additional security patrols over the areas of the Works as may be necessary to protect its own and its subcontractor's work and equipment.
- (4) In order to operate such a security system, it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Site, and which may need to be separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system and the design of passes to suit the requirements of the foregoing and to suit the methods of work to be adopted by the Contractor. The Contractor shall at all times ensure that the Engineer has an up to date list of all persons entitled to be on the Site at any time The contractor shall also introduce a system of issue passes to any outsider or person/vehicles belonging to agencies other than employer/ Engineers who may have to visit the site in connection with work
- (5) The Contractor shall liaise with the Designated Contractors and the contractors responsible for the adjacent and other interfacing contracts and ensure that co-ordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the Site and/or the adjacent sites.
- (6) Security and checking arrangements as felt necessary shall be provided with advice and help of Police.
- (7) Contractor's as well as his Sub Contractor's employees and representative shall wear Identification Badges (cards), uniforms, helmets, safety shoes/gum boots & other safety/protection wear as directed by Engineer, and to be provided by the Contractor. Badges shall identify the Contractor/ Sub Contractor and show the employee's name and number and shall be worn at all times while at site.
- (8) All vehicles used by the Contractor/ Sub Contractor shall be clearly marked with the Contractor's / Sub Contractors name or identification mark.

- (9) The Contractor shall co-ordinate and plants the security of both the works under this Contract and the works of other engaged in adjacent and interfacing contractor's and requiring access to the site. In order to operate such a security system, it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Site, system of separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system including the design of passes to suit the requirements of the foregoing and to suit the methods of works to be adopted by the Contractor. The Contractor shall at all times ensure that the Engineer has an up-to-date list of all persons entitled to be on the Site at any time. The Contractor shall also introduce a system for issue of passes to any outsider or persons/ vehicles belonging to agencies other than Employer/ Engineer who may have to visit the site in connection with work.

12. TESTING GENERAL

- (1) The Contractor shall provide and perform all forms of testing procedures applicable to the Works and various components and the interfacing of the Works with the other Contract works and shall conduct all necessary factory, site and acceptance tests.
- (2) Deleted.
- (3) All testing procedures shall be submitted at least thirty (30) days prior to conducting any Test. The Testing procedures shall show unambiguously the extent of testing covered by each submission, the method of testing, the Acceptance Criteria, the relevant drawing (or modification) status and the location.
- (4) The testing Procedures shall be submitted as required, by the contractor during the duration of the contract to reflect the changes in system design or the identification of additional testing requirements.
- (5) The Engineer shall have the facilities for monitoring all tests and have access to all testing records. Ample time shall be allowed within the testing programmes for necessary alterations to equipment, systems and designs to be undertaken, together with re-testing prior to final commissioning.
- (6) Deleted.
- (7) All costs associated with the Testing shall be borne by the Contractor, unless otherwise specified, including the services of any specialized personnel or independent assessors. The Contractor shall also bear any expenses incurred due to resetting caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.
- (8) Unless agreed in writing by the Engineer, the personnel engaged on testing shall be independent of those directly engaged in the design or installation of the same equipment.
- (9) All testing equipment shall carry an appropriate and valid calibration label.

BATCHES SAMPLES AND SPECIMENS

- (10) A batch of material is a specified quantity of the material that satisfies the specified conditions. If one of the specified conditions is that the material is delivered to the Site at the same time, then material delivered to the Site over a period of a few days may be considered as part of the same batch if in the opinion of the Engineer there is sufficient proof that the other specified conditions applying to the batch apply to all of the material delivered over the period.
- (11) A sample is a specified quantity of material that is taken from a batch for testing and which consists of a specified amount, or a specified number of pieces or units, of the material.
- (12) A specimen is the portion of a sample that is to be tested.

SAMPLES FOR TESTING

- (13) Samples shall be of sufficient size and in accordance with relevant Standards to carry out all specified tests.
- (14) Samples taken on the Site shall be selected by, and taken in the presence of, the Engineer and shall be suitably marked for their identification. An identification marking system should be evolved at the start of works in consultation with the Engineer.
- (15) Samples shall be protected, handled and stored in such a manner that they are not damaged or contaminated and such that the properties of the sample do not change.
- (16) Samples shall be delivered by the Contractor, under the supervision of the Engineer, to the specified place of testing. Samples on which non-destructive tests have been carried out shall be collected from the place of testing after testing and delivered to the Site or other locations instructed by the Engineer. '
- (17) Samples which have been tested may be incorporated in the Permanent Works provided that:
- (a) the sample complies with the specified requirements;
 - (b) the sample is not damaged; and
 - (c) the sample is not required to be retained under any other provision of the Contract.
- (18) Additional samples shall be provided for testing if in the opinion of the engineer:
- (a) material previously tested no longer complies with the specified requirements; or
 - (b) material has been handled or stored in such a manner that it may not comply with the specified requirements.

TESTING

The Contractor shall be responsible for all on-site and off-site testing and for all in-situ testing. All appropriate laboratory tests shall be carried out in the Contractor's laboratory, unless otherwise permitted or required by the Engineer. Where the laboratory is not appropriately equipped and/or staffed for some tests, or if agreed to by the Engineer, tests may be carried out in other laboratories. All materials required approval of Engineer after 3rd party test at approved or reputed laboratory at the discretion of engineer.

K-RIDE & Engineer in charge may recommend any test pertain to work or material to any laboratory of repute if they are accredited for the relevant work to a standard acceptable to the Engineer. The cost of such tests shall born by contractor.

- (19) In-situ tests shall be done in the presence of the Engineer.
- (20) Equipment, apparatus and materials for in-situ tests and laboratory compliance tests carried out by the Contractor shall be provided by the Contractor. The equipment and apparatus shall be maintained by the Contractor and shall be calibrated before the testing starts and at regular intervals as permitted by the Engineer. The equipment, apparatus and materials for in-the situ tests shall be removed by the Contractor as soon as practicable after the testing incomplete.
- (21) The Contractor shall be entitled in all cases to attend the testing carried out in the Employer's or other laboratories, to inspect the calibration certificates of the testing machines and to undertake the testing on counterpart samples. Testing of such samples shall be undertaken in laboratories complying with Clause 12 above and particulars of the laboratory proposed shall be submitted to the Engineer for consent prior to the testing.
- (22) Attendance on tests, including that by the Engineer, Contractor and Designer, shall be as laid down in the Quality Assurance procedures.

COMPLIANCE OF BATCH

- (23) The results of tests on samples or specimens shall be considered to represent the whole batch from which the sample was taken.
- (24) A batch shall be considered as complying with the specified requirements for a material if the <2 results of specific tests for of the specified properties comply with the specified requirements for the properties.
- (25) If additional tests are permitted or required by the Engineer but separate compliance criteria for the additional tests are not stated in the Contract, the Engineer shall determine if the batch complies with the specified requirements for the material on the basis of the results of all tests, including the additional tests, for every property.

RECORDS OF TESTS

- (26) Records of in-situ tests and laboratory compliance tests carried out by the Contractor shall be kept by the Contractor on the Site and a report shall be submitted to the Engineer within seven (7) days, or such other time stated in the Contract or in the Quality Assurance Programme, after

completion of each test. In addition to any other requirements, the report shall contain the following details:

- (a) material or part of the works checked
 - (b) location of the batch from which samples were taken or location of the part of the works.
 - (c) place of testing;
 - (d) date and time of tests;
 - (e) weather conditions in the case of in-sit tests;
 - (f) technical personnel supervising or carrying out the tests;
 - (g) size and description of samples and specimens;
 - (h) method of sampling;
 - (i) properties tested;
 - (j) method of testing;
 - (k) readings and measurements taken during the tests;
 - (l) test results, including any calculations and graphs;
 - (m) specified acceptance criteria; and
 - (n) other details stated in the Contract.
- (27) Reports of tests shall be signed by the site agent or his assistant, or by another representative authorized by the Contractor.
- (28) If requested, records of tests carried out by the Employer's staff or by the Engineer shall be given to the Contractor.

13. RECORDS

DRAWINGS PRODUCED BY THE CONTRACTOR

- (1) Drawings produced by the Contractor including drawings of site layouts, Temporary Works, etc. for submission to the Engineer shall generally be to ISO A1 size. They shall display a title block with the information as detailed in Appendix 7 to these Employer's Requirements. The number of copies to be submitted to the Engineer shall be as stated in the Contract, or as required by Engineer.

PROGRESS PHOTOGRAPHS

- (2) The Contractor shall provide monthly progress photographs which have been properly recorded to show the progress of the works to the Engineer. The photographs, of not less than 72 in number, shall be taken on locations agreed with the Engineer to record the exact progress of the Works. Two sets of photographs shall be provided on CD ROM format with two sets of color prints of 175 mm x 125 mm size.
- (3) The Contractor shall mount each set of each month's progress photographs in a separate album of a type to which the Engineer has given his consent, and shall provide for each photograph two typed self-adhesive labels, one of which shall be mounted immediately below the photograph and one on the back of the photograph. Each label shall record the location, a brief

description of the progress recorded and the date on which the photograph was taken.

- (4) All photographs shall be taken by a skilled photographer whose name and experience shall be submitted to the Engineer for consent and approval received. Processing shall be carried out by a competent processing firm to the satisfaction of the Engineer.
- (5) The Contractor shall ensure that no photography is permitted on the Site without the agreement of the Engineer. Contractor should be aware of the legal regulations and conditions with regard to Photography in some "RESTRICTED AREA" in Bangalore.

RECORDS OF WAGE RATES

- (6) The Contractor shall keep monthly records of the average, high and low wage rates for each trade/tradesman employed on the Site and records shall be made available to the Engineer during inspection.

14. MATERIALS

- (1) Materials and goods for inclusion in the Permanent Works shall be new unless the Engineer has consented otherwise. Preference shall be given to local materials where available. Approved Manufacturers/Suppliers of few important items have been given in Section-8B of Technical Specifications. These materials shall be procured only from these manufacturers/Suppliers. Under special circumstances provision of sub para 4 below may be invoked.
- (2) Certificates of tests by manufacturers which are to be submitted to the Engineer shall be current and shall relate to the batch of material delivered to the Site. Certified true copies of certificates may be submitted if the original certificates could not be obtained from the manufacturer.
- (3) Parts of materials which are to be assembled on the Site shall be marked to identify the different parts.
- (4) Materials which are specified by means of trade or proprietary names may be substituted by materials from a different manufacturer which has received the consent of the Engineer provided that the materials are of the same or better quality and comply with the specified requirements.
- (5) Samples of materials submitted to the Engineer for information or consent shall be kept on the Site and shall not be returned to the Contractor or used in the Permanent Works unless permitted by the Engineer. The samples shall be used as a mean of comparison which the Engineer shall use to determine the quality of the materials subsequently delivered. Materials delivered to the Site for use in the Permanent Works shall be of the same or better quality as the samples which have received consent

PROVISION AND DISPOSAL OF EARTHWORKS MATERIALS

- (6) The Contractor shall be responsible for the provision of all classes of earthworks material required for the Works, whether sourced from the excavations within the Contract or obtained from any

other sources, which are located outside the Site, for which the Engineer has given the consent.

- (7) For fill or dumping sites, the Contractor shall prepare a land plan with details of surface drainage requirements, final formation levels, spreading and compaction of the fill during dumping acceptable to the Engineer. The Contractor shall also provide security for such sites.
- (8) All excavated material, excluding waste material, bentonite fluid and bentonite contaminated material shall be disposed of at the appointed site only. This material shall be placed and compacted in accordance with the Construction Specification for Earth Works or as otherwise directed by the Engineer's Representative. The disposal of waste material shall be the full responsibility of the Contractor and these materials shall be disposed of by the Contractor at an approved location. No dumping sites will be provided by the Employer.
- (9) Rock deposited as fill material at the dumpsites shall be capable of compaction with single pieces no larger than 300mm.

15. PROVISIONS FOR DESIGNATED CONTRACTORS

- (1) Deleted
- (2) The contractor shall make all reasonable provision to accommodate the fastenings and fixings of the designated contractors. Such provisions will be notified by the designated contractors during design interface stage. The contractor shall take a lead in developing the interface management Plan (IMP) with respect to the other contracts having interfacing with the works under the scope of present contract. The IMP will be prepared in conjunction with the other designated contractor to cover all aspects of the implementation of the interface works required. The IMP will define the interface works necessary to complete all the works under this contract.

16. RESTORATION OF AREAS DISTURBED BY CONSTRUCTION.

Unless otherwise directed by the engineer, any area disturbed by the construction activity, either inside or outside the project right of way, shall be reinstated as follows:

All areas affected by the construction work shall be reinstated to their original condition, with new materials, including but not necessarily limited to, sidewalks, parking lots, access roads, and adjacent roads, properties and landscaping. Grass cover shall be provided for any bare earth surface areas, along with proper provisions for surface drainage.

17. CONTRACTORS LABOUR CAMPS

- (1) The employer will not provide living accommodation for use of the contractor or any of his staff or labour employed on the works. Living accommodation shall not be established on any land provided to the contractor by the employer for the works.
- (2) Provisions of Labour Camps.

The contractor, shall, at his own expense make adequate arrangements for the housing, supply of drinking water and provisions for bathrooms, latrines and urinals, with adequate water supply for

his staff as well as for workman employed on the works directly or through subcontractors at the locations authorized by engineers. No labour camp shall be allowed at work site or any unauthorized place.

The contractor at his own cost shall maintain all camp site in a clean and sanitary conditions, the contractor shall obey all health and sanitary rules and regulations and carry out at his cost all health and sanitary measures, that may from time to time be prescribed by the local/medical authorities and permit inspection of all health and sanitary arrangements at all times by the employer, the employer and the staff of the local municipality or the other authority concerned. Should the contractor failed to provide adequate health and sanitary arrangement these shall be provided by the Employer and the cost will be recovered from the contractor.

The contractor shall, at his own cost, provide first-aid and medical facilities at the labour camp and at work sites on the advice of the medical authority consistent with the strength of the contractor's staff and workman, employed directly or through subcontractors.

The contractor shall at his own cost, provide the following minimum requirements for meeting the fire hazards.

- Portable fire extinguishers
- Manual fire alarms
- Water supply for use by the fire service.

The contractor at his own cost shall provide necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers. He should also ensure that electrical installations done by trained electricians. These installations shall be maintained and daily maintenance record must be made available for inspection by the engineer.

(3) CAMP DISCIPLINE

The contractor shall take requisite precautions, use his best endeavors to prevent any riotous or unlawful behavior by or amongst his workmen, others, employed directly or through subcontractors. These precautions shall be for the preservation of the peace and protection of the inhabitants and the security of the property in the neighborhood of the Works. In the event of the Employer requiring the maintaining of a Special Police Force at or in the vicinity of the site, during the tenure of the work, the expenses thereof shall be borne by the contractor and if paid by the Employer, shall be recoverable from the contractor.

The sale of alcoholic drinks or other intoxicating drugs or beverages upon the work, in any labour camp, or in any of the buildings, encampments or tenements, own or occupied by, or with the control of, the contractor or any of his personnel employed on the work directly or through subcontractors shall be forbidden, and the contractor shall exercise his influence and authority to secure strict compliance with this condition. The contractor shall also ensure that no labour or employees are permitted to work at the site in an intoxicated state or under the influence of drugs.

The contractor shall remove from his camp such labour and their families, as refuse protective inoculation and vaccination when called upon to do so by the Engineer on the advice of his Medical

Authority. Should Cholera, Plague or any other infectious disease break out, the Contractor shall at his own cost burn the huts, bedding, cloths and other belongings of or used by the infected parties. The contractor shall promptly erect new heads on healthy sides as required by the Employer. Within the time specified by the Employer, failing which the work may be done by the Employer and the cost recovered from the Contractor.

(4) LABOUR ACCOMODATION

The contractor shall provide living accommodation that is equal to or exceeds the minimum criteria established in the following sub-sections, needed to house his staff as well as workers employed directly or through sub-contractor. The buildings shall be constructed so as to have a minimum life of not less than the length of contract.

- (a) The roof shall be watertight and laid with suitable non-flammable materials permissible for residential use under local regulation and for which the consent of the Engineer has been obtained.
- (b) Each hut shall have suitable ventilation. All doors, windows, and ventilators shall be provided with security leaves and fasteners. Back-to-back units may be avoided.
- (c) The minimum height of each unit shall be 2.1m and shall have separate cooking place.
- (d) Suitable number of common toilets/bath shall be provided.

(5) WATER SUPPLY

The contractor shall provide an adequate supply of water for the use of labours in the camp. The provisions shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand post and where the supply is from wells or river, tanks that may be of metal or masonry shall be provided. The contractor shall also at his expense make arrangements for the provision and laying of water pipe lines from the existing mains wherever available and shall pay for all the fees and charges thereof.

(6) Drainage

The contractor shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy. Surface water shall be drained away from the paths and roads and shall not be allowed be allowed to accumulate into ditches or ponds where mosquitoes can breed.

(7) Sanitation

The contractor shall make arrangements for conservancy and sanitation in the labour camps according to the rules and regulations of the Local Public Health and Medical Authorities.

The contractor shall provide a sewerage system that is adequate for the number of the residents in the camp and which meets the requirements of the Municipal Authorities.

GENERAL PLANNING CRITERIA

PURPOSE AND SCOPE

The purpose of this Appendix is to include other criteria and requirements not included elsewhere that are necessary for the full development and Detailed Design of Viaduct.

OUTLINE DESIGN CRITERIA FOR VIADUCT PORTION

1. GENERAL

- 1.1 This Outline Design Criteria and the Appendices hereto provide minimum standards which are to govern the design of the Permanent Works.
- 1.2 The Outline Design Criteria shall be read in conjunction with the other contract documents including the Outline Construction Specifications.
- 1.3 The Design of the Permanent Works shall comply with codes of practice and standards current at the time of submission of Tender Documents, Regulations made and requirements issued by the Indian Government and by relevant utility companies shall be followed and specified.
- 1.4 Alternative or additional codes, standards and specifications proposed by the DESIGN AND CONSTRUCT CONTRACTOR shall be internationally recognized codes and shall be equivalent to or better than, Indian Standards subject to being, in the opinion of the Engineer, suitable for incorporation into the Specifications.

2. CODES AND STANDARDS

Design and loading requirements for the structures shall be not less than the following Indian Standards and Codes of Practice, together with all applicable amendments.

Where other standards and codes of practice are referred to in the text of other Appendices then the designer is expected to apply those Standards and Codes of Practice unless the designer can show that an economic case exists for use of an Indian Standard. However preferences of codes will be as follows:-

- i. IRS
- ii. IRC
- iii. IS
- iv. AASHTO

Indian Railway Standards (IRS)

IRS - Bridge Rules for loading (Min. of Railway) IRS - Code of practice for Steel bridges.

IRS - Code of practice for plain, reinforcement and pre-stressed concrete for general Bridge construction, latest revision.

IRS - Code of practice for the design of substructures and foundation of bridges.

Indian Roads Congress (IRC) Standards (with Latest Revisions, Addendum & Corrections)

IRC 5:	1985	Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design
IRC 6:	2000	Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses
IRC 10:	1961	Recommended Practice for Borrow pits for Road Embankments Constructed by Manual Operation
IRC 19:	1977	Standard Specifications and code of Practice for Water Bound Macadam
IRC 22:	2008	Standard Specifications and Code of Practice for Road Bridges, Section VI – Composite Construction for Road Bridges
IRC 24:	2010	Standard Specifications and Code of practice for Road Bridges, Section V – Steel Road Bridges
IRC 36:	2010	Recommended Practice for the Construction of Earth Embankments for Road Works
IRC 37:	1984	Guidelines for the Design of Flexible Pavement
IRC 45:	1972	Recommendations for Estimating the Resistance of Soil below the maximum Scour Level in the Design of Well Foundations of Bridges
IRC 48:	1972	Tentative Specifications for Bituminous surface Dressing using Pre-coated Aggregates
IRC 75:	1979	Guidelines for the Design of High Embankments
IRC 78:	2014	Standard Specifications and Code of Practice for Road Bridges, Section VII (Parts 1 and 2), foundations and Substructure

IRC 83:	1999	Standard Specifications and code of practice for Road Bridges, Section IX
IRC 83:	2002	Standard Specifications & Code of Practice For Road Bridges, Part-III Pot, Pot-Cum-PTFE, Pin and Metallic Guide Bearings
IRC 87:	2011	Guidelines for the Design and Erection of False Work for Road Bridges
IRC 112:	2011	Code of Practice for Concrete Road Bridges
IRC: SP 11	1958	Handbook of quality Control for Construction of Roads and Runways.

IS: Codes: National Building Code

SP 7:	2005	Bureau of Indian Standards
IS 73:	1992	Paving Bitumen
IS 215:	1995	Road Tar
IS 217:	1988	Cutback Bitumen
IS 226:	1975	Structural steel (standard quality)
IS 269:	2013	Spec s for Ordinary and low heat Portland Cement
IS 278:	1978	Galvanised steel barbed wire for fencing
IS 280:	1978	Mild Steel wire for general engineering purposes
IS 281:	2009	Mild Steel siding door bolts for use with Padlocks
IS 383:	1970	Coarse and fine aggregates
IS 432:	1982	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement
	(Part 1)	Mild steel and medium tensile steel bars
	(Part 2)	Hard-drawn steel wire
IS 455:	1989	Portland slag cement
IS 456:	2000	Code of practice for plain and reinforced concrete
IS 457:	1957	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures
IS 460:	1985	Test sieves

IS 515:	1959	Natural and manufactured aggregates for use in mass concrete
IS 516:	1959	Method of test for strength of concrete
IS 650:	1991	Standard sand for testing cement
IS 800:	2007	Code of practice for general construction in steel structures
IS 814:	1991	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
IS 815:	1974	Classification coding of covered electrodes for metal arc welding of structural steel
IS 823:	1964	Code of procedure for manual metal arc welding of mild steel
IS 875:	1987	Code of practice for design loads (other than earthquake) for buildings and structures (Parts I, II, IV & V)
IS 875:	2015	Code of practice for design loads (other than earthquake) for buildings and structures (Part III)
IS 1077:	1992	Common burnt, clay building bricks
IS 1080:	1986	Design and construction of shallow foundation in soil (other than rafting and shell)
IS 1161:	1998	Steel tubes for structural purposes
IS 1239:	1990	Mild steel tubes, tubular and other wrought steel fittings
	(Part 1)2004	Mild steel tubes
	(Part 2) 1992	Mild steel tubular and other wrought steel pipe fittings
IS 1322:	1993	Bitumen felts for water proofing and damp-proofing
IS 1343:	2012	Code of practice for Pre-stressed Concrete
IS 1364:	1992	Hexagon Head bolts, screws & nuts of product grades A & B (Part I)
IS 1489:	1991	Portland Pozzolana Cement
IS 1732:	1989	Dimensions for round and square steel bars for structural and general engineering purposes
IS 1785:	1983	Plain hard-drawn steel wire for pre-stressed concrete
	(Part 1)	Cold-drawn stress – relieved wire
	(Part 2)	As drawn wire

IS 1786:	2008	High strength deformed steel bars and wire for concrete reinforcement
IS 1791:	1985	Batch type concrete mixers
IS 1834:	1984	Hot applied sealing compound for joint in concrete
IS 1838:	1983	Pre-formed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type)
	(Part 1)	Bitumen impregnated fiber
IS 1888:	1982	Method of load tests on soils
IS 1892:	1979	Code of practice for sub surface investigations for foundations
IS 1893: Part I	2001	Criteria for earthquake resistant design of structures
IS 1893: Part II	2014	Criteria for earthquake resistant design of structures
IS 1893: Part III	2014	Criteria for earthquake resistant design of structures
IS 1893: Part IV	2005	Criteria for earthquake resistant design of structures
IS 1904:	1986	Design and construction of foundations in soils General Requirements
IS 1905:	1987	Code of practice for Structural use of unreinforced Masonry
IS 1977:	1976	Low Tensile Structural steel
IS 2062:	2006	Steel for general structural purposes
IS 2090:	1983	High tensile steel bards used in pre-stressed concrete
IS 2116:	1980	Sand for masonry mortars (first revision)
IS 2119:	1980	Code of practice for construction of brick-cum-concrete composite
IS 2386:	1963	Methods of test for aggregate for concrete
	(Part 1)	Particle size and shape
	(Part 2)	Estimation of deleterious materials and organic impurities
	(Part 3)	Specific gravity, density, voids, absorption and bulking
	(Part 4)	Mechanical properties

	(Part 5)	Soundness
	(Part 6)	Measuring mortar properties of fine aggregates
	(Part 7)	Alkali aggregate reactivity
	(Part 8)	Petrography examination
IS 2430:	1986	Methods of sampling of aggregate for Concrete
IS 2502	1963	Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
IS 2751:	1979	Recommended practices for welding of mild steel plain and deformed bars used for reinforced construction
IS 2911:	2010	Code of practice for design and construction of pile foundations
	(Part 1)	Concrete piles 3
	Section 1	Driven cast-in-situ concrete piles
	Section 2	Bored cast-in-situ concrete piles
	Section 3	Driven precast concrete piles
	Section 4	Bored precast concrete piles
	(Part 3)	Under-reamed piles
	(Part 4) (2013)	Load test on piles
IS 2950:	1981	Code of practice for design and construction of raft foundations.
IS 3812:	2003	Fly ash for use as pozzolona and admixture
IS 3955:	1967	Code of practice for design and construction of well foundations
IS 4000:	1992	High Strength Bolts in Steel Structures- Code of Practice (First Revision)
IS 4082:	1996	Recommendations on stacking and storage of construction materials at site
IS 4138:	1977	Safety code for working in compressed air
IS 4326:	1993	Earthquake resistant design and construction of buildings – code of practice
IS 4656:	1968	Form vibrators for concrete
IS 4736:	1986	Hot-dip zinc coating on mild steel tubes
IS 4826:	1979	Hot-dipped galvanized coatings – round steel wires
IS 4925:	1968	Concrete batching and mixing plant

IS 4926:	1976	Ready mixed concrete
IS 4923:	1997	Hollow steel sections for structural use -specification
IS 4968:	1976	Method for sub surface sounding forsoils
IS 5525:	1969	Recommendations for detailing of reinforcement in reinforced concrete works
IS 5529:	1985	Code of practice for in-situ permeability tests
IS 5640:	1970	Method of test for determining aggregate impact value of soft coarse aggregate
IS 5816:	1970	Method of test for splitting tensile strength of concrete cylinders
IS 5889:	1994	Vibratory plate compactor
IS 5892:	1970	Concrete transit mixers and agitators
IS 6003:	1983	Specification for indented wire for pre-stressed concrete
IS 6006:	1983	Specification for uncoated stress relieved strands for pre-stressed concrete
IS 6403:	1981	Code of practice for determination of bearing capacity of shallow foundations
IS 6603:	1972	Stainless steel bars and flats
IS 6911:	1992	Stainless steel plate, sheet and strip
IS 7205:	1974	Safety codes for erection of structural steel work
IS 7293:	1974	Safety code for working with construction machinery
IS 7320:	1974	Concrete slump test apparatus
IS 7861:	1975	Code of practice for extreme weather concreting
	(Part 1)	For Hot Weather
	(Part 2)	For Cold Weather
IS 7969:	1975	Safety code for handling and storage of building materials
IS 8009	1976	Calculation of settlement of shallow foundations

IS 8041:	1990	Rapid - hardening Portland cement
IS 8112:	1989	43 grade ordinary Portland cement
IS 8142:	1994	Method of test for determining setting time of concrete by penetration resistance
IS 8500:	1991	Structural steel-micro alloyed (medium and high strength qualities)
IS 9013:	1978	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens
IS 9103:	1979	Admixtures of concrete
IS 9284:	1979	Method of test for abrasion resistance of concrete
IS 9417:	1989	Recommendations for welding cold worked bars for reinforced concrete construction
IS 9595:	1996	Recommendations for metal arc welding of carbon and carbon manganese steels
IS 10262:	1982	Recommended guidelines for concrete mix design
IS 10379:	1982	Code of practice for field control of moisture and compaction of soils for embankment and sub-grade
IS 11384:	1985	Code Of Practice for Composite Construction in Structural Steel and Concrete
IS 12070:	1987	Code of Practice for Design and Construction of Shallow Foundations on Rocks
IS 12269:	2013	53 grade ordinary Portland cement
IS 12894:	2002	Fly ash line bricks
IS 13920:	2016	Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces
IS 14268:	1995	Uncoated Stress Relieved Low relaxation Seven-ply Strands for Prestressed Concrete
IS 14593:	1998	Design And Construction Of Bored Cast-In-Situ Piles Founded On Rocks-Guidelines.

FOREIGN STANDARDS**FOREIGN STANDARDS**

ASTM D-297 Methods for Rubber Product Chemical Analysis

ASTM D-395 Compression set of vulcanized rubber

ASTM D-412 Tension testing of vulcanized rubber

ASTM D-429 Adhesion of vulcanized rubber metal

ASTM D-573 Accelerated ageing of vulcanized rubber by the oven method

ASTM D-624 Tear resistance of vulcanized rubber

ASTM D-797 Young's Modulus in flexure of elastomer at normal and subnormal temperature

ASTM D-1149 Accelerated Ozone cracking of vulcanized rubber

ASTM D-1559 Test for resistance to plastic flow of bituminous mixtures using Marshall Apparatus

ASTM D-2166 Test methods for Unconfined Compressive Strength of Cohesive Soils

ASTM D-2172 Extraction, quantitative, of bitumen from bituminous paving mixtures

ASTM D-2240 Indentation hardness of rubber and plastic by means of a Durometer

ASTM D-2434 Test methods for permeability of Granular Soils

ASTM D-3080 Method for direct shear test of soils under consolidated drained condition

ASTM E-11 Specification for wire cloth sieve for testing purpose AASHTO M 57-80 Materials for embankments and sub-grade

AASHTO M 147-67 Materials for aggregate and soil (1980) base and surface courses
AASHTO M 282-80 Joints sealants, not poured, elastomeric type,
(ASTM: D 3406) for Portland cement cure rate pavements

Note: - The above list is not exhaustive and shall be augmented during detailed design and construction of the viaduct.

OTHER PUBLICATIONS

Indian Standard Hand Book on Steel sections Part I
Indian Railways Manual on Design and Construction of well and pile foundations.

UIC/772 - R The International Union of Railways Publication. IEC International Electromechanical Commission

The provision of UIC-774-3 in relation to rail-structure interaction is well known and is being used in many rail-based structures.

The design relating to fire safety and escape shall be in accordance with the requirements of NFPA 130 Standard for Fixed Guide way Systems.

3. BSRP ALIGNMENTS

3.1 Criteria

- 311 The horizontal and vertical alignments of the BSRP railway shall be provided by K-RIDE.
- 312 The DDC appointed by the Employer will design the civil engineering works to these alignments. Contractor shall strictly adhere to the drawings issued by K-RIDE.
- 313 Any modification to the railway alignment design shall comply with the requirements of the project and as approved by, K-RIDE.

4. BSRP DESIGN REQUIREMENTS

4.1 General

- 411 The Railway Envelope is defined as the extent of works to be constructed to allow installation and operation of the railway equipment.

412 Track Supporting Structure

The contractor shall be responsible for the first stage primary concrete for track supporting structure. Others will undertake the design of the secondary concrete, track slabs and track work under contracts with the K-RIDE. A fundamental obligation of the contractor is to co-ordinate and co-operate with the Track work contractor so that the design of all components of the railway are compatible.

413 Second pour concrete

The Track work Contractor will carry out the second pour concrete for the track work. In this regard, the contractor shall provide starter bars in the primary concrete pour to facilitate anchorage of the second pour concrete. The contractor shall co-ordinate with the Track work contractor as to the size and location of the starter bars.

- 414 The CONTRACTOR shall provide drainage pipes, channels and catch basins to be in the first pour concrete.

415 The design of all railway operating equipment, including signals and signaling cables, the traction power electrification equipment, electrical cables, electrical and mechanical equipment, telecommunication links, etc. that are required for the railway will be undertaken by others contractors working with the Employer. Similar co-ordination and co-operation obligations as expressed in Clause 4.1.2 above apply.

416 The CONTRACTOR shall include in the civil works blind holes, plinths, trenches etc. as required by the other DDC. The extent and detail of such provisions are to be determined by the CONTRACTOR making due enquiries, as design co- ordination, from DDCs engaged to provide railway-operating equipment and from the Track work DDC. Some details of the likely fixing to be provided are given below but it is stressed that this information may not be complete or comprehensive.

417 The CONTRACTOR shall be responsible for coordinating his design with other DDCs and with the Employer's Representative and for ensuring that the design incorporates such fixings as are required in order to avoid any necessity for contractors to drill, weld, burn or cut any part of a structure.

418 **Telecommunication**

CONTRACTOR shall allow for mounting plates or other agreed fixings for the line side telephones and associated cables at spacing to be determined by the system wide Contractor.

4.2 **Stray Current Corrosion Control**

422 The EPC CONTRACTOR shall incorporate into his design precautions as per EN 50122-2 or equivalent to minimize stray current corrosion caused by DC traction power returns through the rails. (For BSRP 25 KV AC Traction is adopted)

423 The continuous electrical path shall be provided by ensuring full and reliable electrical connection throughout the structure.

424 The electrically continuous path shall be provided through the steel reinforcement either by continuous welding of structural reinforcement or by the provision of additional welded mesh reinforcement. Where welded structural reinforcement is used to form a grid, welded cross-connections shall be at a minimum spacing of:

- (a) For longitudinal bars, 600 mm measured in the transverse direction;
- (b) For transverse bars, 6 m measured in the longitudinal direction.

425 The EPC CONTRACTOR shall make provision for the monitoring of this continuous electrical path during construction and the CONTRACTOR will be required to demonstrate to the Engineer during construction that the electrical continuity between all metallic structures has been achieved.

426 The EPC CONTRACTOR shall include in the design, terminals as required from the continuous electrical path through the structures to external connections. The terminals shall be suitable for the connection of 35 mm² copper cable. At each connection, four such terminals shall be provided at the track level, two on each side of the viaduct, one of which shall be kept as spare and suitably

protected. Similar terminals, spare terminals and connections shall be provided over any joint of the structure.

427 General requirements for earthing and bonding the structures are to be determined in liaison with the system wide Contractor.

428 Cross bonding of the running rails, stray current return cabling etc. will be carried out by the system wide Contractor.

429 The EPC CONTRACTOR shall take account in his design of the fact that the Contract will be integrated with others in the Project in respect of the control of stray currents, and may therefore carry stray currents corrosion control measure arising from any foreseeable operating condition of the Project

4.3 Railway Cross Sections and Structure Gauges

431 The Kinematic Envelope for the rolling stock of the railway, and Structure Gauges for straight and curved track as provided by K-RIDE is to be followed.

432 The CONTRACTOR shall ensure that the proposed size of structure is adequate to contain the equipment, required under Clause 4.1 above, outside the Structure Gauge.

433 Structures shall not infringe the clearances specified. See also Clause 4.3.2 above.

5. STRUCTURAL DESIGN CRITERIA

5.1 Design Life

Clauses 6 to 9 below define the design life and serviceability requirements for the various elements of the structures.

5.2 The design life of a structure is that period for which it is designed to fulfill its intended function when inspected and maintained in accordance with agreed procedures. The assumption of a design life for a structure or component does not necessarily mean that the structure will no longer be fit for its purpose at the end of that period. Neither will it necessarily continue to be serviceable for that length of time without adequate and regular inspection and routine maintenance.

5.3 All Design Life criteria shall be confirmed during detailed design by the Employer's Representative.

5.4 CIVIL ENGINEERING STRUCTURES

The design life of all civil engineering structures shall be a minimum of 120 years unless otherwise specified or agreed.

5.5 BRIDGE BEARINGS AND MOVEMENT JOINTS

Bridge bearings and movement joints shall have a minimum design life of 50 years apart from in

or components that can be replaced without complete removal and without interruption to traffic. Such components shall have a service life of 20years.

6. SERVICEABILITY

- 6.1 Paint systems for steelwork shall ensure a minimum life of 15 years before full maintenance painting is required.
- 6.2 The corrosion protection of non-structural steel items shall be appropriate to the accessibility of the item for inspection and maintenance.
- 6.3 Serviceability of electrical and mechanical equipment included in this Contract shall be 5 to 25 years, depending on the various items.

7.0 Structural System

Span arrangement has to be made by the Design and construction contractor. Span arrangement may have to be adjusted based on existing utilities and other street furniture. Certain restrictions for location of piers are given below: -

The structural system shall comprise of pre-stressed segmental super structure/U-Girder Superstructure, sub structure (pier & pier cap) and foundations (pile, based on above provisions). However, EPC Contractor has to provide alternatives for cost effective design and in such case, load combination is to be suggested by Design and construction contractor for approval of K-RIDE.

Load Combinations for Simply Supported Spans Superstructure Constructed by Precast Segmental Construction/U-Girder Superstructure (As per DBR/SOD)

7 BSRP LIVE LOADS (AS PER DBR)

7.1 General

The railway loading applied to structures on the Project shall generally be in accordance with IRS Bridge Rules except as detailed below (Refer DBR)

Dead loads shall be used that are in accordance with IRS Bridge Rules and IS 456 (for buildings) and IS 875 part 1 for unit weights of materials and self-weight of all structural elements shall be worked out as per DBR. Axle Loads and spacing are as per DBR.

7.2 Nominal Loads (As per DBR)

For the purpose of computing stresses and deformations, the following loads and consequential effects shall be taken into account as applicable.

Dead loads Super imposed Dead Load Live Loads Dynamic effects

Forces due to curvature or eccentricity of track

Temperature effects

Frictional resistance of expansion bearings Longitudinal forces

Long welded rail forces Racking forces

Forces on parapets Wind pressure effect

Forces and effect due to earthquake

Erection forces and effects Buoyancy

Differential settlement

7.3 Loading Combinations

The various combinations of loads and forces to which components of the structures can be subjected are given in Bridge Rules/IRS CBC & DBR. Each component of the structure shall be designed checked for all applicable combinations of these loads and forces. They shall resist the effect of the worst combination. The allowable unit stress in a member subjected to a particular combination loading shall not exceed the percentage indicated below against the respective combination.

The loading combinations indicated are not exhaustive. EPC CONTRACTOR shall analyse the effects of any other combination as deemed appropriate.

7.4 Design Loads (As per DBR)

When a structure carries two tracks, both tracks shall be considered to be occupied simultaneously. Traction forces shall act on one track and braking forces acting on the other, with both acting in the same direction to produce the worst loading condition.

Longitudinal forces acting on the track shall be considered to be dispersed through the track before being transmitted to the substructure. This shall be calculated based on IRS Bridge Rules and IS Codes

Provision shall be made for effect of horizontal and longitudinal forces in the rail, especially in the girders with ballast less deck.

Additional permissible stresses while considering this contingency will be proposed by the EPC CONTRACTOR for review by the Employer's Representative. Forces shall be calculated for continuous welded rail with a concrete structure interaction resulting from temperature differential of rail and concrete. Rail structure interaction analysis on representative stretches based on UIC 774 3-R shall be adopted to work out the LWR forces.

Longitudinal forces shall consider the effects on stability and safety arising from a broken rail in ballast less track.

Centrifugal load based on relevant IRS codes/ IRS Bridge Rules shall be worked out for the given track geometry.

Train Derailment Load: Check for derailment loads shall be made as per IRS Bridge Rules.

7.5 Wind Loading (As per DBR)

The viaduct structure shall be designed for wind loading as per IRS Bridge Rules.

However, a bridge shall not be considered to be carrying any live load when the wind pressure at deck level exceeds 150 kg/m². Wind load shall be taken as 400-kg/meter length of train in transverse direction and 90-kg/meter length in longitudinal direction. These are computed for length of train as seen in elevation normal to longitudinal axis. The transverse load will be applied to train as concentrated at axle locations at a height of 3.2 m or at C.G. of projected area of the vehicle as accepted by the Employer's Representative above top of lowest rail and normal to track. The horizontal force component transmitted to rails and superstructure by an axle will be treated as a concentrated load at rail having direct wheel flange to railhead contact.

7.6 Temperature Loading (As per DBR)

Overall temperature and differential temperature effects shall be determined as per provisions of DBR.

7.7 Seismic Loading (As per DBR)

Seismic effects shall be considered on all structures, except culverts as per DBR. It is also required to check the structures for seismic forces as per IS: 1893- 2001 and Latest RDSO guidelines for seismic design of bridges.

7.8 Erection Forces and Effects (As per DBR)

The weight of all permanent and temporary materials together with all other forces and effects which can operate on any part of structure during erection shall be taken into account. Allowance shall be made in the design for stresses caused in any member during erection. For extra allowance in permissible stresses when erection forces are also considered, relevant codal provisions should be followed.

7.9 Shrinkage and Creep

Provision shall be made for the effects of shrinkage and creep of the concrete in the structure.

7.10 Differential Settlement: As per DBR

7.11 Noise Abatement

Allowable Range of Noise Levels:

Generally, the allowable range of noise levels for different land uses is:

- | | |
|-------------------------|-------------|
| ▪ Residential | 50 - 70 dbA |
| ▪ Business & Commercial | 75 d bA |
| ▪ Hospitals | 60 dbA |
| ▪ Rural | 45 - 50 dbA |

Provision of Noise Barriers:

Structures shall be designed to reduce noise to locally acceptable levels by provision of low (C2/ BNH-BAW/AT-GRADE & ELEVATED)

vibration track forms, resilient base plates and also design of parapet walls and treatment of their track side surfaces. They can be supplemented by providing sound elimination material on sides of the viaduct superstructures. But in many locations, existing noise level itself may be much higher at 1.0 to 1.2 meters above walkway level. Noise barriers may be required in some lengths of viaducts and bridges passing through sensitive residential or hospital zones. Noise barrier details shall be provided to successful bidder. The choice of type and their disposition along the parapet railing is also closely related to aesthetics of the structure.

8. BSRP REQUIREMENTS

8.1 Emergency Evacuation

Provision for emergency evacuation shall be provided along the railway for the full length of the structure. Routes assigned for emergency evacuation shall be designed for footway loading in accordance with the requirements stated herein.

8.2 Parapet

8.2.1 Parapet shall be provided on both sides of all viaducts for the full length of the structure. They shall be designed to act as the support structure to the railway cabling and junction boxes as appropriate, and will be cast inbuilt with box segments.

8.2.2 Parapets shall be designed to resist the wind load and other relevant loads based on the codal provision & DBR.

8.2.3 Parapets shall be provided for all transition structures to protect the guide way from intrusion by trespassers, vandals and road vehicles.

8.2.4 Parapets shall be designed to function as Noise Containment Barriers.

8.2.5 Parapets shall be designed to cater the forces of Signal masts, OHE masts and related structures. Bidder to suitably assume OHE locations as per track geometry and traction requirement. Generally on an average, there will be one OHE on each side in a 25 m span (approximately), this can be used for bidding purpose.

8.3 Vertical profile

8.3.1 Profile grade:

The superstructure shall be so designed that, when subject to dead load only, the rail level would be above the theoretical vertical profile of the system by an amount equal to permissible LL deflection for the structure.

Provision for super-elevation shall be made preferably as part of the track structure over the deck. The dead load is to be considered at such locations.

8.3.2 Camber :

The superstructure deck, including the soffit of any overhead structure above the deck, shall be cambered so as to compensate for the combined effect of:

- Vertical Curvature, if any;
- Dead load deflection; and
- Permissible live load plus-impact deflection as accepted by the Employer's Representative.

8.4 Span/Depth ratios:

Length-to-depth ratio should as far as possible be restricted to:

- Reinforced concrete member - 10
- Pre-stressed concrete member : - 14
- Composite members - 16,
- Desirable 12

In Box girders these ratios shall be further subject to stipulations made with regard to internal dimensions required for inspection and future pre-stressing.

8.5 Minimum thickness at members

Desirable Minimum thickness of any RC member

- | | | |
|--------------------------------------|---|---------------------------------|
| • Deck | - | 200 mm |
| • Web of T-beam | - | 250 mm |
| • Web of pre-stressed girders | - | 150 + d |
| • If there are 2 cables at any level | - | 150+3d, d - diameter cable duct |

Box Girders: minimum member thickness:

- | | | |
|-----------------|---|--------|
| • Deck slab | - | 200 mm |
| • Bottom flange | - | 300 mm |
| • Web | - | 250 mm |

or as required by IRS Concrete Bridge Code whichever is greater.

In an aggressive environment, an additional thickness of 10 to 20 mm shall be used.

8.6 Span arrangement

8.6.1 The Tenderer shall provide, by suitable choice of span lengths, a sufficiently stiff deck and supporting sub-structure to resist loading as defined in various Clauses stated above. Static and dynamic rail live load responses, at essential movement joint locations, shall be in compliance with the Employer's Requirements.

8.7 Rail Structural interaction analysis due to continuous welded rail with direct fixation or structure shall be performed in accordance with proven international practice.

8.8 Approach slabs of sufficient sizes shall be provided between abutments and at-grade sections. An approach slab shall be provided in rear of all abutments of elevated structures and bridges. This should not be less than 6 m in length nor be less than the length computed from the formula:

$$L = 1.5 h \tan (45^\circ - \phi/2)$$

Where h = Depth from bottom of slab to bottom of abutment (top of footing)

ϕ = Angle of internal friction of backfill soil indegrees

Slab shall be designed assuming that it does not receive any support from the backfill for a distance of not less than 4.0 m or less than $h \tan (45^\circ - \phi/12)$ from back of abutment or as required by IRS Concrete Bridge Code whichever is greater.

9 Design Considerations

9.1 Vibration and Deflection Limitations (As per DBR)

The Vibration and Deflection Limitations as per DBR. The overall deflection for elevated structure will be limited taking into consideration the effect of vibration in addition to other considerations. Suitable provisions shall be provided at the ends of beams and jacking pads on pier caps shall be provided to allow for replacement of bearings and for any repairs during service.

Provision should be made for adequate fixtures of the superstructure to the substructure, if any loading or loading combination increased by 100% of live load plus impact is likely to cause uplift of any support.

9.2 Design Procedures

Reinforced and Pre-stressed concrete members of elevated structures shall be designed in conformity with the provisions of DBR, IRS and IRC Codes.

9.3 Substructure and Foundations

Substructure and Foundations: As per DBR.

9.4 Method of Construction

Stresses in partially completed structures shall be analyzed for appropriate critical conditions at various stages of the construction. Any restriction on the construction operations resulting from the design assumptions shall be clearly specified on the contract drawings and specifications. Conversely, advantage may be taken by the designer of specified construction procedures or sequences to effect a more favorable distribution of loads or stresses.

9.5 Movement/Expansion Joints

Movement/expansion joints and other necessary measures to control shrinkage and thermal effects shall be incorporated in the structural design so that the performance of architectural finishes or of any services are not adversely affected during normal working conditions.

Movement/expansion joints shall be designed to be easily maintained and replaceable.

9.6 Design Surface Crack Width

Design Surface Crack Width: As per DBR.

9.7 Temperature Effects

Temperature effects: As per DBR.

9.8 Sway of Viaduct Column

Longitudinal sway at the top of viaduct columns due to live loads shall be restricted to a maximum of 5mm.

9.9 Structural Members with Bearing

Consideration shall be given for the easy maintenance and replacement of viaduct bearings.

The minimum clearance between structural members separated by bearings shall be as follows:

Precast Viaduct Beam/Cross Head	:	150mm
In-Situ Viaduct Beam/Column	:	250mm

These are absolute minimum values and the requirement for easy maintenance and replacement of bearings shall prevail.

9.10 Thermal Rail Forces

Provision shall be made for horizontal transverse and longitudinal forces due to temperature variation in rail. The forces shall be applied in a horizontal plane at the top of low rail as follows:

- (1) Transverse Force. The transverse force (T) per linear meter of structure per rail shall be determined by the following formula:

$$T = \frac{650}{R} \text{ kN} \quad \text{Where } R = \text{radius of rail curvature in meters}$$

- (2) Longitudinal Force. A longitudinal force shall be applied in accordance with Indian Standards.
- (3) Provision of UIC 774 3-R shall be used for working out LWR forces.

9.11 Access to Voids

Continuous access between the deck voids shall be provided wherever possible. An easily removable, watertight manhole access to deck voids shall be provided in every span.

9.12 Pre-stressed Concrete

Non-shrink grout shall be used for grouting of post-tensioned tendon ducts.

Pre-stressing anchorages shall be detailed such that they are easily accessible for inspection and maintenance. The detailing shall also prevent the accumulation of water and dirt around the anchorage.

All assumptions made in the determination of the design pre-stress loads, e.g. curvature, friction, cross section and mechanical properties of strand and concrete shall be clearly stated on the

drawings.

9.13 Bearings

9.13.1 The details in DBR may be referred.

9.13.2 In the selection of the bearing layout in viaducts, consideration shall be given to their performance in relation to the supporting structures, economy as well as maintenance and replacement of the bearings.

9.13.3 Due care must be taken to ensure that no pair of bearings act against one another in service conditions to the detriment of the structure and to the bearings themselves.

9.13.4 Design Life

Whenever the expected design life of the bearings is significantly less than that of the structure, provision shall be made for the removal and replacement of the whole or parts of the bearings.

9.13.5 Types of Bearings

Bearings for the viaducts would preferably be elastomeric up to 28m - span and beyond that Pot-cum-PTFE including for continuous/special spans.

Type of Bearing adopted shall be justified by detailed design calculations and codal provisions as per DBR.

9.13.6 Bearing Design

Unless otherwise specified, bearings shall be designed in accordance with the requirements of D B R (IRS or IRC Codes or any other equivalent Code).

Bearings for viaducts shall be designed as per DBR to allow for the following movements:

- Thermal expansion and contraction
- Shrinkage of concrete
- Creep in concrete
- Elastic shortening under pre-stress
- Displacements of structure under load:

Differential settlement between viaduct piers shall re-considered.

Rotation and sway of columns and crossheads under the worst load combination including the effects of temporary loads during construction shall be considered.

Schedule listing the performance requirements for each type of bearings for viaduct shall be incorporated in the drawings. The schedule shall indicate the following:

- Dead load to be supported (SLS and ULS).
- Maximum and minimum vertical live load to be supported (SLS and ULS)
- Horizontal forces to be resisted (SLS and ULS)
- Rotation capacity required
- Translation capacity required (both reversible and irreversible). In the case of in-situ

viaducts, the amount of pre-setting required for the bearings should be clearly indicated.

Calculations for movements of bearings shall take into account the variability of materials and conditions that the structure is expected to encounter during its design life.

In the above ULS and SLS mean Ultimate Limit State and Serviceability Limit State respectively.

Design of the bearings, derailment loads requirements specified in DBR shall be taken into consideration. The corresponding viaduct rotation under derailment loads shall be controlled to minimize damage to the viaduct elements.

In the design of the bearings to resist lateral loads, friction between the bearing and mortar shall be ignored

Mortar bedding composing of sand and EITHER cement, polyester resin or epoxy resin shall have a crushing strength of at least twice the average contact stress. In the choice of bedding due consideration shall be given to the future removal and replacement of the bearing without damage to bedding or to the structural elements bonded to it.

Shear studs or bolts shall be provided to secure the bearing top and bottom plates to the structure. The shear studs or bolts shall be designed in accordance with international practice.

The fixing method to be adopted shall be such that it is convenient and possible to replace the bearings at some future date.

The designer shall ensure that the bearings can be produced to satisfy the design requirements; and that the space allowed for in the overall design is sufficient to accommodate the bearings and enable them to be inspected, maintained and replaced when required.

Highway Clearances

The vertical and horizontal highway clearances required to structures shall generally be in accordance with the requirements described below.

9.14.1 Vertical Clearances

The minimum clearance between the elevated structures and highways, railways, utility lines and other structures and property should be greater by a minimum of 250 mm on those prescribed by the agencies involved. The minimum vertical clearance below the bottom of the structure for any highway road passing below will be 5.5 meters as prevailing presently. In case of minor roads/streets a lower clearance may be adopted with specific approval of the agency owning and/or maintaining the road/street.

9.14.2 Horizontal Clearances

The clear span over the roads passing below the viaduct/bridge shall be determined after evaluation of present and future needs.

Protection shall be necessary for piers against accidental impact from road vehicles on a case by case basis. IRC/UIC codes shall be applied.

9.14 Viaduct Deck Furniture, Drainage and Waterproofing

Viaduct deck furniture, drainage and waterproofing system shall be designed for all effects and requirements of the railway.

Cast-in drains shall be used, provided with rodding eyes at every bend. Runoff on viaduct structures and bridges shall be collected through surface drains that shall lead to down drains at the support columns. The down drains shall be connected to a drainage system which shall consist of collection header pipe and manholes which shall discharge to the nearest suitable drainage system. Silt removal shall be provided where necessary.

9.15 System wide Requirements

9.16.1 System wide requirements must be considered in the development of the structural design. Such consideration shall include:

1. The incorporation of a stray current corrosion control system
2. The incorporation of an adequate water drainage system
3. The necessary design of reinforcement in plinth and deck so as to avoid interference with and attenuation of the signaling circuits
4. Special care taken with the location of gullies in points and crossing areas.
5. Provision for future pre-stressing of cable/strands as per IRS code shall be made for all pre-stressed concrete members (External pre-stressing) as indicated in the conceptual drawings.

9.16.2 System wide details are liable to changes as the requirements of various contracts become known and their designs are developed. The DESIGN AND CONSTRUCT CONTRACTOR shall be responsible for incorporating all System wide requirements as they become available.

9.16.3 All details provided to meet System wide requirements shall be subject to the acceptance by the Employer's Representative.

9.16.4 Rail Structural Interaction analysis (RSI) and LWR forces: RSI analysis is to be carried out for the alignment of BSRP project so as to determine the effects of thermal interaction between the elevated viaduct (Box girder/U-Girder) and continuously welded rail (CWR/LWR). The analysis should incorporate the behavior of various elements of the structure i.e., rail fasteners, stiffness of rail, the deck, the substructure and foundations. As per DBR of K-RIDE, clause 5.16, page 23, RSI has to be carried out duly following the BS report no. 119 of RDSO "Guidelines for carrying out rail structure interaction studies on metro system (version-2)". The contractor to do the necessary design in the connection, which shall be proof checked by GC and approved by K-RIDE. If required, a second opinion can be obtained from a reputed academic institution like IISC or IITM. But for guidance purpose, a load of 1.2t/m/track as used in other Metro, without dynamic augment can be used for preliminary design. The LWR forces shown in bid documents are indicative, bidder need to do detailed analysis.

FOUNDATIONS AND GEOTECHNICAL WORKS**10. GEOTECHNICAL DATA**

10.1 "Geotechnical works" shall mean foundations, earthworks, deep excavations, slopes, embankments and earth retaining structures. It shall also include dewatering and any ground related activities in soil and rock.

102 The EPC CONTRACTOR shall be responsible for determining for his design purposes the Geology and the Geotechnical parameters of the sub-surface strata along the route. The Geo-Technical Investigation details/reports relevant to this contract as available with K-RIDE are enclosed with tender. Further GT investigation details/reports as available with K-RIDE will be supplied during execution of work. The results can be of use for broad reference and information and tentative only. The geo-technical investigations are to be carried out by the EPC CONTRACTOR on which the design should be based. GT Investigation has to be carried out at each pier and bridge locations as directed by Engineer.

The EPC Contractor shall carry out the installation of test piles and testing as per relevant codes. If necessary, modification to design of piles after testing shall be done.

103 The design of pile foundation as per DBR (IS 2911). A safety factor of not less than 2.5 should be adopted as tested load for a single pile and safety factor of not less than 2.0 shall be adopted when considering pile and pile group capacities. A safety factor of at least 1.75 for a single pile and at least 1.5 for group piles shall be adopted when the negative skin friction (which results from downward movement of adjacent soil relative to the pile caused by dewatering and/or the placement of fill) is considered. The Engineer's decision is final.

104 In his design the EPC CONTRACTOR shall take adequate measures to minimize the amount of local differential settlement of road surfaces around underground works

105 Minimum No. of piles in a pile group is generally four.

106 The type of foundation shall depend on soil and site condition, and, where the K-RIDE alignment is close to the Railway line, the foundation design of the adjacent structure.

107 **EARTH WORKS FOR FORMATION, MINOR BRIDGES, MAJOR BRIDGES, ROB & RUB**

Earth Works For Formation: The details given in DBR shall be referred. As per Comprehensive guidelines and specifications for railway formation, specification no. RDSO/2020/GE: IRS-0004-2020. The IRS Codes shall be followed for minor Bridges, Major Bridges, ROB & RUB.

The Standard Drawings of box culverts (25 MT loading) of RDSO for minor bridges may be referred and the tentative spans are given in the minor bridges list. The standard drawings of RDSO for major bridges & ROB may be referred. The standard RUB Drawings (Segmental Construction) as per IRS Codes may be referred, if available otherwise the same has to be designed as per IRS Codes/DBR. The IRS Codes shall be followed in-principle and the design criteria is based on IRS Codes viz. IRS-Bridge Rules, IRS Concrete Bridge Code & IRS Bridge Substructure & Foundation Code.

TENDER DOCUMENTS

APPENDICES

**EMPLOYER'S REQUIREMENTS
APPENDIX 1
DRAWING LIST**

Following drawings are enclosed with tender for guidance and general information: -

General Arrangement Drawings (plan and profile)

EMPLOYER'S REQUIREMENTS

APPENDIX 2A

WORK AREAS

WORK AREAS

No land shall be made available by the employer for casting yard, site offices, and site laboratories. Contractor shall make his own arrangements at his own cost. In case the Railway land/ Govt. land is arranged adjacent to near to railway track for casting of U-Girders & for initial erection and launching activity temporarily, the necessary land rent /lease charges shall be levied as per Railway guidelines / Govt. norms /K-RIDE norms and the same will deducted from RA bills of the Contractor.

EMPLOYER'S REQUIREMENTS

APPENDIX 2B –

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX 2C –

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX 2D

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX-3

PROJECT CALENDAR

- (1) The Project Weeks shall be commenced on a Monday. A day shall be deemed to commence at 0001 hour on the morning of the day in question. Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.
- (2) Requirements for the computation of Key Dates are given in Annexure-1 of Employer's Requirements.
- (3) A 7 day week calendar shall be adopted for various (Work) programme schedules for scheduling purposes.
- (4) For Project purposes, the presentation shall be in "Week" units.

EMPLOYER'S REQUIREMENTS

APPENDIX 4

PROGRAMME REQUIREMENTS

1. GENERAL

(1) Purpose of Programme

There are two primary purposes for the requirement of Programme (Scheduling) information described in this document:

- a. Evaluation of Tender
- b. Status Reports during Construction

To provide the Engineer with status reports for managing, monitoring and coordinating the awarded contracts during their execution within the overall multi-contract project schedule.

The requirements are organized in two stages. The first stage is a requirement for all Tenderers and shall be submitted as part of Tender. The second stage is a requirement of the Employer and describes a series of reports to be submitted by the Contractor to the Engineer during the execution of the contract, following the award of Contract.

- (2) The Tenderer/ Contractor shall programme his work at all times to meet the Key Dates stated in Annexure-1 to the Employer's Requirements and the specified interface periods for the installation of the Works with those of the Designated Contractors and shall during the progress of the Works constantly monitor his progress against the programmes described below.
- (3) The Tenderer/ Contractor shall include in all programmes his work obligations towards shared access, shared Site areas and other coincident or adjacent Works Areas.
- (4) The Works Programme, and all more detailed or revised versions, shall be submitted to the Engineer in hard copy as well as soft copy for his consent in accordance with the provisions of the GCC.

2. METHODOLOGY

- (1) The computerized Critical Path Method (CPM) network using the Precedence Diagramming Method (PDM), has been selected by the Employer as the technique for contract management system and in co-coordinating the multi-contract project. This technique shall also be employed by the Tenderer in preparing their Tender submissions and by the Contractor in their Construction Stage submissions.

- (2) Unless otherwise agreed by the Engineer, all programmes submitted by the Contractor shall be produced using computerized Critical Path Method (CPM) Networks developed implementing the Precedence Diagramming Method (PDM) with Cost Loaded Charts and Tables.
- (3) The Contractor shall implement and use throughout the duration of the Contract, a computerized system to plan, execute, maintain and manage the planning, pre-construction, construction, and sub-contracts in executing the CPM scheduling by PDM. The reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work remaining to be accomplished; shall provide a sound basis for identifying problems, deviations from the planned works, and for making decisions; and shall enable timely preparation of the same for presentation to the Engineer.

3. PROGRAMME MANAGEMENT SOFTWARE

- (1) CPM programming software used shall be Primavera Project Planning (P6) Program - Ver 2.0b or later. Any other compatible system capable of direct file interchange capability with software program used by the Employer - Primavera (P6), Ver 2.0b can be used with Engineer's consent. Scheduling software and relevant instruction manuals, licensed for use in connection with the contract, shall be provided by the Contractor according to the Employer's specifications
- (2) The Tenderer may use a system other than Primavera but will be required to demonstrate that full electronic data transfer to Primavera is available and that the various levels of reporting and coding capabilities are at least equivalent to Primavera. Compatibility and comparable performance between Primavera and the Tenderer's proposed system shall be demonstrated in his Tender submission. Should compatibility not be demonstrated to the Employer's satisfaction the Contractor shall utilise Primavera for development, statusing, updating and revision of all the Programmes during the duration of the Contract. Upon the Engineer's consent of a system other than Primavera, the Contractor shall supply the Engineer with an original licensed copy, including manuals and approved training of the software and any subsequent versions thereof at no extra cost.

4. (Not Used)

5. POST CONTRACT AWARD

- 5.1 The Contractor shall develop his Tender Programme into the Initial Works Programme including an outline Narrative Statement and submit within 15 days of the date of the Notice to Proceed and its more detailed version within sixty (60) days of receiving the Engineer's consent to the proposed Initial Works Programme.
- 5.2 The first Three Month Rolling Programme shall be submitted within thirty (30) days of the date of Notice to Proceed and all subsequent editions shall accompany the Monthly Progress Report. The Monthly Progress Reports shall also include a Programme Update as described below. These programmes shall subsequently be updated as described below.

- 5.3 Following the Contractor's Initial Works Programme submission but in any case no later than six (6) months from the date of award of contract, the contractor shall make submissions of the detailed Works Programme suitably amended to take into account the programmes of Designated Contractors. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to review, revise and finalise his Initial Work Programme so as not to affect the progress of Works/ and or the works of the Designated Contractors. The resubmitted programme when approved by the Engineer shall form the Baseline Programme against which actual progress of the Contract shall be reckoned. As the work progresses, it may be necessary to update/ revise the Baseline programme but such updating shall only be carried out with the prior consent of the Engineer or when directed by them.
- 5.4 For Initial & Detail Work Programme submission, one (1) original and six (6) copies each of the following Programmes and Reports shall be submitted to the Engineer:
- a) Programme: Baseline CPM Network
 - b) Programme: Baseline Milestone based Cost Activity Schedule
 - c) Baseline Schedule Report
 - d) Narrative
 - e) Baseline physical progress's 'S' Curve
 - f) Baseline resource units.
- 5.4.1 The Engineer shall review and comment on the Contractor's programmes and information submitted under this Clause. The Engineer will confirm his consent or otherwise of the submissions within thirty (30) calendar days.
- 5.5 The Engineer shall require the Contractor to re-submit within thirty (30) calendar days if he is of the opinion that the programmes and information submitted by the Contractor is unlikely to meet the Contract key dates.
- 5.6 If in the opinion of the Engineer, any of the Contractor's revised programmes or Baseline Schedule Report is not acceptable, it shall be construed as a failure of the Contractor to meet a Milestone.
- 5.7 Notwithstanding the above, the Engineer may at any time during the course of the Contract require the Contractor to reproduce the computer-generated Baseline Schedule Report described above to reflect actual activity dates and generate schedules based upon "what if statements. The initial computer-generated report after receiving the Engineer's consent will serve as the base against which the contract progress will be measured. Any changes to the Report reflected in subsequent Baseline Schedule Reports shall also require the Engineer's consent.
- 5.8 Failure to include any element of work required for performance of the Contract shall not relieve the Contractor from completing all works required under the Contract to achieve the original or any extended key completion date.

6. WORKS PROGRAMME

- (1) The Works Programme shall show the Contractor's plan for organising and carrying out whole of the Works.
- (2) The Works Programme shall be a computerized Critical Path Method (CPM) network developed using the Precedence Diagramming Method (PDM) and shall be present in bar chart and time-scaled network diagram format to a weekly or monthly timescale.
- (3) Tasks in the Works Programme shall be sufficiently detailed to describe activities and events that include, but are not limited to, the following:
 - (a) Key Dates,
 - (b) All physical work to be undertaken in the performance of the Contract obligations, including Temporary Works,
 - (c) The requested date for issue of any drawings or information by the Engineer,
 - (d) Incorporation of principal aspects of the Design Submission Programme,
 - (e) Procurement of major materials and the delivery and/or partial delivery date on-Site of principal items of Contractor's Equipment,
 - (f) Any off-site work such as production or pre-fabrication of components,
 - (g) Installation of temporary construction facilities,
 - (h) Interface periods with Designated Contractors or utility undertakings,
 - (i) Design, supply and/or construction activities of sub-contractors,
 - (j) Any outside influence which will or may affect the Works.
- (4) The Works Programme shall show achievement of all Key Dates.
- (5) Activity descriptions shall be unique, describing discrete elements of work. Any activity creating an imposed time or other constraint shall be fully defined by the Contractor.
- (6) The Works Programme shall be organized in a logical work-breakdown structure including work stages and phases, and shall clearly indicate the critical path(s).

Each activity in the Works Programme shall be coded to indicate:

- (a) Activity ID and Activity Code.
- (b) The Engineer may request additional activity coding to the extent available without restraint to the Contractor's utilisation of the programme software. When requested, the Contractor shall add the required additional coding to the Programme. The Contractor shall use additional code fields as requested to comply with the requirements and for the use of the Contractor.
- (7) Activity duration shall not exceed two (2) weeks, unless otherwise consented to by the Engineer, except non-construction activities such as submittals, submittal reviews,

procurement and delivery of materials or equipment and concrete curing. The Contractor shall submit a Programme/Project Calendar cross reference clearly indicating the allowance for holidays.

- (8) The Works Programme, in each submission, shall be accompanied by an Activity Report and a Narrative Statement as described below in both electronic {3 ½" diskettes or CD-R) and hard copy format (time scale logic diagrams in A1 size, reports in A4 size).
- (9) Activity Report shall list all activities, and events in the Works Programme, sorted by activity identification number.

The Activity Report shall include the following for each activity and event:

- (a) Activity identification number and description,
- (b) Duration expressed in Days,
- (c) Early and Late start, & Early and Late finish dates. Planned start and finish dates,
- (d) Calculated total float and free float,
- (e) Predecessor and successor(s), accompanying relationships and lead/lag duration,
- (f) Imposed time or date constraints,
- (g) Calendar.

(10) Narrative Statement

The Narrative shall be a comprehensive statement of the Contractor's plan and approach for the execution of the Works and the achievement of key dates, handover dates, submission dates and any intermediate dates. It shall incorporate outline method statements in respect of major items of work including construction sequences and primary item of plant, Construction Equipment, Temporary Works and the like. It shall fully explain the reasons for the main logic links in the Programme and include particulars of how activity duration are established. This shall include estimated quantities, production rates, hours per shift, work days per week and a listing of the major items of Construction Equipment planned for use on the project. Activities, which may be expedited by use of overtime or additional shifts, shall be identified and explained. A listing of holidays, and other special non-work days being used for the computer reports shall be included.

(11) Baseline Physical Progress 'S' Curve

The Contractor shall also submit a forecast Cumulative Physical Progress 'S' curve based on the time-phased distribution of cost in the CPM Network Logic Diagram, expressed in percentage terms. This 'S' curve shall be generated from the computerised CPM Network Logic Diagram.

(12) Baseline Resources Charts

The Contractor shall also submit a Resource Charts, generated from the Contractor's CPM Network Diagram, showing the anticipated manpower and main Construction Equipment usage during the execution of the Project.

As an additional monitoring facility, indicator resources shall be assigned to relevant activities for the major items of work. Indicator resources shall be directly allocated for excavation (cum.), piling (no.), pile cap (no, pier & pier cap(no), viaduct (RM), parapet wall (RM) concrete (cum) for station etc. Resource indicators may be input as a daily rate, expected required rate, or as an activity total in the relevant units. These are purely indicative quantities and do not form part of contract

- (13) All submissions of proposed Works Programmes subsequently, after approval of the Initial Works Programme, shall include the actual physical progress of work and forecast of the remaining work. Actual progress shall be stated in percent complete, remaining duration, and actual start and finish dates for each activity in the Works Programme.

7. INITIAL WORKS PROGRAMME

- (1) The Initial Works Programme submitted as under Clause 5.1 need not include the full details given under Clause 6 above. It should be a condensed version with combined activities of longer. The outline Narrative Statement shall be in sufficient detail to clearly show the Contractor's intention.
- (2) Within sixty (30) days of the Engineer's consent to the Initial Works Programme, the Contractor shall submit to the Engineer an expanded and more detailed version of the Initial Works Programme containing all of the information and detail required under Clause 5 above.
- (3) Such submission shall make use of the Tender Programme submitted earlier but refined to include the best estimates of dates for the work of Designated Contracts which has impact on the Contractor's programme. Such programmes shall be amended subsequently to incorporate the actual dates/ schedule of the affecting contracts. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to finalise the Initial Programme, without affecting progress of the work.

8. WORKS PROGRAMME REVISIONS

- (1) The Contractor shall immediately notify the Engineer in writing of the need for any changes in the Works Programme, whether due to a change of intention or of circumstances or for any other reason. Where such proposed change affects timely completion of the Works or any other Key Date the Contractor shall within fourteen (14) days of the date of notifying the Engineer submit for the Engineer's consent its proposed revised Works Programme and accompanying Narrative Statement. The proposed revised Works Programme shall show the sequence of operations of any and all works related to the change and the impact of changed work or changed conditions.

- (2) If at any time the Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Programme, he may request the Contractor to submit a proposed revised Programme which together with an accompanying Activity Report and Narrative Statement, shall be submitted by the Contractor within fourteen (14) days after the Engineer's instruction. The proposed revised Works Programme shall show the sequence of operations of any and all work related to the change and the impact of changed work or changed conditions.
- (3) All activities that have negative float must be analysed by the Contractor to identify the impact on the timely completion of the Works or on the achievement of Key Dates.

9. THREE MONTH ROLLING PROGRAMME.

- (1) The three-month rolling programme shall be an expansion of the current works programme covering sequential periods of three months. The Three-Month Rolling Programme shall provide more detail of the Contractor's plan, organisation and execution of the work within these periods. In particular, the Contractor shall expand each activity planned to occur during the next three (3) month period, if necessary to a daily level of detail.
- (2) The Three-Month Rolling Programme shall be developed as a Critical Path Method (CPM) network, and shall be presented in bar chart and time-scaled network diagram format. Bar charts shall be presented on an A4 and time-scaled networks diagrams on an A1 size reproducible media. Tasks in the programme shall be derivatives of and directly related to tasks in the approved Works Programme.
- (3) The Contractor shall describe the discrete work elements and work element inter-relationships necessary to complete all works and any separable parts thereof including work assigned to subcontractors.
- (4) Activity duration shall not exceed two (2) weeks unless otherwise consented to by the Engineer.
- (5) Each activity in the Three-Month Rolling Programme shall be coded, or described so as clearly to indicate the corresponding activity in the Works Programme

10. THREE MONTH ROLLING PROGRAMME REVISIONS AND UPDATE

- (1) The Three-Month Rolling Programme shall be extended forward each month as described under Clause 5(1) above. Each submission of the Three-Month Rolling Programme shall be accompanied by a Programme Analysis Report, describing actual progress to date, and the forecast for activities occurring over the next three-month period.
- (2) If the Three-Month Rolling Programme is at variance with the Works Programme, the Programme Analysis Report shall be accompanied by a supporting Narrative Statement describing the Contractor's plan for the execution of the activities to be undertaken over

the three month period, including programme assumptions and methods to be employed in achieving timely completion.

- (3) The Contractor shall revise the Three-Month Rolling Programme or propose revisions of the Works Programme, or both, from time to time as may be appropriate to ensure consistency between them.

11. THREE WEEK ROLLING BAR CHART SCHEDULE

Once a week, on a day mutually agreed to by the Engineer and the Contractor, a meeting will be held to assess progress by the Contractor during the previous work week. The Contractor shall submit a construction schedule listing activities completed and in-progress from the previous week and the activities scheduled for the succeeding two weeks based on the detailed Works Programme. Copies of the schedule shall be submitted on A3 sized paper.

12. PROJECT CALENDAR

For the Project, the Contractor shall adopt 7 days a week calendar, identical calendar for the purpose of programming and Execution of Works. Official documents shall be transacted during 5 days week -Monday through Friday, except for National (Govt, of India) Holidays. For Project purposes, a week begins at 0001 hours on a Monday and ends at 2359 hours on a Sunday. The completion of an activity or the achievement of an event when given a week number shall be taken to mean midnight on the Sunday at the end of the numbered week. An access date or activity start date when given as a week number shall be taken to mean 0001 hours on a Monday of the Numbered week.

13. PROGRAMMING PERSONNEL

The Contractor shall submit, as part of its Staff Organisation Plan, the names and required information for the staff to be employed on Works Programming. The principal Works Programmer shall hold reputable professional qualifications acceptable to the engineer including at least five (5) years relevant experience in programming civil engineering works. Others in the groups shall have at least three (3) years experience in such works. The programmer shall be employed by the contractor full time on the contract until the completion or such earlier time the Engineer may give his consent.

14. PROGRAMME AND REPORT SUBMISSION FORMAT

The Contractor shall submit one (1) original and six (6) copies and one (1) reproducible (for Programmes) of all submissions to the Engineer. All submissions shall be in AO, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Engineer. In addition, the computerised programme and report shall be submitted in 3-1/2 inches diskettes (similarly for submissions required under Clause 5.4)

The format for all Programme and Report submissions shall be strictly in accordance with the format as stated herein or as requested by the Engineer.

15. FAILURE TO SUBMIT PROGRAMME

Failure of the Contractor to submit any programme, or any required revisions thereto within the time limits stated for acceptance by the Engineer, shall be sufficient reason for not making the relevant stage on account payment by the Engineer

The Contractor should actively participate in implementing PMIS & BIM system by K-RIDE.

Employers Requirements

Appendix-5

Monthly Progress Report

General

The Contractor shall submit to the Engineer, a Monthly Progress Report. This Report shall be submitted by the end of each calendar month and shall account for all work actually performed from 26th day of the last month and up to and including the twenty-fifth (25th) day of the month of the submission. It shall be submitted in a format to which the Engineer shall have given his consent and shall contain sections /sub-sections.

1. FINANCIAL STATUS

- (1) A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.
- (2) A spread sheet summarizing each activity, the budget, costs incurred during the period, costs to date, costs to go, cost forecast (total of costs to date and costs to go) and cost variance (difference between cost forecast and budget).
- (3) A spread sheet indicating the status of all payments due and made.
- (4) A report on of the status of any outstanding claims. The report shall in particular provide interim updated accounts of continuing claims.

2. PHYSICAL PROGRESS

- (1) It shall describe the status of work performed, significant accomplishments, including critical items and problem areas, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues, problems and resolutions.
- (2) It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Programme.

3. PROGRAMME UPDATE (For Entire Project)

Programme updating shall include:

- (a) the monthly Programme Update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the twenty-fifth (25th) of the month together with estimates of remaining duration and expected activity completion based on current progress. The Programme Update shall be accompanied by an Activity Report and a Narrative Statement. The Narrative Statement shall explain the basis of the Contractor's submittal:

- (i) Early Work and Baseline Submittals - explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in the Contract.
 - (ii) Updated Detail Programme Submittals - state in narrative the Works actually completed and reflected along critical path in terms of days ahead or behind allowable date. The requirements of the narrative are
 - If the Updated Detailed Work Programme indicates an actual or potential delay to Contract Completion date or Key Dates, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Dates or mitigate potential delays. Identify deviation from previous month's critical path.
 - Identify by activity number and description, activities in progress and activities scheduled to be completed.
 - Discuss Variation Order Work Items, if any.
- (b) The Programme Status which shall:
- (i) Show Works Programme status up to and including the current report period, display Cumulative progress to date and a forecast of remaining work.
 - (ii) Be presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings;
 - (iii) The Activity Variance Analysis- which shall analyse activities planned to start prior to 01 during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works

EMPLOYER'S REQUIREMENTS

APPENDIX 6

QUALITY ASSURANCE

1. General

The Contractor shall implement a Project Quality Management Plan in accordance with ISO- 9001 "Quality System - Model for Quality Assurance in Design/Development, Production, Installation and Servicing" to ensure that all materials, workmanship, plant and equipment supplied and work done under the contract meets the requirements of the contract. This plan shall apply to all activities related to the quality of items, including designing, purchasing, inspecting, handling, assembling, testing, storing, and shipping of materials and equipment and different elements of construction work and installations of system components.

The Quality Plan to be prepared by the Contractor and submitted to the Engineer shall follow the requirements of ISO 9000 and address each element therein.

Registration of the Contractor's organisation, or subcontractors or sub-consultants is not required for this Project but the Project Quality Management Plan as submitted shall meet the intent of the ISO 9000 requirement in that there is a comprehensive and documented approach to achieving the project quality requirements.

2. Quality Assurance Management Plan

The Project Quality Management Plan (PQMP) shall as a minimum address the quality system elements as required by ISO 9001, generally noting the applicability to the Contractor's Works Programme for the Project. Procedures or Quality Plans to be prepared by others (Suppliers, Subcontractors, and Sub-consultants) and their incorporation in the overall PQMP shall be identified.

The Contractor shall provide and maintain a Quality Assurance Plan (QA) to regulate methods, procedures, and processes to ensure compliance with the Contract requirements. The QA Plan, including QA written procedures, shall be submitted to the Engineer for his review.

Adequate records shall be maintained in a readily retrievable manner to provide documented evidence of quality monitoring and accountability. These records shall be available to Employer at all times during the term of the Contract and during the Defects Liability Period and for a five year period thereafter.

The Plan shall identify:

- Design Process: that control, check and verify the accuracy, completeness and integration of the design shall be performed by certified personnel and in accordance with documented procedure that have the written consent of the Engineer.

- Special Processes: that control or verify quality shall be performed by certified personnel and in accordance with documented procedures that have the written consent of the Engineer;
- Inspection and Test: Inspection and testing instructions shall provide for reporting non-conformances or questionable conditions to the Engineer; Inspection shall occur at appropriate points in the installation sequences to ensure compliance with drawings, test specifications, process specifications, and quality standards. The Engineer shall designate, if necessary, inspection hold points into installation or inspection planning procedures;
- Receiving Inspection: These procedures shall be used to preclude the use of nonconforming materials and to ensure that only correct and accepted items are used and installed;
- Identification and Inspection Status: a system for identifying the progressive inspection status equipment, materials, components, subassemblies, and assemblies as to their acceptance, rejection, non-inspection shall be maintained;
- Identification and Control of Items: an item identification and traceability control shall be provided;
- Handling, Storage, and Delivery: provide for adequate work, surveillance and inspection instructions.

The Plan shall ensure that conditions adverse to quality such as failures, malfunctions, deficiencies deviations, and defects in materials and equipment shall be promptly identified and corrected.

The Plan shall provide for establishing, and maintaining an effective and positive system for controlling non-conforming material including procedures for the identification, segregation, and disposal of all non-conforming material. Dispositions for the use or repair of non-conforming materials shall require the Engineers consent.

3. Plan Implementation and Verification

The Plan shall clearly define the QA Organisation. Management responsibility for the QA shall be set forth on the Contractor's policy and organisation chart. The Plan shall define the requirements for Q/ personnel, their skills and training. Records of personnel certifications shall be maintained and monitored by the QA personnel. These records shall be made available to the Engineer for review, upon request.

The QA operations shall be subject to the Engineers, Employer or Employer's authorised representative's verification at any time, including: surveillance of the operations to determine that practices, methods and procedures of the plan are being properly applied; inspection to measure quality of items to be offered for acceptance; and audits to ensure compliance with the Contract documents.

The contractor's Quality Audit Schedule shall be submitted to the Engineer for consent every three months or more frequently as required.

The results of Quality Audits shall be summarised in the Contractor's monthly reports.

The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer to carry out on-site and off-site surveillance of Quality Assurance Audits to verify that the quality system which has the consent of the Engineer is being implemented fully and properly.

EMPLOYER'S REQUIREMENTS**APPENDIX 7****DRAFTING AND CAD STANDARDS****1. INTRODUCTION**

- (1) The purpose of this document is to define the minimum Drafting and CAD standard to be achieved by the Contractor for all drawings produced by the Contractor for the purpose of the Works.
- (2) By defining a common format for the presentations of drawings and CAD files, the exchange of drawn information is improved and will maximise the use of CAD in the co-ordination process.
- (3) All submissions shall be made to the Employer's Requirement in a format reviewed without objection by the Employer's Requirement and in accordance with the requirements in:
 - (a) the Contract;
 - (b) the Document Submittal Instructions to Consultants and Contractors.
- (4) Paper and drawing sizes shall be "A" series sheets as specified in BS3429.
- (5) The following software latest and update version compatible for use with Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

Document Type	Electronic DocumentFormat
Text Documents	MS Word,
Spread Sheets	MS Excel,
Data Base Files	MS Access,
Presentation Files	MS PowerPoint,
Programmes Ver2.0a	Primavera for Windows, Sure trackAutoCAD Graphics CorelDraw / AutoCAD
Photographic	Adobe Photoshop,
Desktop Publishing	Page Maker
CADD Drawings	AutoCAD

- (6) Media for Electronic File Submission

One copy shall be submitted unless otherwise stated in CD-ROM.
- (7) Internet File Formats/Standards

- (a) The following guidelines shall be followed when the Contractor uses the Internet browser as the communication media to share information with the Employer.
- (b) All the data formats or standards must be supported by Microsoft Internet Explorer version 3 or above running on Windows NT and Windows 98 or the latest.
- (c) The following lists the file types and the corresponding data formats to be used on Internet.

The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different Data format:

File Type	Data Format
Photo Image	Joint Photographic Experts Group (JPEG)
Image other than Photo	GIF or JPEG
Computer Aid Design files(CAD)	Computer Graphics Metafile (CGM)
Video	Window video (.avi)
Sound	Wave file (.wav)

- (8) The following states the standards to be used on Internet when connecting to database(s). The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different standard:

Function to be Implemented	Standard to be Complied With
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Markup Language (HTML)

The hard copy of all documents shall be the contractual copy.

2. GENERAL REQUIREMENTS

a. General

- (1) The Contractor shall adopt a title block similar to that used in the Drawings for all drawings prepared under the Contract.
- (2) Each drawing shall be uniquely referenced by a drawing number and shall define both the current status and revision of the drawing.
- (3) The current status of each drawing shall be clearly defined by the use of a single letter code as follows:

P	-	Preliminary Design Drawing
D	-	Definitive Design Drawing
C	-	Construction Reference Drawing
W	-	Working Drawing

- B - As-Built Drawing
- M - As Manufactured Drawing
- E - Employer's Drawing

2.2 Types of Drawing

- 1) 'Design drawings' mean all drawings except shop drawings and as-built drawings.
- 2) Working drawings are design drawing of sufficient detail to fully describe the works and adequate to use for construction or installation.
- 3) Site drawings and sketches are drawings, often in sketch form, prepared on site to describe modifications of the Working drawings where site conditions warrant changes that do not invalidate the design.
- 4) 'Shop drawings' are special drawings prepared by the manufacturer or fabricator of various items within the Works to facilitate manufacture or fabrication.
- 5) 'As-built drawings' show the Works exactly as constructed or installed. They are usually prepared by amending the working drawings to take into account changes necessitated by site conditions and described in Site drawings. These drawings shall be completed on a regular basis as the works progress, and shall not be left until completion of the entire works.

3 COMPUTER AIDED DESIGN & DRAFTING (CAD) STANDARDS

3.1 Introduction

Scope of Use

Data input procedures between the Engineer and contractors must be co-ordinated, and the key parameters used to form CAD data files must be standardised. The production of all CAD data files shall comply with the following requirements.

3.2 Objectives

The main objectives of the CAD standards are as follows:

- (a) To ensure that the CAD data files produced for Project are co-ordinated and referenced in a consistent manner.
- (b) To provide the information and procedures necessary for a CAD user from one discipline or external organisation to access (and use as background reference), information from a CAD data file prepared by another discipline or external organisation.
- (c) To standardise the information contained within CAD data files which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.
- (d) To establish procedures necessary for the management of CAD data files.

- (e) To ensure all contractors use 'Model space' and 'Paper space' in the production of their CAD files.

3.3 General

- (1) To facilitate co-ordination between contractors, it is a requirement that all drawings issued by contractors for co-ordination or record purposes shall be produced using CAD methods. Drawings shall be issued in digital format in addition to the paper copies.
- (2) The intent of the issue of digital information is to aid the related design by others. The definitive version of all drawings shall always be the paper or polyester film copies which have been issued by the contractor or organisation originating the drawing.
- (3) Drawings and drawing packages issued for co-ordination, record purposes or for acceptance shall be accompanied by a complete set of the corresponding CAD datafiles.
- (4) Any contractor or organization making use of the CAD data from others shall be responsible for satisfying him that such data is producing an accurate representation of the information on the corresponding paper drawing which is satisfactory for the purpose for which he is using it. Provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.
- (5) In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings. Figured dimensions shall always be taken as correct where discrepancies occur.

3.4 Terminology & Associated Standards /Guidelines

Any terminology used within this section that is ambiguous to the user shall be clarified with the Employer's Requirement. British Standard BS1192 is used in principle as a guide for drawing practice, convention, CAD data structure and translation.

3.5 Paper Drawings

- (1) For the Project "Paper" drawings are considered to be the main vehicle for the receipt and transmittal of design and production information, typically plans, elevations and sections.
- (2) The Project wide accepted media for the receipt and transmittal of "Paper" drawings will be paper and polyester film of various standard ISO 'A' sizes. The composition of this information shall be derived from a CAD "Model".
- (3) The CAD derived "Paper" drawing composition will reflect a window of information contained within a CAD "Model Space" file together with a selection of information

contained within the associated CAD "Paper Space" file.

3.6 CAD Data Creation, Content & Presentation

A consistent method of CAD data creation, together with content and presentation is essential. The method of CAD "Model Space and Paper Space" creation is as follows:

- (1) Model Space Files
 - (a) Typically, CAD "Model Space" files are required for general arrangement and location plans and will consist of a series of other "Model Space" referenced CAD files covering the total design extents at a defined building level (the number of referenced files should be kept to an absolute minimum). Data contained within a CAD "Model Space" file is drawn at full size (1:1) and located at the correct global position and orientation on the Project Grid / or defined reference points.
 - (b) Each CAD "Model Space" file will relate to an individual discipline. Drawing border / text, match / section lines or detailed notation shall NOT be included within a CAD "Model Space" file. Dimensions shall be included within a CAD "Model Space" but located on a dedicated layer. Elevations, Long Sections and Cross Sections shall also be presented in CAD "Model Space" as defined above, but do not need to be positioned and orientated on the Project Grid.
- (2) Paper Space CAD Files
 - (a) Paper Space" CAD files are utilized to aid the process of plotting "Paper" drawings and are primarily a window of the CAD "Model Space" file. A "Paper Space" CAD file will typically contain drawing borders, text, match or section lines & detailed notation. Once these files are initially set up and positioned the majority of "Paper Drawing" plots at various approved scales re efficiently and consistently generated by displaying different combinations of element verse and symbology contained within the "Paper Space" file and the referenced "Model pace" files.
 - (b) The purpose is to ensure that total co-ordination is achieved between the CAD "Model Space" file and the "Paper Drawing" output during the revision cycle of the design and production process. Duplicated data in "Model and paper Space" files will not be acceptable unless an automatic update link exists between the two data sets. "Paper Space" files are not typically required as part of the CAD Media Receipt from contractors, unless specifically requested.

3.7 CAD Quality Control Checks

- (1) Random CAD Quality Control Audits will be carried out by Engineer on all CAD media received and transmitted.
- (2) These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organization), however

compliance with Project CAD and Draughting Standards shall be checked.

- (3) In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place. A typical quality control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

3.8 CAD Data Transfer Media and Format

When CAD data is received & transmittal between Engineer and the Contractor, the media shall be as follows:

- (a) Data Exchange Format - AutoCAD Release 14 (.DWG) or latest version
- (b) Operating System -/ Window NT 3.51 AA/windows Latest version
- (c) Data Transfer Media: CD ROM/ RW of adequate capacity
- (d) All CDs must be labeled on the data shield with:
 - (i) Name of Company
 - (ii) Project Title
 - (iii) Drawing Filenames (for diskettes only)
 - (iv) CD no.
- (e) All media shall be submitted with a completed Form
- (f) The Contractor must ensure the supplied media is free from virus. SUB-directories on tapes or disks are not permitted. If CAD Data is created using UNIX, archive commands must be unrooted.

3.9 CAD Media Receipt & Transmittal

- (1) CAD Media Transmittal (from the Contractor to Engineer) - this will consist of the following:
 - (a) CAD Digital Media
 - (b) CAD data sheet
 - (c) CAD issue / revision sheet
 - (d) CAD Quality Checklist confirming compliance.
 - (e) Plot of each "Model Space" file issued on an A1 drawing sheet (to best fit).
- (2) The above CAD media will be collectively known as "CAD Media Transmittal Set". The CAD data file transmittal format required by Employer 's Representative from all contractors shall be in AutoCAD (Latest version)
- (3) All CAD media received from contractors will be retained by Engineer except for SCSI disk (if used) as an audit trail / archive of a specific contractor's design evolution.
- (4) CAD Media Receipt (from Engineer to the Contractor)

- (a) CAD media should normally be obtained from the respective interfacing contractor(s), but should Engineer issue CAD media it will consist of the following:
 - (i) CAD Digital Media typically contain only CAD "Model Space" files.
 - (ii) CAD data sheet.
 - (iii) CAD issue / revision sheet
- (b) The above CAD media will be collectively known as the "CAD Media Receipt Set". The CAD data file transmittal format used by Engineer to all contractors will be in AutoCAD (version 14)
- (c) Each CAD transmittal CD will be labeled with proper disk label as approved by the Engineer/ Any CAD data transmitted without this label is assumed to be provisional information not to have been quality checked and therefore not formally issued.

3.10 Revisions

- (1) All 'Revisions', 'In Abeyance' and 'Deletions' shall be located on a common layer. This layer can be turned on or off for plotting purposes.
- (2) The following example text indicates the current CAD file revision, i.e., 'Revision [A]'. This shall be allocated to a defined layer on all CAD "Model Space" files, in text of a size that will be readable when the CAD "Model Space" file is fitted to the screen, with all levels on.

3.11 Block Libraries, Blocks, & Block Names

- (1) All Construction Industry symbols produced as CAD Cells shall typically conform to BritishStandard BS1192 - part 3.
- (2) All Blocks created shall be Primitive (i.e., NOT Complex) and shall be placed Absolute (i.e. NOT Relative).
- (3) The Contractor's specific block libraries shall be transmitted to Engineer together with an associated block library list containing the filename (max. 6 characters) and block description. The Contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.
- (4) All Blocks of a common type, symbols or details should initially be created within a CAD "Model Space File" specifically utilized for that purpose. These files will be made available on request by Employer's Representative.
- (5) Blocks created will typically be 2D unless 3D is specifically requested. In both instances they shall have an origin at a logical point located within the extents of each Block's masked area or volume.

3.12 CAD Dimensioning

Automatic CAD Dimensioning will be used at all times. Any dimensional change must involve the necessary revision to the model space file. If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

3.13 CAD Layering

All CAD elements shall be placed on the layers allocated for each different discipline. The layer naming convention to be adopted by the Contractor shall be submitted for acceptance and inclusion within these standards.

3.14 Global origin, Location & Orientation on the Alignment Drawing.

- (1) Location or Plan information in "Model Space" files shall coincide with the correct location and orientation on the Project grid for each specific contract.
- (2) Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross-hair together with related Eastings and Northings co-ordinates. The Civil Contractor(s) will establish the three setting out co-ordinates for their respective works, which will then be used by all other contractors including the Contractor.

3.15 Line Thickness and Colour

To assist plotting by other users, the following colour codes will be assigned to the following line thickness / pen sizes.

Colour	Code No	Line Thickness
Red	10	0.18
White	7	0.25
Yellow	2	0.35
Brown	34	0.5
Blue	130	0.7
Orange	30	1.0
Green	3	1.4
Grey	253	2.0

3.16 CAD Utilization of 2D & 3DFiles

Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualization

process (i.e., Architecture, Survey and Utilities). In these specific instances 3D CAD data will only be transmitted if all other users can use this data. If this is not the case, 3D to 2D translation shall be processed by the creator prior to issue.

3.17 CAD File Numbering

- (1) Contractors CAD File Numbering shall be described in 2.2above.
- (2) Employer CAD File numbering unlike most of the contractors, Employer will not be required to produce numerous CAD files. This will follow the numbering system Except that the status of the drawing in 2.1(3) shall be "E".

3.18 CAD File Naming Convention - General

CAD "Model Space" files shall be named in accordance with general drawing conventions. Note: The CAD standards shall be compatible with BIM platform of K-RIDE

3.19 ERP, OSO and 3D BIM Platform

The Contractor shall utilise a PMIS integrating with BIM software such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer office at site and the Employer's Office by the Contractor.

EMPLOYER'S REQUIREMENTS APPENDIX 8

WORKS AREAS & TEMPORARY POWERSUPPLY

1. INTRODUCTION

- (1) The Contractor shall provide within the designated principal Works Areas, at locations agreed with the Engineer, the compounds and facilities for the Engineer and other contractors of the Employer defined under Clause 2 of this Appendix.
- (2) The standard conditions applying to the use of any Works Area by the Contractor for its site facilities are given under Clause 2 of this Appendix.
- (3) The Conditions for supply of electricity by the Contractor to Designated Contractors are given under Clause 3 of this Appendix.

2. STANDARD ENGINEERING CONDITIONS

The following standard engineering conditions apply to all Works Areas:

- (1) Formation
 - (a) The Works Areas shall be formed to the levels that the Engineer has given his consent. No such levels shall be amended without prior consent of the Engineer.
 - (b) The Works Areas shall be surfaced in a manner agreed with the Engineer, compatible with their intended use, and, in particular, footpaths and roadways connecting facilities shall be clearly defined. Measures shall be taken to the satisfaction of the Engineer to ensure all areas are properly drained and kept free of static water.
 - (c) The removal, diversion or reinstatement elsewhere as may be required of any existing works or installation whatsoever within the Works Areas shall be carried out to the satisfaction of the Engineer.
- (2) Roads & Parking
 - (a) Space shall be provided within the Works Areas for parking, loading/unloading and maneuvering of motor vehicles.
 - (b) Any damage done to the adjoining public roads and fixtures and properties (public or private) shall be made good to the satisfaction of the Engineer.
- (3) Drainage & Sewerage
 - (a) All storm or rainwater from the Work Areas including any access roads thereto shall be conveyed to the nearest stream course, catch-pit, channel or storm water drain as

required by the Engineer. All temporary and permanent works shall be carried out in such a manner that no damage or nuisance are caused by storm water or rain water to the adjacent property.

- (b) No drain or watercourse shall be used without consent of the Engineer.
 - (c) Damages or obstructions caused to any watercourse, drain, water-main or other installation within or adjoining the Works areas shall be made good to the satisfaction of the engineer.
 - (d) Treatment and disposal of sewage and waste water from the works areas shall be provided to the satisfaction of the engineer.
- (4) Buildings
- (a) No permanent structures other than those required for the Permanent Works shall be Temporary permitted on the Works Areas.
 - (b) Electricity, water, telephone and sewerage shall be provided by the Contractor, as required, for all temporary buildings.
 - (c) No potable water obtained from the Govt. sources shall be used for heating, cooling and humidification purposes, or vehicle washing without the written consent of the Engineer.
- (5) Pedestrian Access
- Every existing pedestrian access throughout the Works Areas shall be maintained in a usable condition at all times to the satisfaction of the Engineer including lighting, signing and guarding.
- (6) Fencing
- The Works Areas shall be secured against unauthorised access at all times. In particular fencing or the like shall be maintained, removed and re-erected in the new location wherever and whenever a Works Area is relinquished in stages.

3. Applicability

- (1) Where the Contractor is required to provide temporary electrical supplies, or to use, extend or expand on temporary supplies installed by others, all such activity shall be executed in accordance with Paragraphs of this Appendix.
- (2) When the Contractor makes use of temporary electrical supplies provided by others he will observe and comply with the requirements of this Appendix.

4. Work on Site

- (1) The contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Engineer for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring the all necessary electrical equipment on site. The contractor shall not install or operate any temporary site electrical systems until his representative is appointed and has commenced duties.
- (2) The name and contact telephone number of the representative having been reviewed without objection by the Engineer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.
- (3) Schematic diagrams and the details of the equipment for all temporary electrical installations shall be submitted by the Contractor, and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for his consent.
- (4) All electrical installation work on Site shall be carried out in accordance with the requirements laid down in BS 7375 and the Specification. All work shall be supervised or executed by qualified and suitably categorized electricians, who are registered as such under the Electricity Ordinance 1990/Electricity (Registration) Regulations1990.

5. Electrical General

Temporary electrical Site installations and distribution systems shall be in accordance with: -

- (1) Indian Electricity Rules
- (2) The Power Companies' Supply Rules;
- (3) Electricity and its subsidiary Regulations;
- (4) IEE Wiring Regulations (16th Edition);
- (5) BS 7375 Distribution of Electricity on Construction and Building Sites;
- (6) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites; and
- (7) BS 6164 Safety in Tunneling in the Construction Industry.
- (8) Any other applicable national standards

6. Materials, Appliances and Components

All materials, appliances and components used within the distribution system shall comply with BS 4363 and BS 7375 Appendix A.

7. Design Considerations

- (1) Distribution equipment utilized within the temporary electrical distribution system shall incorporate the following features:-
 - (a) Flexibility in application for repeated use;
 - (b) Suitability for transport and storage;
 - (c) Robust construction to resist moisture and damage; and
 - (d) Safety in use.
- (2) All cabling shall be run at high level whenever possible and firmly secured to ensure they do not present a hazard or obstruction to people and equipment.
- (3) The installation on Site shall allow convenient access to authorized and competent operators to work on the apparatus contained within.

8. Mains Voltage

- (1) The site mains voltage shall be as per the electricity authority, 415V/3 phase 4 wire system.

(a) single phase voltage shall be as per the electricity authority, 230V supply.

(b) Reduced voltages shall conform to BS 7375.

(2) Types of Distribution Supply

The following voltages shall be adhered to for typical applications throughout the distribution systems:

(a) fixed plant - 415V/ 3 phase;

(b) movable plant fed by trailing cable - 415V /3phase;

(c) installations in Site buildings - 230V /1phase;

(d) fixed flood lighting - 230V/1phase;

(e) portable and hand held tools -115V /1phase;

(f) Site lighting (other than flood lighting) -115V /1 phase; and

(g) Portable hand-lamps (general use) -115V /1phase.

- (3) When the low voltage supply is energized via the Employer's transformer, any power utilized from that source shall be- either 415 V. 3 phase or 230 V. 1 phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.

(4) Protection of Circuits

- (a) Protection shall be provided for all main and sub-circuits against excess current, under and over voltage, residual current and earth faults. The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.
- (b) Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with: -
 - (i) BS 88;
 - (ii) BS EN 60898; and
 - (iii) BS 7375;
 - (iv) Any other appropriate Indian Standards.

9. Earthing

- (1) Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.
- (2) Earthing systems shall conform to the following standards: -
 - (a) IEE Wiring Regulations (16th Edition);
 - (b) BS 7430;
 - (c) BS 7375; and
 - (d) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

10. Plugs, Socket Outlets and Couplers

Low voltage plugs, sockets and couplers shall be color coded in accordance with BS 7375, and constructed to conform BS EN 63809 high voltage couplers and 'T' connections shall be in accordance with BS 3905.

11. Cables

- (1) Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. Supply cables up to 3.3KV shall be in accordance with BS 6346.
- (2) For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to one of the following specifications appropriate to the duties imposed on it:
 - (a) BS 6708 flexible cables for use at mines and quarries;
 - (b) BS 6007 rubber insulated cables for electric power and lighting; and

- (c) BS 6500 insulated flexible cords and cables.
- (3) Where low voltage cables are to be used, reference shall be made to BS 7375. The following specifications shall also be referred to particularly for under ground cables:-
 - (a) BS 6346 for armored PVC insulated cables; and
 - (b) BS 6708 Flexible cables for use at mines and quarries.
- (4) All cables which have a voltage to earth exceeding 65 V (except for supplies from welding transformers to welding electrodes shall be of a type having a metal sheath and/or armour which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.
- (5) Armoured cables having an over sheath of polyvinyl chloride (PVC) or an oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring.
- (6) For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.
- (7) Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be of a type insulated and sheathed with a general purpose or heat resisting elastomer.
- (8) All cables which are likely to be frequently moved in normal use shall be flexible cables. Flexible cables shall be in accordance with BS 6500 and BS 7375.

12. Lighting Installation

- (1) Where Site inspection of the Works is required during the nights, the Lighting circuits shall be run separate from other sub-circuits and shall be accordance with BS 7375 and BS4363.
- (2) Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.
- (3) Luminaries shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.
- (4) The Contractor shall upgrade the lighting level to a minimum of 200 lux by localised lighting in all areas where required by the Engineer.
- (5) Mechanical protection of luminaries against damage by impact shall be provided by use of wire guards or other such devices whenever risk of damage occurs.

13. Electrical Motors

- (1) Totally enclosed fan cooled motors to BS 4999: Part 105 shall be used.
- (2) Motor control and protection circuits shall be as stipulated in BS 6164. The emergency stops for machinery shall be provided

14. Inspection and Testing.

Electrical installations on Site shall be inspected and tested in accordance with the requirements of the I EE Wiring Regulations (16th Edition).

15. Identification

Identification labels of a type reviewed without objection by the Engineer shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

16. Maintenance:

- (1) Strict maintenance and regular checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall submit for review by the Engineer details of his maintenance schedule and maintenance worksrecord.
- (2) All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection carried out and the recommended inspection period.

17. Metering

The Contractor shall install a separately metered and invoiced supply or supplies of electricity for: -

- (a) Site fabrication facilities;
- (b) Site workshops and work yards; and
- (c) Site offices and stores.

EMPLOYER'S REQUIREMENTS

APPENDIX 9

RAILWAY ENVELOPE

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX 10

APPROVED MANUFACTURERS /SUPPLIERS

Refer Annexure to Technical Specification

EMPLOYER'S REQUIREMENTS

APPENDIX 11

CURVE AND GRADIENT DETAILS

BSRP CORRIDOR

Horizontal and Vertical Alignment

All details with regard to the Horizontal and Vertical Alignment are shown on the plan & profile sheets of the drawings provided in tender document. It is indicative for guidance purpose only.

EMPLOYER'S REQUIREMENTS

APPENDIX 12

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX 13

DELETED

EMPLOYER'S REQUIREMENTS**APPENDIX 14****CONTRACTOR'S SITE LABORATORY****1. SITE LABORATORY**

(1) The Site Laboratory shall be approximately 250 sqm in area. It shall consist of the following accommodation:

1 concrete laboratory	60 sqm floor area
1 Soil laboratory	30 sqm floor area
1 office	each 15 sqm floor area
1 store room	10 sqm floor area
1 kitchen	10 sqm floor area
Male toilets, changing room& shower	sufficient for 6 persons

(2) The remainder of the 250 sqm shall consist of storage area for concrete cube curing tanks. The laboratory, office etc. shall be in one building; the curing tank storage building may be in a separate building, but if so, it shall be adjacent to the laboratory building & connected to it by a level, weatherproof passageway. In addition, an area of covered hard standing of 50 sqm for motor vehicles shall be provided adjacent to the laboratory.

2. STANDARD OF CONSTRUCTION

- (1) The laboratory shall be constructed to the best Engineering practice and as approved by the Engineer. Two independent telephone lines with two extensions each shall be provided for the laboratory. Telephones shall be located in areas as agreed with the Engineer.
- (2) A water tank with minimum capacity of 2000 liters shall be installed. Constant water pressure of 15 KPa minimum shall be ensured in each laboratory.
- (3) In the case of sinks used for washing samples, adequate trapping and/or separating devices shall be provided to ensure the proper functioning of the facility.

3. FURNISHINGS AND FIXTURES

The contractor's site laboratory shall be provided with required furnishings and fixtures.

4. LABORATORY EQUIPMENT

- (1) The laboratory equipment, as listed below, shall be approved by the Engineer. The Contractor shall submit for the Engineer's approval within 2 weeks of the order to commence work the name of the supplier it intends to use for each piece of apparatus together with the relevant catalogue number.

- (2) The layout of the equipment in the testing laboratory shall be instructed by the Engineer. The equipment shall be maintained to accuracy appropriate to the required testing methods with routine calibration by an accredited organisation as recommended by the appropriate Authority. Equipment shall also be calibrated after maintenance or relocation.
- (3) The Contractor's site laboratory shall be equipped with the following material testing equipment as a minimum. The nature and quality of equipment required for pre-stressing may be varied by the Engineer depending on the detail of the Contractor's Design and Construction methods or for any other reason which he deems to be valid and necessary for the proper control of quality:

Determining Liquid Limit (1 complete set)

Liquid limit device (Casagrande type)	1 set
Grooving tools	1 No
Evaporating dish	1 No
Spatula 100mm blade	1 No
Laboratory balance, capacity 500 gm, (Sensitivity 0.01 gms.)	1 No
Wash bottle, capacity 500 ml.	1 No
Moisture cans capacity 50 ml.	24 No

Determining Plastic Limit (1 complete set)

Evaporating dish	1 No
Spatula 100mm blade	1 No
Glass plate 250mmx250mmx12mm	2 No
Moisture cans capacity 50 ml.	12No
Stainless steel rods, 3 mm dia.	2 No

Determining Moisture Content (1 complete set)

Micro Oven, capacity 35 liters, control temperature up to 200 °c	
1 No Balance capacity 200 gm., sensitivity 0.01 gm.	1 No
Lab. Tongs 1 no, Moisture cans 75ml. with lid	36 No

Compaction Characteristics (1 complete set)

Standard compaction mould 100mm dia.	1 No
Modified compaction mould 150mm dia	1 No

Standard compaction Rammer, 2.5 kg.	1 No
Modified compaction Rammer, 4.5kg.	1 No
Straight edge 300mm long	1 No
Sample ejector for 100mm and 150mm	1 No
mould Sample tray 60 x 60 x 8 cm	3 No
Wash bottle, 500 ml.	2 No
Moisture cans 250 ml	24 No

Density of soil in-place by sand core method (2 complete set)

Sand density cone apparatus 150ml	2 No
Plate, 300mm X 300mm	2 No
Chisel 25mmX 150mm	2 No
Hammer	2 No
One gallons field cans	24 No
Sampling spoons	2 No
Soft hair brush	2 No
Moisture cans 250ml	48 No

Sieve Analysis

Sieve shaker (portable) 100mm to 10mm #40, #50, #100, #200 each)	1 unit Coarse sieves in sizes from (1set Fine sieves #4, #8, #16, #30,
Pans & covers	

Specific gravity and absorption of coarse aggregate

Wire basket, 200mm dia Heavy duty suspension balance, 20kg X 1gm with accessory for weight in water	1set
Suitable water container	1 No.

Unit wt. of aggregate

Balance, 100Kg cap. With 10gm precision	1No
Tamping rod 16mm diaX600mm long	1No
Measuring containers (3, 10,15,30 ltrs)	1 each

Flakiness & Elongation

Flakiness gauge, Elongation Index	1 set
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Soundness Test

Sodium Sulphate	25Kg
Soaking Tank	1 nos
Balance, Cap. 3Kg, sensitivity 0.1gm	1set
Sieves: coarse, Fine	1set

Concrete

Bickets for concrete sampling	12Nos
Slump Cone	12Nos
Tamping rod	12 No
Base plate	12 No
Mixing pan for concrete	2 No
Scoop for general purpose	2 No
Concrete thermometer mm * 300mm;	2 NoConcrete cylinder mould, 150
100 mm* 300 mm	10each
Concrete cube mould, 100 mm cube & 150 mm cube dismantling cube moulds	10eachAdjustable spanners for 6 Nos
Capping set	2 No

Capping compound

Concrete curing tank with capacity for 270 cubes, temperature controlled, with circulation system drain and lockable cover 5 No.

Schmidt test hammer	1No.
Compression testing machine (simple hand operated)	1 No. Mould oil
Temperature chart recorder	1 No.

Miscellaneous

Vernier callipers to measure up to 200mm, with 300 mm long graduated	elongated jaws 2 Nos	5 NosSteel rule,
Rubber gloves	10 Pair	
Cotton working gloves	20 Pair	
First aid kit	1 set	
Wire brush	6 Nos	
Steel tape, 3m, 5m, 30m	3 each	
Ball peen hammer, 1 kg	2 Nos	
Paint scraper. Approx. 100mm wide	8 Nos	
Float, steel Approx. 280 x 120 mm	8 Nos	
Sack barrow	1 No	
Shovel: Square Mouthed	2 Nos	
Round Mouthed	2 Nos	

24 wheel trolley, heavy duty, approx. 0.7m X 1.0m long Pneumatic tyred type	1 no
Wheel barrow, rubber tyred and Comprehensive tool kit	1 no
claw hammer, multi-grips, spanners (adjustable)	1No Type NR Schmidt
Hammer and tester with recording device	1 no Testing Anvil for Schmidt Hammer test (SHT 1 No.
Chart recording paper for SHT	10 pkts Cover meter for detecting metal objects to depth of 100mm
below the surface of non-magnetic objects	3 No.
Noise meter	1 No.
RCPT Testing Machine	1 No.
Permeability Testing Machine	1 No.

EMPLOYER'S REQUIREMENTS

APPENDIX 15

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX-16

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX 17

DELETED

EMPLOYER'S REQUIREMENTS

APPENDIX 18

DELETED

SCHEDULES

SITE OF THE PROJECT

1 The Site

1. Site of the Railway Project shall include the land, buildings, structures and track works as described.
2. The dates of handing over Right of Way to the Contractor: It will be handed over progressively.
3. An inventory of the Site including the land, buildings, structures, track works, trees and any other immovable property on, or attached to, the Site shall be prepared jointly by the Authority's Representative and the Contractor, and such inventory shall form part of the Agreement.
4. The alignment plans of the BSRP Project are specified in Tender Drawings.
5. The status of the environment clearances and forest clearances obtained or awaited is given in Annexure.

Annexure- I

Site

1. Site

The Site of the BSRP Project comprises the section commencing from km -0.964 to km 24.425 i.e., the Benniganahalli - Chikkabanavara section in Bangalore in the State of Karnataka. The land and other structures comprising the Site are described below:

2. Route Length

The route length of Corridor-2 of BSRP Project comprises the section as described below (Dead end to dead end):

Sl. No	Name of location from	Name of location to	Start Chainage (km)	End Chainage (km)	Length (km)	Remarks
1	Benniganahalli	Chikkabanavara	-0.964	24.425	25.578 (25.389+0.189)	Including Viaduct and At-grade sections.
I	AT-Grade section	-	-	-	17.551	Details are in GAD
ii	Viaduct section	-	-	-	8.027	

3. ALIGNMENT AND LAND PLAN: The tentative land plan and alignment plan are attached.

4. Details of existing structures and Proposed structures (For BSRP line projects)

4.1 Major Bridges:

The Site includes the following Major Bridges:

Sl. No.	Existing	Proposed			No. of Spans with span length (m)
	Bridge No. and location (km)	Type of Structure			
		Foundation	Sub-structure	Superstructure	
1	Bridge No 560 @Ch: 9.992	Pile Foundation	RCC abutment	OPEN WEB GIRDER	4X30.5 (two spans for BSRP tracks and two spans for IR tracks)

4.2 Minor Bridges

The Site includes the following Minor Bridges:

Sl. No.	Existing		Proposed (Tentative)		Barrel Length (m)
	Chainage (km)	Bridge No.	Type of Structure	Size (m)	
1	0.220	534	RCC Box	3X1.8	27.629
2	0.947	535	RCC Box	4X2.65	25.699
3	1.667	536	RCC Box	4X2.65	14.176
4	1.822	537	RCC Box	2X2.65	14.956
5	3.640	538 (1)	RCC Box	2X5.45	12.359
6	3.816	538 (2)	RCC Box	2X2.65	14.025
7	4.275	540	RCC Box	2X2.65	6.87
8	4.722	541A	RCC Box	2nosx3x2.65	29.85 (Barrel length is inclusive of both cells)
9	4.722	541C	RCC Box	2nosx3x1.8	32.274 (Barrel length is inclusive of both cells)
10	4.802	542	RCC Box	2X2.65	16.126
11	4.974	543	RCC Box	2X2.65	27.154
12	5.102	544	RCC Box	2X1.8	25.243

SECTION-8A- PART-2 EMPLOYER'S/WORK REQUIREMENT & APPENDIXES(SCOPE OF WORK)

13	5.398	545	RCC Box	2X2.65	31.108
14	5.566	546	RCC Box	2X2.65	34.296
15	5.806	547	RCC Box	2X2.5	40.896
16	6.490	548	RCC Box	2X2.5	43.064
17	6.913	549	RCC Box	2X2.5	31.367
18	7.028	550	RCC Box	2X2.5	61.54
19	7.131	550A	RCC Box	5X3.53	62.01
20	7.192	551	RCC Box	2X2.91	59.778
21	7.408	552	RCC Box	2X2.65	53.858
22	8.238	553	RCC Box	2X2.5	48.44
23	8.378	554	RCC Box	2X1.8	54.588
24	8.607	555	RCC Box	2X2.5	56.9
25	8.750	556	RCC Box	2X2.5	49.474
26	9.200	557	RCC Box	2X2.5	30.593
27	9.466	558	RCC Box	2X2.5	35.684
28	9.900	559	RCC Box	2X1.80	51.888
29	10.059	561	RCC Box	2X1.8	38.893
30	10.150	562	RCC Box	2X2.5	45.381
31	10.244	563	RCC Box	2X2.5	39.466
32	10.564	564	RCC Box	2X2.5	20.825
33	10.750	565	RCC Box	2X2.65	20.845
34	10.965	566	RCC Box	2X2.65	21.225
35	11.078	567	RCC Box	2X2.65	21.229
36	11.145	568	RCC Box	2X2.65	21.528
37	11.202	569	RCC Box	2X1.8	32.453
38	11.370	570	RCC Box	2X2.5	28.485
39	11.470	571	RCC Box	2X2.5	35.817
40	18.631	412	RCC Box	2X2.65	18.425
41	18.722	411	RCC Box	2X2.65	15.907
42	19.108	410D	RCC Box	2X2.65	24.425
43	19.152	410C	RCC Box	2X1.8	38.383
44	19.175	410B	RCC Box	2X1.8	35.476

SECTION-8A- PART-2 EMPLOYER'S/WORK REQUIREMENT & APPENDIXES(SCOPE OF WORK)

45	19.561	410	RCC Box	3X2.65	26.858
46	19.640	409	RCC Box	2X2.65	22.071
47	20.959	407	RCC Box	4X2.65	13.19
48	21.772	406	RCC Box	5X5	13.525
49	21.800	406DN	RCC Box	3X2.65	15.401
50	22.613	405	RCC Box	8.1X7.20	12.212
51	23.640	404	RCC Box	8.4X5.35	17.28
52	24.006	403	RCC Box	2X2.65	27.625
53	24.523	402	RCC Box	4X4	30
Total Barrel length (m)					1628.77

4.3 Road Under Bridges (RUB) / Road Over Bridges (ROB)

The Site includes the following RUB (Road Under Railway line)/ ROB (Road Over Railway line):

Sl. No	Existing		Proposed			
	Chainage (km)	Bridge No.	Type of Structure	Span (Nos. × length)	RUB/ ROB	Barrel Length (m)
1	4.137	539	RCC Box	1 No X 6.1 mX3	RUB	13.925
2	4.709	541B	RCC Box	1 No X 7.5 mX5	RUB	7.867
3	18.430	412B	RCC Box	1 No X 6X5.5	RUB	15.00
4	22.917	-	RCC Box	2 Nos X 8.5mX5.0	RUB	28.00
5	23.725	-	RCC Box	1 No X 4mX4	RUB	15.701
6	2.610	LC No-137	RCC Box	1no (5.5x4.5) RCC Box/ New construction	RUB	18.045
7	6.313	LC No-140	RCC box	1no (9.5x3.6) RCC Box/ New construction	RUB	41.310
8	6.680	LC No-141	RCC box	1no (9.5x3.6) RCC Box/ New construction	RUB	41.310
9	6.944	LC No-142	RCC box	2no (9.5x5.5) RCC Box/ New construction	RUB	82.62 (Barrel length is inclusive of both cells)
10	7.547	LC No-143	RCC box	1no (9.5x4.5) RCC Box/ New construction	RUB	48.960
11	8.185	LC No-144	RCC box	1no (9.5x3.6) RCC Box/ New construction	RUB	41.310
12	8.780	LC No-144A	RCC box	1no (9.5x4.5) RCC Box/ New const.	RUB	62.730

13	7.075	Nagavara station	RCC box	1no (5.5x3.6) RCC Box/ New construction	RUB	40.00
14	8.675	Kanaka nagar	RCC box	1no (5.5x3.6) RCC Box/ New construction	RUB	40.00
15	20.590	407 A	RCC Pre-cast box	Pre-cast RCC box for accommodating one BSRP track below ROB of size (5.5m X 6.75m height), barrel length 35m	RUB	35.00
16	19.187	410A	Cable stay bridge/Suspension bridge	Re-construction (1noX60m)	ROB	
17	19.857	408B	Cable stay bridge/Suspension bridge	Re-construction (1no x 30m)	ROB	

4.4 Railway level crossings

The Site includes the following railway level crossings and to be eliminated by constructing the RUB's:

S. No.	Chainage (km)	LC No:	Remarks	Proposal
1	2.610	LC No-137	To be Eliminated	RUB
2	6.313	LC No-140	To be Eliminated	RUB
3	6.680	LC No-141	To be Eliminated	RUB
4	6.944	LC No-142	To be Eliminated	RUB
5	7.547	LC No-143	To be Eliminated	RUB
6	8.185	LC No-144	To be Eliminated	RUB
7	8.780	LC No-144A	To be Eliminated	RUB
8	22.917	LC No-6	To be Eliminated (in case the RUB is constructed by Railway/ K-RIDE, the total value for the same shall be deducted as per price schedule in variation conditions).	RUB

4.5 BSRP/Railway stations on Corridor-2.

The Site includes the following BSRP/Railway stations of corridor-2

Sl. No.	Station	Chainage (km)	Station Formation Area (Approx.)	Nos. of P.F. & Length	Remarks (Whether Jn. Station)
1	Benniganahalli	-0.560	40 X 205	2 X 205	Jn. For Corridor-2 & 4
2	Kasturi Nagar	1.101	25 X 205	2 X 205	

3	Seva Nagar	2.854	25 X 205	1 X 205	
4	Banasawadi	4.170	25 X 205	2 X 205	Jn. For BSRP & Railway
5	Kaveri Nagar	5.470	25 X 205		Future station. The earthwork and structures to be constructed up to formation level.
6	Nagavara	7.136	25 X 205	1 X 205	
7	Kanaka Nagar	8.612	25 X 205	1 X 205	
8	Hebbal (Elevated)	11.526	25 X 205	2 X 205	Jn. For BSRP & Railway
9	Lottegollahalli (Elevated)	14.650	25 X 205	2 X 205	Jn. For BSRP & Railway
10	Yeshwantpur (Elevated)	16.840	20 X 205	2 X 205	Jn. For BSRP corridor-(2 & 1) & Railway
11	Jalahalli	19.005	25 X 205	1 X 205	Future station. The earthwork and structures to be constructed up to formation level.
12	Shettyhalli	20.322	25 X 205	2 X 205	
13	Mydarahalli	23.219	25 X 205	1 X 205	
14	Chikkabanavara	24.306	25 X 205	2 X 205	Jn. For BSRP & Railway

4.6 BSRP/Railway yards

The Site includes the following BSRP/Railway yards:

K-RIDE

(C2/ BNH-BAW/AT-GRADE & ELEVATED)

Sl. No.	Name of Yard	Number of Lines	Remarks
1	Banaswadi		Railway
2	Yeshwantpur		Railway
3	Chikkabanavara		Railway
4	Benniganahalli	2 lines	BSRP Stabling Lines
5	Hebbal (Pocket)	1 line	BSRP Stabling Lines
6	Yeshwantpur	As per Drawing	BSRP Stabling Lines
7	Chikkabanavara	1 line	BSRP Stabling Lines

4.7

Transmission lines crossing the Right of Way

The Site includes the following transmission lines crossing the Right of Way:

Sl. No.	Section	IR Chainage	HT/LT	OH/UG	Height above IR RL/ Depth below RL (m)
1	Mydarahalli- Chikkabanavara	12/100 - 200	High tension line- 220KV	OH	10.652
2	Mydarahalli- Shettyhalli	11/200	High tension line-	OH	12.387
3	Jalahalli- Yeshwantpur	7/000 - 100	High tension line- 220KV	OH	15.184
4	Hebbal- Lottegollahalli	217/500 - 600	High tension line- 220KV	OH	15.270
5	Nagavara- kanakanagar	213/300 - 400	High tension line- 66KV	OH	9.224
6	Nagavara- Kaveri nagar	211/500 - 600	High tension line- 66KV	OH	8.300

4.8 GAIL (Gas Authority of India Limited) pipe line details (tentative) are in tender drawing.

4.9 GPR report (Ground Penetration Radar) is attached in tender drawing.

▪

Annexure – 2

Dates for providing Right of Way

The Right of way shall be handed over progressively.

The major portion of the required Railway land for the execution of works is available along the alignment. The remaining land or portion of land near to the Railway boundary shall be acquired and handed over to the contractor progressively.

Annexure – 3

Alignment Plans (GAD)

The proposed alignment plan of the BSRP Project Line is attached. This is based on survey conducted by the Authority. The Contractor may validate and modify the plan and profile of the alignment so as to get the best fit designed alignment within the Right of Way boundaries, with the approval of Engineer/Employer.

Annexure – 4

Environment Clearances - Not applicable

Tree cutting and Forest Clearances – In process

Annexure - 5**Time Schedule for Review of Drawings by the Authority:**

Sl. No.	Item	Preparation	GC/K-RIDE Review with time limit
1.	Alignment Design Report	Contractor	45 Days
2.	L-Section	Contractor	30 Days
3.	GAD of major and minor bridges.	Contractor	30 Days
4.	Structural drawings of major bridges	Contractor	30 Days
5.	Structural drawings of minor bridges	Contractor	30 Days
6.	GADs of ROB's/ RUBs	Contractor	30 Days
7.	Structural Drawings of ROB's/RUBs	Contractor	30 Days
8.	Drainage Plans	Contractor	15 Days
9.	Protection Work Design and Drawings	Contractor	15 Days
10.	Viaduct portion	Contractor	
	a) Test Pile drawing	Contractor	15 Days
	b) Segment drawing	Contractor	15 Days
	c) Working pile drawings	Contractor	15 Days
	d) Pile cap drawings	Contractor	30 Days
	e) Pier and pier cap drawings	Contractor	30 Days
	f) Bearing drawings	Contractor	30 Days
	g) Superstructure and parapet drawings	Contractor	30 Days
11.	Earthwork in Embankment and Cutting drawings, retaining wall, Drain etc.,	Contractor	15 Days
12.	Temporary structures design.	Contractor	30 Days

Annexure - 6

APPLICABLE PERMITS

1 Applicable Permits

1.1 The Contractor shall obtain, as required under Applicable Laws, the following Applicable Permits:

- (a) Permission of the State Government for extraction of boulders from quarry;
- (b) Permission of Village Panchayats and Pollution Control Board for installation of crushers;
- (c) Licence for use of explosives;
- (d) Permission of the State Government for drawing water from river/reservoir;
- (e) Licence from inspector of factories or other competent Authority for setting up batching plant;
- (f) Clearance of Pollution Control Board for setting up batching plant;
- (g) Clearance of Village Panchayats and Pollution Control Board for setting up asphalt plant;
- (h) Permission of Village Panchayats and State Government for borrow earth; and
- (i) Any other permits or clearances required under Applicable Laws.

Annexure – 7

PROVISIONAL CERTIFICATE

- 1 I/We, (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated (the "**Agreement**"), for construction of the section (km to km ...) in the State of in- BSRP (the "**BSRP Project**") on Engineering, Procurement and Construction (EPC) basis through (Name of Contractor), hereby certify that the Tests in accordance with the Agreement have been undertaken to determine compliance of the BSRP Project with the provisions of the Agreement.
- 2 Certain minor works are incomplete and these are not likely to cause material inconvenience to the Users of the BSRP Project or affect their safety or the movement of rail traffic in any manner. These works have been specified in the Punch List appended hereto, and the Contractor has agreed and accepted that it shall complete all such works in the time and manner set forth in the Agreement.
- 3 In view of the foregoing, I/We am/are satisfied that the BSRP Project from km to km can be safely and reliably placed in service of the Authority for railway freight and passenger traffic, subject to authorisation by the Commissioner of Railway Safety in accordance with Applicable Laws. In terms of the Agreement, the BSRP Project is hereby provisionally declared fit for entry into operation on this the day of 20.....

ACCEPTED, SIGNED, SEALED
AND DELIVERED
For and on behalf of
CONTRACTOR by:

(Signature)

SIGNED, SEALED AND
DELIVERED
For and on behalf of
AUTHORITY'S ENGINEER by:

(Signature)

Annexure - 8

COMPLETION CERTIFICATE

- 1 I/We, (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated (the "**Agreement**"), for construction of thesection (km to km) of in the State of in- BSRP (the "**BSRP Project**") on Engineering, Procurement and Construction (EPC) basis through (Name of Contractor), hereby certify that the Tests in accordance with the Agreement have been successfully undertaken to determine compliance of the BSRP Project with the provisions of the Agreement, and the authorisation by the Commissioner for Railway Safety under Applicable Laws has been obtained.

- 2 It is certified that, in terms of the aforesaid Agreement, all works forming part of Railway Project have been completed, and the BSRP Project is hereby declared fit for entry into operation on this the day of 20.....

SIGNED, SEALED AND DELIVERED

For and on behalf of the Authority's Engineer by:

(Signature)

(Name)

(Designation)

(Address)

SECTION-8B
TECHNICAL SPECIFICATIONS

Section-8B
TECHNICAL SPECIFICATIONS

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2	SECTION- 02	EARTHWORK : ACCORDING TO SPECIFICATION NO. RDSO/2020/GE: IRS-0004(SEPT 2020)	557-795
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SECTION - 01

GENERAL

1. GENERAL

1.1 General

- 1.1.1 These Specifications contained herein shall be read in conjunction with other tender documents.
- 1.1.2 The Work shall be carried out in accordance with the "Good for Construction" drawings and designs as would be submitted by the contractor and approved by the Engineer duly signed and stamped or issued to the Contractor by the Engineer duly signed and stamped by him as the case may be. The Contractor shall not take cognisance of any drawings, designs, specifications, etc. not bearing Engineer's signature and stamp. Similarly, the Contractor shall not take cognisance of instructions given by any other Authority except the instructions given by the Engineer in writing.
- 1.1.3 The work shall be executed and measured as per metric units given in the Schedule of Quantities, drawings etc. (FPS units where indicated are for guidance only).
- 1.1.4 Absence of terms such as providing, supplying, laying, installing, fixing etc. in the descriptions does not even remotely suggest that the Contractor is absolved of such providing, supplying etc. unless an explicit stipulation is made in this contract.
- 1.1.5 The specifications have been divided into different sections / sub-heads for convenience only. They do not restrict any cross-references. The Contractor shall take into account inter-relations between various parts of works/trades. No claim shall be entertained on the basis of compartmental interpretations.
- 1.1.6 The classification of various items of works for purposes of measurements and payments shall be as per Price Schedule. Except where distinguished by Price Schedule, the Lumpsum Price apply to all heights, depths, leads, lifts, sizes, shapes and locations. They also cater for all cuts and wastes. No height wise / floor wise separation. Likewise, all heights of centering, shuttering, staging, formwork and scaffolding, launching trusses and other launching methods are covered by the quoted Lumpsum Price including multi stage propping for heights greater than one lift / floor as per drawings.
- 1.1.7 Reference to the Standard Codes of Practice.
1. The contractor shall make available at site all relevant Codes of practice as applicable.
 2. Legend:

ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
BS	British Standard
CPWD	Central Public Works Department

DIN	Deutsches Institut für Normung e.V.
IRC	Indian Road Congress
IRS	Indian Railway Standards
IS	Indian Standards
JIS	Japanese Industrial Standard
MORTH	Ministry of Road Transport and Highways

1.1.8 Other Publications:

- American Petroleum Industry (API) Standard 1104
- Indian Standard Hand Book on steel sections Part-I
- Indian Railway Manual on Design and Construction of well and pile foundations
- UIC/772-R The International Union of Railways Publication
- CIRIA Report 80 A review of instruments for gas and dust monitoring underground
- CIRIA Report 81 Tunnel Water proofing
- CIRIA Report 44 model code of practice for work in compressed air
- CIRIA Report C660 Early age thermal crack control in concrete
- CIRIA Report 91 Early age thermal crack control in concrete
- Swedish standard 05 59 00
- PCI STD-112-84
- CRRRI and IOC, New Delhi Bituminous Road Construction Hand Book

Alternative or additional codes and standards proposed by the contractor shall be internationally recognised codes and shall be equivalent to or better than, Indian Standards issued by the Bureau of Indian Standards or any other Indian professional body or organisation, subject to being, in the opinion of the Employer's Representative, suitable for incorporation or reference into the specifications

1.1.9 Contractor to Provide

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, except for the items specified in the Price Schedule the cost being held to be included in the Contract Lumpsum Price:

1. General works such as setting out, site clearance before setting out and on completion of works. All weather approach roads to the site office should also be constructed and maintained in good condition.
2. All labour, materials, plant, equipment and temporary works, overhead charges as well as general liabilities, obligations, insurance and risks arising out of GCC, required completing and maintaining the works to the satisfaction of the Engineer.
3. Adequate lighting for night works, and also at other times whenever and wherever required by the Engineer.

4. Temporary fences, barricades, guards, lights and protective work necessary for protection of workmen, supervisors, engineers, General public and any other persons permitted access to the site. Contractor shall provide proper signages as directed.

All fences, barricade shall be painted with colour shades as specified by the Engineer. The barricading should be of adequate height to ensure visual obstruction of work from public view.

5. All equipment, instruments, labour and materials required by the Engineer for checking alignment, levels, slopes and evenness of surfaces measurements and quality etc.
6. Design mixes and testing them as per relevant clauses of specifications giving proportion of ingredients, sources of aggregates and binder along with accompanying trial mixes. Test results to be submitted to the Engineer for his approval before adoption on works.
7. Cost of Preparation and compliance with provision of a quality assurance control program.
8. Cost of safe guarding the environment as per SCC.
9. Contractor has to provide Method statements ie detailed work procedure for all the works
10. A testing laboratory as specified by the Engineer equipped with not limited to the following apparatus, materials and competent trained staff required for carrying out tests, as specified in the relevant sections of the specifications in adequate quantity.
11.
 - (i) 1 Set of standard sieves for testing grading of sand with mechanical sieve shaker.
 - (ii) Sieves with openings respectively of 4.75mm, 10mm, 20mm, 25mm, and 30mm for testing and grading of aggregates.
 - (iii) Digital Weighing Balance of capacity up to 10 Kg. reading up to 1 gm.
 - (iv) Electric controlled oven and pans for drying of sand and aggregates.
 - (v) Glass measuring flasks /2, 1 liter & 2 liter capacities.
 - (vi) Flask for determining moisture content of sand.
 - (vii) Slump cone with rod and V B Apparatus, flow table to measure slump or DIN Specifications (separate sets for laboratory and at Site).
 - (viii) Apparatus to measure permeability of concrete as per Appendix 1700/II of MORTH Specifications.
 - (ix) Sufficient Nos. steel moulds for 150mm x 150mm x 150mm concrete test cubes. It may be necessary to provide more steel cube moulds depending upon concreting programme.
 - (x) Sufficient number of 25mm dia vibrator for compaction of concrete in test cubes, vibrating table.
 - (xi) Digital Concrete cube testing machine of 200 tones Minimum capacity with direct print out facility.
 - (xii) Work benches, shelves, desks, sinks and any other furniture and lighting as required by the Engineer.
 - (xiii) Abrasion, Flakiness & Impact testing Equipment for testing coarse aggregates.

- (xiv) Silt Testing Equipment.
- (xv) Any other equipment specified by Engineer.
- (xvi) Permeability Testing Apparatus.

Note: All the above equipment and apparatus shall be calibrated at the time of setting up and at specified intervals by NABL accredited agency.

1.1.10 Quality Assurance & Quality Control

1. The work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing. The Contractor shall conform to the Quality standards prescribed, which shall form the backbone for the Quality Assurance and Quality Control system.
2. At the site, the Contractor shall arrange the materials, their stacking/storage in as per MORTH standards manner to ensure the quality. The Contractor shall provide all the necessary equipment and qualified manpower to test the quality of materials, assemblies etc., as directed by the Engineer. The tests shall be conducted at specified intervals and the results of tests properly documented. The cost of all such testing shall be included in the quoted Lumpsum Price and nothing extra shall be paid for in this regard. In addition, the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of the surfaces.
3. (a) The Engineer shall be free to carry out such tests as may be decided by him at his sole discretion, from time to time, in addition to those specified in this document as per provisions of General Conditions of Contract. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples, or for the collection of the samples. The test shall be conducted at the Site laboratory that may be established by the Contractor or at any other Standard Laboratory having NABL certification.

(b) The test shall be conducted at the Site laboratory that may (to) be established by the Contractor at his cost or at any other Standard Laboratory selected by the Engineer.

(c) The Contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of the Contractor failing to arrange transportation of the samples in proper time the Engineer shall have them transported and recover two times the actual cost from the Contractor's bills.

(d) All testing shall be performed in the presence of Engineer or his authorised representative. Testing may be witnessed by the Contractor or his authorised representative if permitted by the Test House. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.
4. The Engineer shall have the right at all times to inspect all operations including the sources of materials, procurement, its transportation, layout and storage of materials, all equipment

including the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and the Engineer's approval obtained prior to starting of the particular item of work. This shall however, not relieve the Contractor of his responsibilities.

5. All materials which do not conform to these specifications shall be rejected. In the event of contractor not being able to arrange the material conforming to these specifications or in the event of failure of the contractor to get the sources approved within the agreed schedule submitted by contractor, the Engineer shall have the powers to cause the Contractors to purchase and use such materials from any particular source, as may, in the Engineer's opinion, be necessary for the proper execution of work.

1.1.11 Dimensions

1. Figured dimensions on drawings shall only be followed and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.
2. The dimensions where stated do not allow for waste, laps, joints, etc. but the Contractor shall provide at his own cost sufficient labour and materials to cover such waste, laps, joints, etc.
3. The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

1.1.12 Setting out of Works

The Contractor shall set out the Works indicated in the Conditions of Contract. The Contractor shall provide suitable stones with flat tops and build the same in concrete for temporary bench marks. All the pegs for setting out the Works and fixing the levels required for the execution thereof shall, as desired by the Engineer, likewise be built in masonry at such places and in such a manner as the Engineer may direct. The Contractor shall carefully protect and preserve all bench marks and other marks used in setting out the works. The contractor will make and maintain overall layout of complete work and get it checked from engineer periodically. The cost of all operations of setting out including construction of bench marks is deemed to be included in the quoted Lumpsum Price as per Bill of Quantities.

- (a) All the survey work except leveling shall work shall be carried out using total stations with one second accuracy. The leveling work shall be carried out using Auto level.
- (b) The triangulation points given by Employer/Engineer before start of work shall be maintained during execution and handed over back to Employer / Engineer after completion of work.

1.1.13 Materials

1. Source of Materials

It shall be the responsibility of the contractor to procure all the materials required for construction and completion of the contract. The contractor shall indicate in writing the source of materials well in advance to the Engineer, after the award of the work and get it approved from the Engineer before commencing the work. If the material from any source is found to be unacceptable at any time, it shall be rejected by the Engineer.

2. Quality

All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid down in the specifications, with the requirements of the latest issues of the relevant Indian & other Standards.

3. Sampling and Testing

All materials used in the works shall be subjected to inspection and test in addition to test certificates. Samples of all materials proposed to be employed in the permanent works shall be submitted to the Engineer at least 45 days in advance for approval before they are brought to the site.

Samples provided to the Engineer for their retention are to be labeled in boxes suitable for storage. A sample room will be made at casting yard and maintained at no cost. Materials or workmanship not corresponding in character and quality with approved samples will be rejected by the Engineer.

Samples required for approval and testing must be supplied sufficiently in advance in required quantity and number to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected further samples may be required. Delay to the works arising from the late submission of samples will not be acceptable as a reason for delay in completion of the works.

Materials shall be tested before leaving the manufacturer's premises, quarry or source. Materials shall also be tested at site and they may be rejected if not found suitable or in accordance with the specifications, notwithstanding the results of the tests at the manufacturer's works or elsewhere or test certificates or any approval given earlier.

The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer subject to the provisions of No extra payment shall be made on this account.

4. Dispatch of materials

Materials shall not be dispatched from the manufacturer's works to the site without written authority from the Engineer.

5. Test certificates

All manufacturer's certificates of test, proof sheets, etc showing that the materials have been tested in accordance with the requirement of these specifications and of the appropriate Indian Standards are to be supplied free of charge to the Engineer.

6. Rejection

Any materials that have not been found to conform to the specifications or otherwise not acceptable to the Engineer will be rejected forthwith and shall be removed from the site by the Contractor at his own cost within three days or as instructed by the Engineer.

1.1.14 Storing of Materials at site

All materials used in the works shall be stored on racks, supports, in bins, silos, go-downs, under cover etc. as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer.

The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage of construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials".

The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place, where material is stored by the Contractor, be required by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer within the time as communicated by the Engineer and at no extra cost to the Employer.

1.1.15 Water

1. Water from approved source:

Potable water only shall be used for the works. Contractor shall have his own source of water duly tested and approved by Engineer. The water shall be free from any deleterious matter in solution or in suspension and be obtained from an approved source. The quality of water shall conform to IS 456.

2. Storage:

The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to see that water is not contaminated in any way.

3. Testing:

Before starting any concreting work and wherever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the Engineer. No water shall be used until tested and found satisfactory. Cost of all such Tests shall be borne by the contractor.

1.1.16 Workmanship

1. All works shall be true to level, plumb and square and the corners, edges and rises in all cases shall be unbroken and neat.
2. Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified, or removed and replaced with work of the required standard of workmanship at no extra cost.

1.1.17 Load Testing On Completed Structures

- 1.1.17.1 During the period of construction or within the defect liability period the Engineer may at his discretion order the load testing of any completed structure or any part thereof if he has reasonable doubts about the adequacy of the strength of such structure for any of the following reasons or otherwise:
- (i) Results of compressive strength on concrete test cubes falling below the specified strength.
 - (ii) Premature removal of formwork.
 - (iii) Inadequate curing of concrete.
 - (iv) Over loading during the construction of the structure or part thereof.
 - (v) Carrying out concreting of any portion without prior approval of the Engineer.
 - (vi) Honey combed or damaged concrete which in the opinion of the Engineer is particularly weak and will affect the stability of the structure to carry the design load, more so in important or critical areas of the structure.
 - (vii) Any other circumstances attributable to alleged negligence of the contractor which in the opinion of the Engineer may result in the structure or any part thereof being of less than the expected strength.
- 1.1.17.2 All the loading tests shall be carried out by the contractor strictly in accordance with the instructions of the Engineer, as per IRS:CB;1997 clause 18, IRC:SP-51 IS: 456, and as

indicated in the Price Schedule and as indicated hereunder. Such tests shall be carried out only after expiry of minimum 28 days or such longer period as directed by the Engineer.

1.1.17.3 In such cases the portion of the work concerned shall be taken down or cut out and reconstructed to comply with the specifications. Other remedial measures may be taken to make the structure secure at the discretion of the Engineer. However, such remedial measures shall be carried out to the complete satisfaction of the Engineer.

1.1.17.4 All costs involved in carrying out the test ordered on the grounds as mentioned in, (except load and integrity test for piles) and other incidental expense thereto shall be borne by the contractor regardless of the result of the test. In case of failure of the test the contractor shall take down or cut out and reconstruct the defective work or shall take the remedial measures, as instructed, at his own cost.

If the load testing is instructed on any ground other than mentioned in then the cost of the same shall be reimbursed if the test results are found to be satisfactory.

1.1.17.5 In addition to the above load tests, non-destructive tests on various elements such as core test and ultrasonic pulse velocity test shall be carried out by the contractor at his own expense if so desired by the Engineer. Such tests shall be carried out by an agency approved by the Engineer and shall be done using only recommended testing equipment. The acceptance criteria for these tests shall be as specified by the testing agency or good engineering practice and as approved by the Engineer.

1.2 STRUCTURAL WORK

- (a) Unless otherwise specified, only controlled concrete with design mix and weigh batching is to be used for the work.
- (b) Minimum cement content specified in CPWD specification 1996 / 2002 is purely from durability point of view. Larger content of cement shall have to be provided if demanded by mix design.
- (c) Provision of cement slurry to create bond between plain / reinforced concrete surface and subsequent applied finishes shall not be paid extra.
- (d) Mix design using smaller aggregates of 10mm down shall also be done in advance for the use in the junction having congested reinforcement.
- (e) Procedure of mixing the admixtures shall be strictly as per the manufacturer's recommendations or as directed by the Engineer.
- (f) All the water tanks and other liquid retaining concrete structures shall undergo hydro-testing.
- (g) Special benches shall be provided at site for stacking reinforcement bars of different sizes.

- (h) Formwork for beams of RCC works shall be designed in such a way that the formwork of the adjacent slabs can be removed without disturbing the props / supports of the beams.
- (i) Wherever there are tension or suspended concrete members which are suspended from upper level structural members, the shuttering / scaffolding of such members at lower level shall have to be kept in place till the time the upper level supporting members gain minimum required strength. Cost of such larger duration of keeping in place the shuttering / scaffolding shall be deemed to be included in the price quoted for respective structural members.
- (j) Formwork shall be provided for full height at all locations. Special precautions for such tall formwork shall be taken to ensure its safety. Extra costs for providing such formwork shall be deemed to have been included in the prices quoted in Lumpsum price schedule.
- (k) In the mobilization period the contractor shall carry out expeditiously and without delay the following works
 - i. Material testing and mix designs of concrete as contemplated in the specifications.
 - ii. Setting up of fully fledged site laboratory as per the requirements of these specifications.
 - iii. Any other pre-requisite items required for final execution.
 - iv. Site office for the use of the Engineer staff
 - v. Casting yard with complete facilities
 - vi. Identify and get approved the source of various major construction materials.
 - vii. Setting up concrete batching and mixing plant.
 - viii. Construction of site office set up.
 - ix. Construction of labour houses etc.
- (l) Casting yard shall have following minimum facilities:
 - i. Casting beds as required.
 - ii. All handling facilities for precast elements like over gantry, etc.
 - iii. Curing arrangements as required.
 - iv. Stacking arrangements for material and precast elements.
 - v. Storing arrangement of materials.
 - vi. Proper drainage and all weather approach roads.
 - vii. All handling elements of pre cast elements.

1.2.1 Supply of Monthly Progress Photographs and Album

- a) The work covers the supply of digital color photographs (Hard copy duly annotated) along with soft copy in an album to serve as a permanent record of various stages/facets of work needed for an authentic documentation as approved by the Engineer.
- b) The photographs shall be of acceptable quality and they shall be taken by a professionally competent photographer with camera having the facility to record the date of the photographs taken in the prints and negative. The Digital camera, type and quality of photo paper shall be of

standard make approved by the Engineer. Each photograph in the album shall be suitably captioned and dated.

- c) The photographs and materials including soft copy shall form a part of the records of concerned organization and prints of the same cannot be supplied to anybody else or published without the written permission.

1.2.2 Supply of Monthly Progress Video CD's

The work consists of taking video films of important activities of the works as directed by the Engineer during the currency of the Project and editing them to a video film of playing time not less than 60 minutes. It shall contain narration of the activities in English by a competent narrator. The edition of the film and script of the narration shall be approved by the Engineer

1.2.3 Survey Work

The said work involves at the very start of work taking-over of reference point from the Engineer, establishment of control points by using DGPS double frequency and the accuracy of 1 in 50,000, triangulation points, bench marks, grid layout for all the piers and other structures maintaining horizontal and vertical control within the permissible limits, incorporating changes (if any), submission of full data in the tabulation form and survey drawings. The survey shall be including setting and layout of various works during the progress of work and matching of the station area track alignment with the alignment of the approaches at station ends and incorporating the changes (if any).

1.2.4 Barricading

The work covers barricading for the work done along the Existing IR track, median and areas affecting road or rail traffic. Barricading for other areas like casting yard, batching plant, storage and other working area shall be done at own cost by the contractor. The detailed scope of work is:

- (i) Providing and installing the barricade of the design and type as shown in the typical sketch furnished as per the approved plan firmly to the ground and maintaining it during the progress of work.
- (ii) Providing adequate road and IR track safety devices. A tentative list given hereunder identifies minimum items, which may be required. However, actual numbers required shall be as per plan approved by the Engineer and clearance obtained from traffic department, Bangalore and concerned division of Railway officials. During execution of works, if any additional cost to this list is required then the contractor shall not be paid any extra cost.
- (iii) Dismantling of barricade, other temporary installation from the site and cleaning the site shall be as per direction of Engineer upon completion and acceptance of work.

Tentative Road or IR track Safety Devices are mentioned below or any other safety devices as per site requirement

1. Supply of Red portable traffic cones of 750mm height with white reflective tape bands on 100mm width all around.
2. Hazard warning light flashes with rechargeable. Maintenance free battery & charging system.
3. Safety light island post with 11 nos. parallel reflective.
4. Red reflective arrow fitted on enabled mild steel board of 360 x 220mm size.
5. Traffic Triangular Tripod made of fluorescent cloth fitted on steel frame.
6. Retro-reflective tape (I) 50mm width.
7. Fluorescent Jackets with reflective tape all around.
8. Yellow reflective cat eyes of size 115 x 11 x 22 mm made of ABS material having 19 glass beads on each side.
9. Metal Tabular Delineator of 610mm height with reflective tapes.
10. Retro-reflective arrows diversion board 450 x 900mm with crystal clear protective transparent coat to avoid damage on 14-gauge Mild Steel sheet with and without pole.
11. Retro-reflective "Men at Work" triangular board of size 900mm with crystal protective transparent coat to avoid damage on 14-gauge Mild Steel board with and without poles.
12. Retro-reflective board for "Go Slow Work in Progress" of size 1200 x 750mm with crystal clear protective transparent coat to avoid damage to the Mild Steel board with and without pole.
13. Retro-reflective advance direction signs cum Diversion Boards of size 1200 x 900mm with crystal clear protective transparent coat to avoid damage to the 14 gauge Mild Steel sheet with and without pole.
14. Retro-reflective speed limit circular sign Boards of 600mm Diameter with crystal clear protective transparent coat to avoid damage on 14 gauge sheet (without pole).
15. 'SORRY FOR INCONVENIENCE' Retro-reflective Boards of size 900 x 300mm size with crystal clear protective transparent coat to avoid damage on 14 gauge Mild Steel sheet (without pole).
16. HAZARD MARKERS (Yellow & Black) must be put all over the construction sites. This Retro-reflective board is of size 300 x 900mm with crystal clear protective coat to avoid damage and the 14 gauge Mild Steel with or without pole.
17. 'CAUTION' tape which is normally yellow tape of special Polyether Material having 75mm width 'CAUTION' is written all over with Black colour is rolls of 300 meter.
18. For running trains ,Retro-reflective speed limit as per IR Specifications.

1.2.4.1 Measurement

The barricading including all the required safety devices as listed under the above table shall be measured as per relevant item in Price Schedule. (Payment of the item shall be made on monthly basis over contract period including extended period, if any. The availability of maximum road width is essential requirement for smooth flow of traffic on road. Therefore contractor may be required to shift barricading from original location to alternate location to permit smooth & free flow of road traffic. It shall be incumbent on contractor to minimize the suburban rail corridor (barricading space) at any point of time to facilitate free movement of road traffic. For such alternation of barricading work no separate payment shall be admissible to contractor. Payment

shall be deducted for the period during which the barricading and arrangements for traffic diversion are not satisfactory to the Engineer. The payment and deduction (if any) for the item shall be on pro-rata basis).

1.2.5 **Transplantation of Trees**

The item shall be carried out as per the approved plan by the Engineer after the identification of the trees to be transplanted. The actual number of trees shall be finalized after the necessary clearances by the concerned departments. The item is complete and including all expenditures for carrying out all operations i.e. excavation, watering, feeding of chemicals, back filling, lifting of trees by crane and transporting to the designated site where it is to be transplanted and all necessary care to be taken for the specified initial period till the tree gets settled at new site and up to the full satisfaction of the Engineer.

1.2.5.1 **Measurement**

The item shall be measured in numbers according to size of the tree as specified in the item and the full payment shall be released only when the item is executed fully as per the Scope of Work detailed out in the approved plan for transplantation of trees.

The rate shall include all required operations during the transplantation and specified duration afterwards, clearances from the concerned authorities.

Sub-Contractor

Works as listed below and those dealing with proprietary materials/ products may be carried out by the Contractor through the Sub-Contractors as may be approved by the Engineer in writing. The Sub-Contractors must be firms of repute and long standing, having adequate experience and complete facilities to carry out all items of work required for completion as per Specifications and expected quality to the satisfaction of the Engineer. The Sub-Contractor must also have personnel experienced in preparing shop drawings. All such works shall be carried out under the direct supervision of the manufacturers of the proprietary materials/ products or their trained and accredited licensee.

- i. Waterproofing
- ii. Caulking & Sealants
- iii. Seismic Joints
- iv. Expansion joints
- v. Application of Silicone water repellent solution where specified.
- vi. Bearings
- vii. Painting and polishing works.

1.3 Guarantees and Maintenance:

- (i) The Contractor shall guarantee and undertake to maintain and rectify the various components of the Civil Works for their successful performance for the periods as specified in other documents. The Contractor shall indemnify the Engineer for a similar period against any damage to property and injury to persons on account of any defective work or maintenance carried out by the Contractor. The format and text of the Guarantee and the Indemnity Bond shall be as followed in CPWD or as approved by the Engineer.
- (ii) Waterproofing for basements (which include raft, retaining walls, and expansion/separation joints in retaining walls) and roofs shall be guaranteed for 10 years. The waterproofing shall include all allied works on the roof such as concrete screed and the China Mosaic roof finish/ stone cladding on the parapet between which the waterproofing treatment shall be sandwiched.
- (iii) Waterproofing for the other areas such as toilets, kitchens, chhajjas etc. shall be guaranteed for 10 years. The waterproofing shall include all allied works on the slab etc. such as concrete/ mortar screeding, if any, floor finish between which the waterproofing treatment shall be sandwiched

1.3.1 Responsibility for Shop drawings, Samples and Mock-ups:

Approval of shop drawings, samples and mock-ups for the various components shall not absolve the Contractor of his responsibility of completing the work to the specifications, standards, tests for performance and guarantees given in these documents and to a quality of finish as desired by the Engineer.

1.3.2 Cleaning

Surfaces on which finishes are to be provided shall be cleaned with water jets or oil free compressed air or power tools with wire brushes and detergents all as approved by the Engineer.

1.3.3 Expansion bolts/ fasteners:

- (a) Unless specified otherwise all expansion bolts/ fasteners shall be fabricated from austenitic stainless steel sheet, strip or plate conforming to ASTM A 240 Gr 304 or bar to ASTM A 479 Gr 304 of approved make and design. The material of the bolt shall not cause any bimetallic corrosion with the reinforcing bars of the RCC/ brickwork or with any other fixings or doors or windows or skylights etc.
- (b) For steel backings the fasteners shall be prevented from contact with other metals, which would lead to bimetallic corrosion.
- (c) For brick masonry backing the sleeves of the expansion bolts shall be fixed in wedge shaped pockets having an area of 75mm x 75mm at the surface and 100mm x 100mm at the inner surface and shall be 125mm deep. The wedge could also be as a truncated cone of 75mm dia/ 100mm dia. The dimensions shall be reviewed by the Engineer during execution of the work. The

wedge shall be filled with PCC 1:1:2 (1 Cement, 1 Sand and 2 Coarse Aggregate) mixed with non-Shrink Compound in the proportion as recommended by the manufacturer.

- (d) The holes drilled for the expansion fasteners shall be cleaned of all ground material, dust, etc. before inserting the expansion sleeves.
- (e) All expansion bolts fixed into soffits shall be bonded to the backing with epoxy/ polyester resin of approved make.
- (f) All expansion bolt fixings shall be tightened in accordance with the recommended torque figures by the manufacturer. Where such values are not available the Contractor shall test at least 6 samples to determine the safe torque values. All bolts shall be tightened using torque spanner/ wrenches. All bolts shall be checked 24 hours (minimum) after installation and retightened if necessary.
- (g) No walls, terraces shall be cut for making any opening after water proofing has been done without written approval of the Engineer. Cutting of waterproofing when authorised by the Engineer in writing shall be done very carefully so that no other portion of the waterproofing is damaged. On completion of the work at such places, the water proofing membrane shall be made good and ensured that the opening / cutting is made fully water proof as per specifications and details of water proofing approved by the Engineer at no extra cost. No structural member shall be cut or chased without the written permission of the Engineer.

Provision of grooves in plaster, drip courses etc, if directed, at junction of walls-ceilings, columnswalls, frames-plaster and such other generally typical locations shall not be paid extra, including grooves in concrete, masonry, stonework.

1.4 Applicable Codes, Standards & Publications for Structural work

The important Codes, Standards and Publications to Contract are listed here under:

A	General
IS:875 (Part 3)	Code of practice for design loads (other than earthquake) for buildings and structures
IS:1322	Bitumen felts for water proofing and damp-proofing
IS:1893	Criteria for earthquake resistant design of structures
IS:2572	Code of Practice for construction of hollow concrete block masonry
IS:3414	Code of practice for design and installation of joints in buildings
IS:6408 (Parts 1,2)	Recommendations For Modular Co-Ordination In Building Industry - Tolerances
IS:10958	General check list of functions of joints in building
IS:11817	Classification of joints in buildings for accommodation of dimensional deviations during construction

IS:11818	Method of test for laboratory determination of air permeability of joints in buildings
IS:12440	Precast concrete stone masonry blocks
CPWD	Specifications 2009.
BS:476 (Part 7)	Method for classification of the surface spread of flame of products
BS:476 (Part 20)	Method of determination of the fire resistance of elements of construction (general principles)
BS:476 (Part 22)	Methods for determination of the fire resistance of non-load bearing elements of construction
BS:5215	Specification for one-part gun grade polysulphide-based sealants
BS:5606	Guide to accuracy in building
BS:6093	Code of practice for the design of joints and jointing in building construction
BS:8200	Code of practice for the design of non-load bearing external vertical enclosure of building
ASTM C 332	Specification for light weight aggregate for insulating concrete
SP 7	National Building Code of India
SP 23 (S&T)	Hand Book on Concrete Mixes
B	Bitumen
IS:702	Industrial Bitumen
IS:3384	Specification for bitumen primer for use in waterproofing and damp-proofing
C	Building Construction Practices
IS:1838 Parts I and II.	Specifications for preformed fillers for expansion joint in concrete pavements and structures.
IS:1946	Code of Practice for use of fixing devices in walls, ceilings, and floors of solid construction.
IS:6509	Code of Practice for installation of joints in concrete pavements.
IS:11134	Code of Practice for setting out of buildings.
IS:11433	Parts I and II. Specifications for one part Gun grade polysulphide based joint sealant.
IS:12200	Code of Practice for provision of water stops at transverse contraction joints in masonry and concrete dams
D	Cement
IS:269	33 grade ordinary Portland cement
IS:455	Portland Slag Cement
IS:650	Specification for standard sand for testing cement.
IS:1489 (Part 1)	Portland pozzolana cement: Flyash based
IS:1489 (Part 2)	Portland pozzolana cement: Calcined clay based
IS:3535	Method of Sampling Hydraulic Cements
IS:4031	(Parts 1 to 15) Methods of physical tests for hydraulic cement.
IS:4032	Method of chemical analysis of hydraulic cement.
IS:6925	Methods of test for determination of water soluble chlorides in concrete admixtures.
IS:8042	White Portland Cement
IS:8112	Specification for 43 grade ordinary Portland cement.

IS:12269	Specification for 53 grade ordinary Portland cement.
IS:12330	Specification for sulphate resistant Portland cement.
E	Concrete
IS:456	Code of practice for plain and reinforced concrete.
IS:457	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS:460 (Parts I to III)	Specification for Test Sieves
IS:516	Methods of test for strength of concrete.
IS:1199	Methods of sampling & analysis of concrete.
IS:1200	Method of measurement of building and civil engineering works (Parts 1 to 15)
IS:1343	Code of practice for prestressed concrete
IS:1607	Method of Test Sieving
IS:2386	Parts I-VIII. Methods of tests for aggregates for concrete.
IS:2430	Methods of Sampling of Aggregates of Concrete
IS:2438	Specification for roller pan mixer
IS:2514	Specification for concrete vibrating tables
IS:2571	Code of practice for laying in-situ cement concrete flooring
IS:2645	Specifications for integral water proofing compounds for cement mortar and concrete
IS:2722	Specifications for portable swing weigh batchers for concrete (single and double bucket type)
IS:2770	Methods of testing bond in reinforced concrete part I pull out test
IS:3025	Methods of sampling and tests (physical and chemical) for water & waste water (Parts 1 to 14)
IS:3370	Code of practice for concrete structures for storage of liquids
IS:3935.	Code of practice for composite construction
IS:4326	Code of practice for earthquake resistant construction of building
IS:6925.	Methods of test for determination of water soluble chlorides in concrete Admixtures
IS:7242	Specifications for concrete spreaders
IS:7251	Specifications for concrete finishers
IS:7861	Parts I & II. Code of practice for extreme weather concreting.
IS:7969	Safety code for handling and storage of building materials
IS:8989	Safety code for erection of concrete framed structures
IS:8142	Methods of test for determining setting time of concrete by penetration resistance
IS:9103	Specifications for admixtures for concrete
IS:9013	Method of making, curing and determining compressive strengths of accelerated cured concrete test specimens
IS:9284	Method of test for abrasion resistance of concrete
IS:10262	Recommended guidelines for concrete mix design.
MORTH	Specifications for Road and Bridge Works, Ministry of Road Transport and Highways (Roads Wing)

IRS	Concrete Bridge Codes
IRC -112-2011	Concrete Bridge Codes
ASTM - C - 94 IS 4926:2003	Ready Mix Concrete Ready Mixed Concrete – Code of Practice
ASTM – C - 1240	Specifications for Silica Fume for use in Hydraulic Cement and Mortar
F	Construction Plant and Machinery.
IS:1791	Specification for batch type concrete mixers.
IS:2505	General requirements for concrete vibrators: Immersion type.
IS:2506	General requirements for screed board concrete vibrators.
IS:3558	Code of Practice for use of immersion vibrators for consolidating concrete.
IS:4925	Specification for concrete batching and mixing plant.
IS:11993	Code of Practice for use of screed board concrete vibrators.
IS-3366	Specifictaion for Pan vibrations
IS-4656	Specifictaion for form vibrations
G	Formwork
IS:4990	Specifications for plywood for concrete shuttering work.
IRC:87	Guidelines for the design and erection of false work for road bridges.
IS:806	Code of practice for use of steel tubes in general building construction.
IS:1161	Specification of steel tubes for structural purposes.
IS:1239	Specification for mild steel tubes. Tubulars and other wrought steel fittings.
H	Gypsum and Gypsum Board
IS:2095	Gypsum plaster boards
IS:2542 (Part 1/Sec 1 to 12)	Methods of test for gypsum plaster, concrete and products: plaster and concrete
IS:2542 (Part 2/Sec 1 to 8)	Methods of test for gypsum plaster, concrete and products: Gypsum products
IS:2547 (Part 1)	Gypsum building plaster: Excluding premixed lightweight plaster
IS:2547 (Part 2)	Gypsum building plaster: Premixed lightweight plaster
I	Handling and Storage
IS:4082	Recommendation of Stacking and Storage of construction materials
IS:8348	Code of practice for stacking and packing of stone slabs for transportation
J	Instruments For Testing Cement and Concrete
IS:5513	Specification for vicat apparatus.
IS:5514	Specification for apparatus used in Le-Chaterlier test.
IS:5515	Specification for compaction factor apparatus.
IS:7320	Specification for concrete slump test apparatus.
IS:7325	Specification for apparatus to determine constituents of fresh concrete.
IS:10080	Specification for vibration machine.
IS:10086	Specification for moulds for use in tests of cement and concrete.
IS:10510	Specification for vee-bee consistometer.
K	Joint Fillers

IS:1838 (Part 1)	Preformed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type): Bitumen impregnated fiber
L	Paints and Coatings
IS:109	Ready mixed paint, brushing, priming, plaster, to Indian Standard Colour No. 361 and 631 white and off white.
IS:347	Varnish, shellac, for general purpose.
IS:2074	Ready mixed paint, air drying, red oxide-zinc chrome, priming
BS:6496	Specification for powder organic coatings for application and stoving to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and preformed sections coated with powder organic coatings
BS:EN:10152	Specification for electrolytically zinc coated cold rolled steel flat products. Technical delivery conditions
ASTM A 164-71	Specification for electrodeposited coatings of zinc on steel
IS 102	Ready mix paint, brushing red lead non sealing
M	Pigment for Cement
BS:1014	Specification for pigments for Portland cement and Portland cement products
N	Re-inforcement & Structural Steel
IS:280	Mild steel wire for general engineering purposes
IS:432	Part I. Mild steel and medium tensile steel bars. Part II Hard drawn steel wire.
IS:815	Parts I & II. Electrodes for metal arc welding of structural steel.
IS:816	Code of Practice for use of metal arc welding for general construction in mild steel.
IS:1566	(Part I) Specifications for hard-drawn steel wire fabric for concrete reinforcement.
IS:1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS:2502	Code of Practice for bending and fixing of bars for concrete reinforcement.
IS:2629	Recommended practice for hot-dip galvanising of iron and steel.
IS:2751	Code of Practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS:4759	Hot-dip zinc coating on structural steel and other allied products.
IS:5525	Recommendations for detailing of reinforcement in reinforced concrete works
IS:9417	Recommendations for welding cold-worked steel bars for reinforced concrete construction.
IS:14268	Uncoated stress relieved low relaxation steel class 2 for Pre-stressed concrete
IS:226	Structural steel (Standard Quality)
IS:800	Code of practice for use of structural steel in general building construction.
IS:813	Scheme of symbols for welding.

IS:814	Covered electrodes for metal arc welding of structural steel. (Part I & Part II)
IS:816	Code of practice for use of metal arc welding for general construction in mild steel.
IS:822	Code of practice for inspection of welds.
IS:1024	Code of practice for use of welding in bridges and structures subject to dynamic loading.
IS:1161	Steel tubes for structural purposes.
IS:1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
IS:2062	Structural steel
IS:3757	Specification for high strength structural bolts.
IS:5624	Specification for foundation bolts.
IS:3600	Code of practice for testing of fusion welded (Part I) joints and weld metal in steel.
IS:4923	Hollow steel sections for structural use.
IS:801	Code of practice for use of cold formed light gauge steel structural members in general building construction.
IS:811	Specifications for cold formed light gauge structural steel sections.
IS:8910	General requirements steel products
IS:9595	Recommendations for metal arc welding of carbon & Carbon-Manganese steels
IS:7205	Safety Code for erection of Structural Steel Works
O	Aggregates
IS:383	Coarse and fine aggregates from natural sources for concrete.
P	Scaffolding
IS:2750	Specification for steel scaffoldings
IS:3696 (Part 1)	Safety Code of scaffolds and ladders: Scaffolds
IS:3696 (Part 2)	Safety Code of scaffolds and ladders: Ladders
IS:4014 (Part 1)	Code of practice for steel tubular scaffolding: Definition and materials
IS:4014 (Part 2)	Code of practice for steel tubular scaffolding: Safety regulations for scaffolding
IRC:87	Guidelines for the design and erection of falsework for road bridges
Q	Sealants
IS:10959	Glossary of terms for sealants for building purposes
IS:11433 (Part 1)	One part gun- grade polysulphide based joints sealants: General requirements
IS:11433 (Part 2)	One part gun- grade polysulphide based joint sealants: Methods of test
IS:13055	Methods of sampling and test for anaerobic adhesives and sealants
BS:5889	Specification for one part gun grade silicone-based sealants.
R	Wood

IS:303	Plywood for General Purposes
IS:848	Synthetic resin adhesives for plywood (phenolic and aminoplastic)
IS:1141	Seasoning of Timber - Code of Practice
IS:1328	Veneered decorative plywood
IS:1659	Block Boards
IS:2046	Decorative thermosetting synthetic resin bonded laminated sheets
IS:2202 (Part 1)	Wooden flush door shutters (solid core type): Plywood face panels
IS:2202 (Part 2)	Wooden flush door shutters (solid core (type): Particle face panels and hardboard face panels
S IRC:83Part-II IRC:83 Part-III	Bearings Standard specifications and code of practice for road bridges Elastomeric Bearings Standard specifications and code of practice for road bridges Pot Bearings Standard specifications and code of practice Spherical Bearings for road bridges
T IS 4985	UPVC Pipe for Drainage Unplasticized PVC Pipes for portable water supplies
U IS :2911 PART-I IRC:78	PILING Bored Cast in-situ Concrete Piles Standard specifications and code of practice for road bridges Foundation And Substructure
IS : 3764	Code of safety for excavation work
	RDSO guidelines and Bridge manual
V	All Indian Railway Standards
W	MORT&H Specifications for Road and Bridge works (latest Revision)
X	CPWD Specifications (latest Revision)

SECTION – 02

**EARTHWORK : ACCORDING TO SPECIFICATION
NO.RDSO/2020/GE: IRS-0004 (SEPT 2020)**

SECTION-02

2. EARTHWORK: According to Specification No .RDSO/2020/GE: IRS-0004 (Sept 2020)

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Terminology

Commonly used terms in context of the subject and in this document, with their specific meanings are mentioned as under:

1.0 Formation:

In a general way, collectively refers to the layers comprising blanket, prepared subgrade/Subgrade.

2.0 Formation Top:

Boundary (interface) between ballast and top of blanket or prepared subgrade/Subgrade (where blanket layer is not provided).

3.0 Track Foundation:

Constitutes ballast, blanket, Prepared subgrade/Subgrade, which is placed / exist below track structure to transmit load to subsoil.

4.0 Cess:

Portion at top of formation level, extending from toe of ballast to edge of formation.

5.0 Ballast:

Crushed stones with desired specifications placed directly below the sleepers.

6.0 Blanket:

Blanket is a layer of coarse, granular material of designed thickness & specification provided over full width of formation between subgrade and ballast.

7.0 Prepared Subgrade:

In case of two layer systems, it is provided over the subgrade and below the blanket layer with a view to economise the thickness of blanket layer.

8.0 Sub-grade:

It is the upper part of Railway Embankment constructed by borrowed soil of suitable quality upto bottom of blanket/prepared subgrade. It is divided into top layer and lower layer (fill).

9.0 Subsoil:

The existing soil below natural ground level.

10.0 Cohesive Subgrade:

Subgrade constructed with soils having cohesive behavior, shear strength is predominantly derived from cohesion of the soil is termed as cohesive subgrade. Normally, soils having particles finer than 75 micron exceeding 12% exhibit cohesive behaviour.

11.0 Cohesionless Subgrade:

Subgrade constructed with cohesion-less, coarse-grained soils i.e., shear strength is predominantly derived from internal friction of the soil are termed as cohesion-less subgrade. Normally, soils having particles finer than 75 micron less than 5% exhibit cohesion-less behavior.

12.0 Dispersive Soil:

Dispersive soils are those, which normally deflocculate when exposed to water of low salt content. Generally, dispersive soils are clays which are highly erosive and have high shrink and swell potential. These soils can be identified by Crumb, Double Hydrometer, Pin Hole and Chemical Tests.

13.0 Unstable Formation:

It is yielding formation with continued settlement including slope failure, which requires excessive maintenance efforts.

14.0 Shear Strength:

Shear strength of soil is its ability to resist shearing at a shearing surface (plane) under direct stress (vertical pressure)

15.0 Soil Pressure Units,

equivalence: 1 Pascal (Pa) = 1 N/m² and 1 Mega Pascal (MPa) = 1 N/mm²
100 kPa = 10 t/m² = 1 Kg/cm² = 1/10 N/mm² = 1/10 MPa

16.0 Deformation Modulus (E_{v2}) :

It is modulus of elasticity (also deformation) in the second cycle of loading in the cyclic plate load test. It is determined by cyclic Plate Load Test on top of compacted blanket layer/prepared subgrade/Embankment fill in accordance with DIN:18134-2012 (Ref :Appendix- H).

17.0 Geosynthetic:

A planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure, or system.

18.0 Geogrid:

Geogrid is a planar, polymeric structure consisting of a regular open network of integrally connected tensile elements, which may be linked by extrusion, bonding or interlacing. They have open grid like configuration with large apertures between individual ribs.

19.0 Geotextile:

Geotextiles are planar and permeable members which are used in contact with soil/rock and/or any other geotechnical material for civil engineering applications. They are basically textiles manufactured from synthetic fibers.

20.0 Geonet:

A geosynthetic consisting of integrally connected parallel sets of ribs overlying similar sets at various angles for planar drainage of liquids or gases.

21.0 Geocomposite Drain:

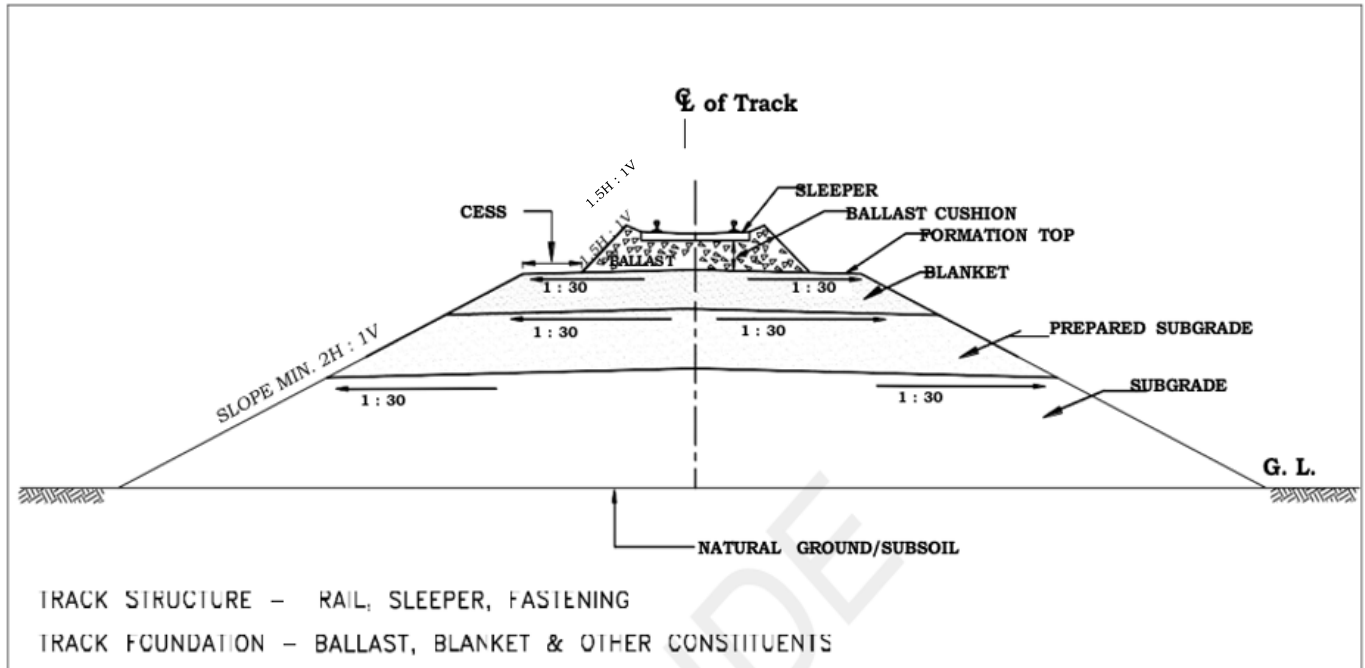
Geocomposite drains, consisting of a geonet bonded with non-woven geotextile layer(s) on one or both sides are used for drainage.

22.0 Pre-Fabricated Vertical Drain (PVD):

A geocomposite consisting of geotextile cover and drainage core installed vertically into soil to provide drainage for accelerating consolidation of soils. Also known as band or wick drain.

23.0 Formation components:

Formation comprises of granular layer (blanket) overprepared subgrade and subgrade. General profile of formation given below.



Typical cross-section representing formation component

CHAPTER-1

SOIL EXPLORATION & SURVEY

Objectives of constructing a stable formation can only be achieved if soil exploration, as envisaged in “**Indian Railways Code For The Engineering Department**” (Engineering Code) Paras 409, 425 and 528, is undertaken in right earnest and precautions are taken to design embankment & cutting against likely causes which could render it troublesome during service. Adequate provision for soil surveys & explorations at different stages, as per requirements of the terrain, should be made in the project estimates to cover the cost for this activity.

1.1 Objectives of Soil Exploration:

Main objectives of soil survey and exploration work are:

- a) To determine soil type with a view to identify their suitability for earthwork and to design the foundation for other structures.
- b) To avoid known troublesome spots, unstable hill sides, swampy areas, soft rock areas, peat lands, etc.
- c) To determine method of handling and compaction of subgrade.
- d) To identify suitable alignment for Embankment and cutting from stability, safety, economy in construction and maintenance considerations.
- e) To identify suitable borrow areas for desired quality and quantity of subgrade and blanket material.
- f) To determine depth of various strata of sub-soil and bedrock level.
- g) To determine ground water table position and its seasonal variation and general hydrology of the area such as flood plains, river streams, etc.
- h) To determine behaviour of existing track or road structure nature and causes of geo-technical problems in them, if any.

1.2 Soil survey and exploration/investigation for construction projects should be carried out in following three stages

1.2.1 During Reconnaissance Survey

- a) The main objective of soil survey during Reconnaissance is to collect maximum surface and sub-surface information without drilling exploratory boring/ test pits to avoid obviously weak locations such as unstable hillsides, talus formation/scree (accumulation of broken rock debris, as at the base of a cliff or other high place), swampy areas, peat grounds, very soft rocks or highly weathered rocks, etc.
- b) At the reconnaissance stage, available data from geological and topological maps and other soil surveys done in the past, existing soil profiles in nearby cuts, quarries are scrutinized. Water table is recorded from local observation and inquiry. The involved soils are classified by visual examination and if necessary, few field/ laboratory tests are conducted for this purpose.

- c) Survey reports available from other Departments/Agencies such as Geological Survey of India, Ministry of Road Transport and Highways, Central Board of Irrigation and Power, CPWD, State Irrigation, PWD, etc. can be acquired to obtain information on the accessibility, geology and soils, subsurface information, etc.
- d) Areas of prospective borrow soil and blanket material should also be surveyed to give idea of quality and quantity of materials to be used for construction of Railway Embankment.
- e) Above collection of data should be incorporated in the Feasibility Report required to be submitted as per “Indian Railways Code For The Engineering Department” (Engineering Code) Paras 555 and 576 in chapter of Project Engineering under heading of formation (para 528 of Engineering Code).
- f) The data and information collected during survey should be presented in suitable format such as graphs, bar charts or in tabular or statement form.

1.2.2 During Preliminary Survey

- a) Primary objective of preliminary exploration is to obtain sufficient subsurface data to permit selection of the type, location and principal dimensions of all major structures and estimation of earthwork and design of formation. The scope of preliminary survey is restricted to determination of depths, thickness and composition of each soil stratum, location of rock and ground water and also to obtain appropriate information regarding strength and compressibility characteristics of various soil strata.
- b) As stated in Para 409 of “Indian Railways Code For The Engineering Department”, the field work in Preliminary Survey includes a compass traverse along one or more routes with transverse and longitudinal levels to prepare an L-section of routes proposed. This fieldwork shall also cover a soil survey by sampling at suitable intervals in order to obtain a fair idea of the soil classification and characteristics of soils on proposed routes. Testing of disturbed soil samples is usually adequate; however core drilling will be necessary in rocks. This will help in determining the thickness of the blanket layer on different sections and total quantity of blanket material to be required.
- c) Exploratory boring with hand/ auger samplers and soil sampling should be undertaken along the alignment and soil samples also should be collected from borrow pit area, at an interval of 500 meter or at a closer interval, wherever change of soil strata occurs. The boring should be done upto 1.5 to 2.0 m depth below existing ground level. In case of Embankments more than 4m height and embankments with problematic substrata, the boring should be taken down to a depth equal to twice the height of Embankment. Samples should be collected from each stratum found in each boring.

- d) Bore logs are prepared based on laboratory test results of disturbed samples obtained by auguring or split spoon sampler. Particle size distribution, soil classification and index properties of the soils are determined from laboratory tests.
- e) In case of soft clays and sensitive clays, in-situ vane shear tests should be conducted to determine its shear strength and depth of underlying compressible clay layer. Undisturbed samples should also be collected to know actual moisture content, natural dry density and shear and consolidation parameters of the soil.
- f) Geo-physical investigations for bedrock profile, sub-surface strata and soil properties are required to be carried out for foundation of major structures such as bridges. Methods such as Seismic Refraction Method (IS: 1892-1979) (Reaffirmed 2016), Standard Penetration Test (IS: 2131- 1981) (Reaffirmed 2016), Dynamic Cone Penetration Test (IS: 4968-1976) (Reaffirmed 2016) etc., will be required to be carried out to ascertain constituents of substrata and their properties and design foundation of such structures. In alluvial strata, deep auger boring upto 6m may be deployed for subsurface exploration and sampling.
- g) The data and information collected during survey should be presented in suitable format such as graphs, bar charts or in tabular or statement form.

1.2.3 During Final Location Survey

- a) During Final Location survey, detailed investigations are done at locations where important structures viz. high embankment, deep cuttings, major bridges etc. are to be located and where weak sub-soil, swampy ground, marshy land exist. Undisturbed soil samples with the help of deep auger sampler or Split spoon samplers are collected for conducting detailed tests viz. shear strength tests & consolidation test to design safe and economical structure and predict settlements. However, if some tests during preliminary survey are deficient, the same should also be covered.
- b) Assistance may be taken from Geologists, in case of rocky strata, known unstable hill slopes, earthquake prone area and geological fault.
- c) Detailed subsoil exploration is necessary to check stability of structures against failure and to predict anticipated settlement. Bores are made along alignment normally at 200 m to 300m apart in case of uniform type of soil and closely spaced in critical zones. Soil samples within the boreholes are obtained at every change of stratum and interval not exceeding 1.5 m. In case of sandy and gravely soils, Standard Penetration Test may be adequate, as taking out samples in these types of strata is difficult.
- d) Besides classification tests, soil samples should be tested for shear strength and consolidation properties. In case of very soft clays, vane shear test should be conducted for each boring site. Free swell index test should also be carried out in case of expansive soil and organic contents of soil should be determined if soil is suspected to be having large organic contents.

- e) Availability of naturally occurring source of blanket material conforming to the laid down specification shall be explored during the survey. Sources of blanket material of specified quality and its availability around the project site needs to be located to assess its realistic costs for inclusion in project estimates. The source identification should cover various logistics involved in its utilization.
- f) The data and information collected during survey should be presented in suitable format such as graphs, bar charts or in tabular or statement form.

1.2.4 The availability of borrow soil sources shall be explored during the survey. As formation design will primarily depend upon the type of the soil being used in construction, it is essential that soil classification and assessment of bearing capacity is done during soil exploration.

The results of soil exploration shall be reviewed and finally approved at the level of the CAO/Construction as this will be the basis of further design. In case of PSUs the powers of PCE/CAO shall be exercised at appropriate level of authority as nominated by CMD/MD of the PSU.

1.3 Soil Survey & Exploration for Gauge Conversion, Doubling & Rehabilitation Work

For these projects, additional information required will be as follows:

- 1.3.1 A statement listing out problematic stretches on existing track should be prepared/obtained after scrutiny of gang charts for identifying locations requiring frequent attention, having unsatisfactory TRC results, past history of stretches having failure like slips, subsidence, pre-mature ballast recoupment, ballast penetration etc.
- 1.3.2 Failure of existing formation is accompanied by signs of distress/instability. The identified and suspected locations shall be subjected to detailed examination as per symptoms of failures. Recommended scheme of soil exploration and testing is given in table 1.1 below:

Table: 1.1 Recommended Scheme for soil exploration and data collection & testing

Sl. No.	Symptoms	Type of failure	Recommended Scheme for soil exploration and data collection	Soil testing
1	<ul style="list-style-type: none"> i) Embankment settlement - loss of longitudinal profile ii) Heaving of soil beyond toe iii) Leaning of telegraph posts, trees, etc. on the embankment and at the toe 	Base failure	<ul style="list-style-type: none"> i) Recording of embankment profiles and ballast profile in x-section ii) Undisturbed sampling iii) Field tests- Vane shear DCP/SPT 	<ul style="list-style-type: none"> i) Classification tests ii) Consolidation tests iii) Natural moisture content and Natural iv) Peak and residual shear strength tests
2	<ul style="list-style-type: none"> i) Flattening of Embankment/ slope Bulging of slope surface. iii) Longitudinal cracks on cess/slopes ii) Leaning of OHE masts 	Slope failure	<ul style="list-style-type: none"> i) Recording of embankment profile and x-section of ballast profile. ii) Survey and recording of surface cracks iii) Undisturbed sampling 	<ul style="list-style-type: none"> i) Classification and swell tests ii) Peak & residual share strength tests iii) Natural moisture content and Natural dry density tests.
3	<ul style="list-style-type: none"> i) Soil heaving on cess and on slopes ii) Ballast penetration exceeding 30 cm below formation iii) Excessive – cross level variations 	Subgrade failure (by shear)	<ul style="list-style-type: none"> i) Recording of embankment profile and ballast penetration profiles inside subgrade ii) Collection of data <ul style="list-style-type: none"> a. Track geometry variations b. Excessive maintenance inputs c. Quantum of ballast recoupmnt d. Speed restrictions imposed iii) Undisturbed and Disturbed soil samples below the ballast penetration 	<ul style="list-style-type: none"> i) Classification and swell tests ii) Shear strength tests iii) Natural Moisture content and Natural Dry Density tests iv) CBR test
4	<ul style="list-style-type: none"> i) Fouling of ballast with subgrade fines ii) Ballast penetration below formation – 30 cm or less iii) Impaired drainage iv) Excessive cross level variations in Monsoon 	Subgrade failure (by mud pumping)	<ul style="list-style-type: none"> i) Recording of embankment profile and ballast penetration inside subgrade ii) Collection of data – <ul style="list-style-type: none"> a. Track geometry variations b. Excessive maintenance 	<ul style="list-style-type: none"> i) Classification and swell tests ii) Shear tests iii) Natural Moisture Content and Natural Dry Density tests iv) CBR Test

	v) Hard running during summer		inputs c. Speed restrictions imposed iii) Undisturbed & Disturbed soil samples from below the ballast penetration	
5	i) Reduced cess & denuded slopes- loss of soil/absence of vegetation. ii) Formation of rills/gullies and pot holes on slopes & on cess	Erosion failure of Slopes leading to ballast penetration and Slope failure	i) Recording of embankment profile ii) Undisturbed soil samples	i) Classification tests ii) Field crumb test for soil dispersivity iii) Pinhole test iv) Double hydrometer tests v) Natural Moisture Content and Natural Dry Density tests
6	i) Cut slope failures ii) Choked side drains iii) Seepage of water iv) Saturated subgrade	Failure of Cuttings	i) Recording of profile side slope, longitudinal drain sections, HFL and Ground water table ii) Cross-section and Ballast penetration profile iii) Undisturbed soil sample	i) Classification of soils ii) Natural Moisture Content and Natural Dry Density tests iii) Lab. Shear tests

Note: a) In practice generally more than one type of failure is encountered.
b) Recommended scheme and soil tests are for general guidance.

- 1.3.3 Frequency of soil sampling shall depend on the extent and type of problems in the troublesome stretches. However, samples should be taken at 500m intervals for determination of natural dry density and soil type only where no formation problem is reported.
- 1.3.4 In order to ensure proper bonding of earthwork and soil compatibility behaviour of old and new earthwork, samples of soils from mid-slope of existing bank at about 1 m depth and 500m length or closer intervals should be collected and tested for particle size, natural moisture content, natural dry density and consistency limits.
- 1.3.5 In case of doubling, where existing formation is troublesome as described in Para 1.3.2 above, soil investigation shall be planned for remedial measures to be undertaken before execution of doubling work and additional possibility of construction of new line away from centre line of the existing track may also be explored in such cases.

1.4 Soil Classification system as per Indian Standard 1498 is also explained in brief in Appendix: L for reference.

CHAPTER-2 SUITABILITY OF SUBSOIL & GROUND IMPROVEMENT TECHNIQUES

2.1 General

Field tests are required to be conducted on sub-soil strata, i.e. Plate load test for determination of Elastic Modulus in second cycle of loading (E_{v2}), Standard Penetration test to determine N-value, and Unconfined Compression Test or Vane Shear Test to determine unconfined compressive strength or undrained cohesion, c_u . If any of these parameters, as specified in following para do not meet with specified requirement then ground improvement needs to be undertaken.

2.2 Suitability of sub-soil

Strengthening of sub soil, including in cutting shall be required when;

- (i) E_{v2} value less than 20 MPa, or
- (ii) Undrained cohesion (c_u) < 25 kPa, only for soils having particles finer than 75microns exceeding 12%, or
- (iii) N-value < 5,

In such cases Ground Improvement Techniques mentioned below can be adopted. However, these are suggestive in nature and depend on site conditions before implementing these techniques, proper planning and investigation is required.

2.3 Ground Improvement Techniques/ Methods for Soft soil

Soil at a construction site may not always be totally suitable for supporting structures in its natural state. In such a case, the soil needs to be improved to increase its bearing capacity and decrease the expected settlement. These techniques can be adopted to improve the ground strength on which the Embankment/fills is constructed.

2.3.1 Removal and replacement of weak sub-soil

Soil replacement is one of the oldest and simplest methods for Ground improvement. The foundation condition can be improved by replacing poor soil (e.g. organic soils and medium or soft clay) with more competent materials which can improve the bearing capacity of subsoil.

The removal and replacement may be required even in 'cutting' areas where the naturally occurring soils are found to be of low shear strength. Subsurface drainage may have to be introduced in most of such areas. Excavation and replacement can be carried out for soft soil up to the depth of 1.5 to 2 m as per site condition.

2.3.2 Preloading

The preloading technique is a simple and economical method for accelerating consolidation railway fills on soft clays, since; the material can stay in place and need not be relocated. Preloading is especially attractive when fill material is subsequently used on the same project for site preparation.

For low Embankment over soft compressible soil where the poor ground is of limited thickness (short drainage path) or is capable of compressing rapidly under the load of excess preload fill due to

presence of sand lenses, preloading may be resorted. Preloading of soft soils is based on the consolidation concepts, whereby pore water is squeezed from the voids until the water content and the volume of the soil are in equilibrium under the loading stresses imposed by the surcharge. This is usually accompanied by gain in shear strength of soil. To a certain extent, the primary consolidation under final loading can be achieved during construction and hence post construction settlement reduces.

The pre-loading technique takes two forms:

- i) Overloading
- ii) Stage construction

(i) **Overloading**

In the overloading process, a surcharge (overload) is placed temporarily on the ground and after a pre-determined time lapse, the intended structure can be built with occurrence of little or no additional settlement. The ratio of surcharge load to design load is known as overload coefficient. The charge is normally a uniformly distributed surface load which is placed prior to the construction of the intended structure. A part or the entire surcharge may be removed before the construction commences, depending on the requirements. The magnitude of the surcharge load and its duration of application are determined by the conventional settlement calculations. The settlement which occur under overloading results in an increase in the undrained shear strength of the clay. The principle of overloading method is shown in fig-2.1.

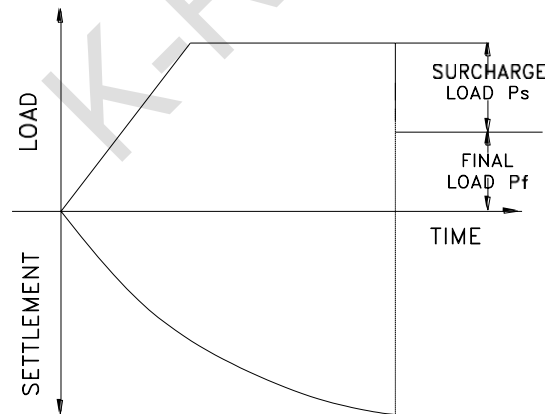


Fig-2.1: Principle of overloading

(ii) **Stage Construction (Improvement of Shear Parameters)**

This technique enhances the bearing capacity of the sub-soil and provides the site for construction of Embankment up to the design height in the phases/stages, with a designed strength of the soil & calculated waiting period for the next loading after the previous loading.

Stage construction is employed mainly as a means of gradually increasing the shear strength of soft clay which would otherwise be inadequate to carry the intended Embankment load. In stage construction, advantage of increase in shear strength of sub-soil strata due to consolidation by surcharge load of Embankment is taken into account. Work on next stage filling can be permitted only after it is ascertained that the strength gain needed for building the next stage has been reached. The principle of stage construction method is shown in Fig-2.2 below :

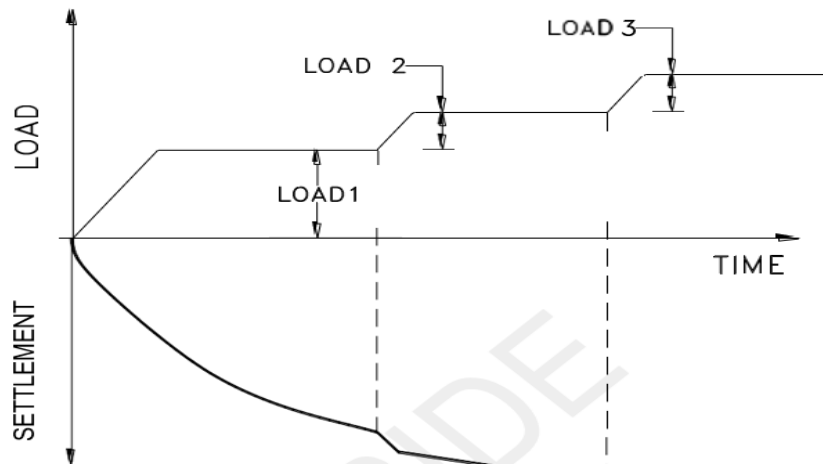


Fig-2.2: stage construction method

Theoretical basis of design using stage construction method, solved practical examples and instrumentation scheme for monitoring the behavior of Embankment on soft soil are covered in "RDSO Guidelines on Soft Soils-Stage Construction Method (Guideline No: GE:G-5)-April 2005".

2.3.3 Ground improvement using Vertical drains

Because of low permeability the consolidation settlement of soft clay takes long time to complete. Wherever in such case if preloading is not sufficient, to shorten the consolidation time vertical drain are installed together with preloading. Vertical drain are artificially created drainage path which are inserted in soft clay In order to accelerate the process of consolidation settlement for the construction of structure.

The Sand drain is one of such method being used for this purpose.

Sand drains (Fig-2.3) are constructed by driving down casing or hollow mandrels in to the soil and then the holes are filled with sand and casing is taken out. When the surcharge is applied on the ground surface the pore water pressure in the soil increases and the drainage in vertical and horizontal direction starts. Process of dissipation of excess pore water pressure created by loading is accelerated and hence the settlement rate. Top of sand drain are connected to granular sand blanket to allow the pore water to flow out.

Now days mostly **PVD** are being used for this purpose as they are easy to install and less time consuming. PVD have been explained in para 2.4 Stabilization & Ground Improvement Methods Using Geosynthetics of this chapter.

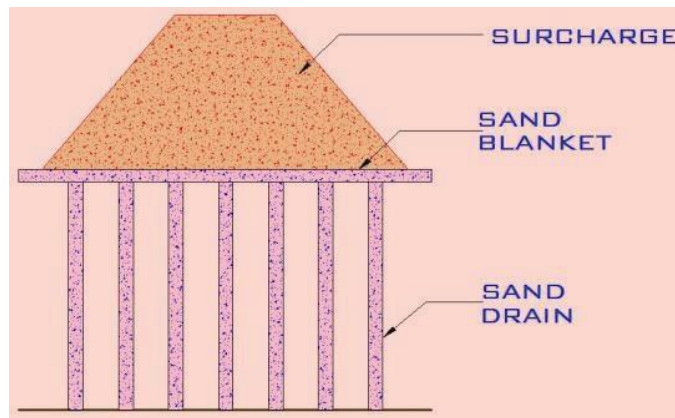


Fig 2.3 Ground improvements using sand drain

2.3.4 Ground improvement using Stone Columns

Stone column method of ground improvement is an efficient method of improving the strength parameter like bearing capacity and it also reduces the consolidation settlement time. Stone column consist of compacted crushed stone or well graded gravel of 75 mm to 2mm size and can be extended through the most compressible strata that contribute the settlement to foundation. The stone should be chemically inert, hard and resistant to breakage.

Stone column will transmit some load to soil by shear stress and end bearing but the predominant load transfer mechanism is due to the lateral bulging into the surrounding soil. Generally, column bulging will be closer to the top of column where the over burden pressure is lowest thus distributes the stresses at the upper portion of the soil profile rather than transferring the stresses in to the deeper layer, thus causing the soil to support it. Along with this rapid consolidation due to accelerated dissipation of pore water pressure into the drainage path formed by stone column. Due to this combined effect construction can be started soon after instillation of stone column completed.

Stone column provides rapid consolidation and immediate increase in shear strength hence there is no waiting period is required (such as in case of ground improvement by PVD/sand drain) and construction of embankment can be begin soon after the installation up to full height with non-compressible fill without further stage construction.

Subsurface conditions for which stone columns are generally not suited include sensitive clays and silts (sensitivity is > 4) which lose strength when vibrated and also where suitable bearing strata for resting the toe of the column are not available under the weak strata.

Stone column can be installed by Non-Displacement method (Fig-2.4) or by Displacement method. In case of displacement installation, the soil is laterally displaced while making the hole due to driving of tube or a casing, while in case of non-displacement method soil is taken out during boring. Compacted crushed coarse aggregate of various sizes fed in to the hole created and on top of stone column a clean medium to coarse sand layer is laid; it should be exposed to atmosphere at its periphery for dissipation of pore water pressure.

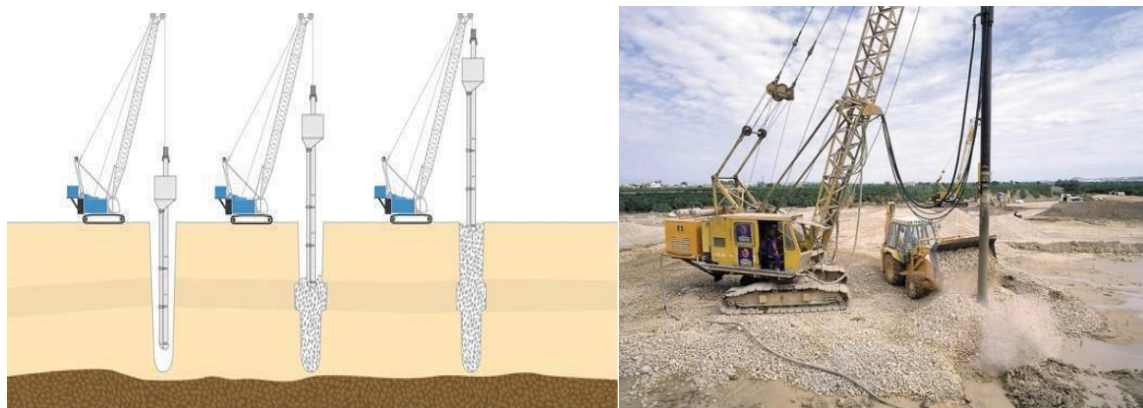


Fig- 2.4: Ground improvement using stone column

2.3.5 Ground Improvement for expansive soils using CNS material

Using a layer of Cohesive Non-Swelling soil (CNS) is one of the effective methods of ground improvement in expansive soils area. CNS layer shall be provided below the bottom layer of Embankment fill in case of Embankment and below subgrade/prepared subgrade level in case of cuttings, of suitably designed thickness and width, compacted to 97% of MDD at optimum moisture content (OMC). The width of treatment should be extended minimum 3.0m beyond the toe line on both sides.

The CNS material possesses the property of cohesion of varying degree and non-expanding type clay minerals such as illite and kaolinite, having low plasticity with liquid limit not exceeding 50 percent.

The properties of CNS material are defined below (Ref- IS 9451: 1994): Grain Size Distribution

Clay (less than 2 micron)	: 15-20 %
Silt (0.06 mm to 0.002 mm)	: 30-40 %
Sand (2 mm to 0.06 mm)	: 30-40%
Gravel (greater than 2 mm)	: 0-10%
Liquid Limit	: >30 but less than 50
Plasticity Index	: >15 but less than 30
Swelling Pressure	: <10kN/m ²
Unconfined Compression strength	: >10kN/m ²

The thickness of CNS materials required for balancing the different swelling pressures are as follows:

Table-1

Swelling Pressure of Soil (KN/m ²)	Thickness of CNS Materials (cm)(Min)
--	--------------------------------------

50 to 150	75
150 to 300	85
300 to 500	100

In case naturally occurring, soil do not meet the parameters of CNS soil, same can be produced by blending suitable combination of locally available materials. Such artificial CNS should satisfy all the parameters of CNS soil.

2.4 Stabilization & Ground Improvement Methods Using Geo-synthetics

Some of the ground improvement methods (list is not exhaustive), wherein geo-synthetics are used, are as under:

2.4.1 Use of Geo-composite drain for Construction of new embankment over soft subsoil

In case of embankments over weak/fine grained sub-soils (which are mostly soft clays) and having water table at higher level (shallow depth), it is a good practice to provide a “separator-cum-drainage layer” of Geo-composite drain layer, sandwiched between two layers of sand of about 75mm thickness (**Fig-2.5**), at the ground level to provide adequate drainage path for the water coming from sub-soil (reducing excess pore water pressure in embankment and thereby increasing its’ stability) and to prevent fouling of subgrade by the fine grained subsoil. Alternatively, a 1000mm thick sand layer can be provided. Its thickness may be varied depending on the bank height, characteristics of sub-soil and water table. The sand layer to be used in both the cases should be clean medium to coarse sand with minimum permeability of the order of 10^{-5} m/second.

Specification for Geo-composite drains to be used at the base of the Embankment for Railway Formation, for Embankment height upto 8m (Specification No. RDSO/2018/GE: IRS-0004-Part-II) is given in **APPENDIX-C**. These specifications have been issued to Zonal Railway/PSU’s initially for trial purpose. On satisfactory performance report from the field, the mandating of its usage will be decided.

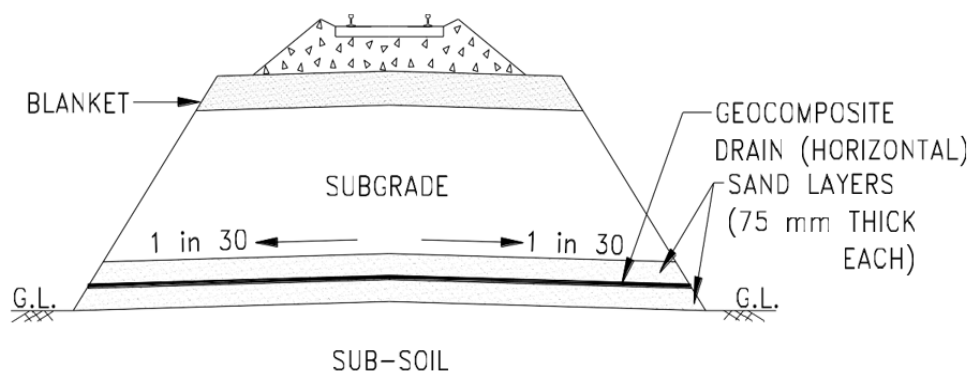


Fig- 2.5: Use of Geo-Composite Drain in bank over soft subsoil

2.4.2 Use of Geo cell

Geo cell is another form of Geosynthetics used as basal mattress in embankments for Ground improvement [Fig-2.6(a)]

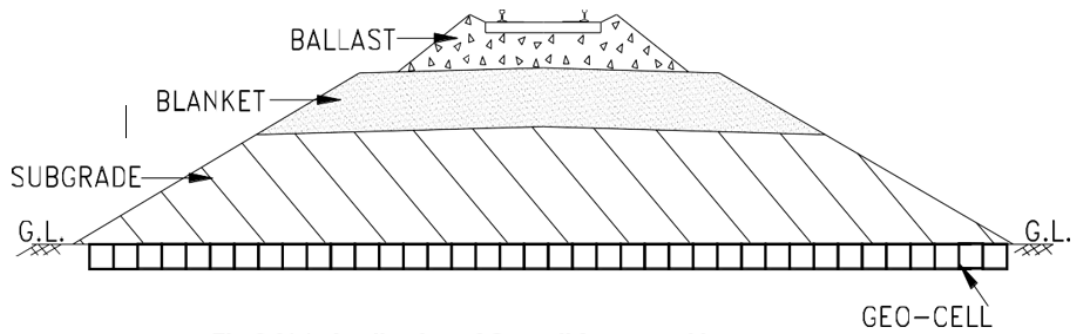


Fig-2.6(a): Application of Geocell for ground improvement



Fig-2.6(b): Geocell and it's applications

Geocell is a three dimensional honeycomb like cellular structure, consisting of a regular open network of synthetic strips, linked by extrusion or adhesion or other methods [Fig-2.6(b)]. On site, the Geocell sections are fastened together and placed directly on the subsoil or on a Non-woven Geotextile filter placed on the subgrade surface and propped open in an accordion-like fashion with an external stretcher assembly.

They are then filled with various infill materials, such as soil, sand, aggregate or recycled materials and then compacted using vibratory compactors.

When the soil contained within Geocell is subjected to pressure, it causes lateral stresses on cell perimeter walls. The 3D zone of confinement reduces the lateral movement of soil particles while vertical loading on the contained infill results in high lateral stress and resistance on the cell-soil interface. This increases the shear strength of the confined soil, which creates a stiff mattress/slab to distribute the load over a wider area, reduces punching of soft soil, increases shear resistance and bearing capacity and decreases deformation. Confinement from adjacent cells provides additional resistance against the loaded cell through passive resistance, while lateral expansion of the infill is restricted by high hoop strength. Compaction is maintained by the confinement, resulting in long-term reinforcement.

In Railway Embankment applications, Geocell can improve the load support capacity of soft subsoil. It is often recommended for swampy conditions where the ground water is close to the surface.

2.4.3 Use of Prefabricated vertical drain (PVD):

Prefabricated vertical drains consist of channeled synthetics core wrapped in Non- woven geotextile fabric known as filter (Fig-2.7). Prefabricated Vertical drains are used where preloading alone is not sufficient.

Prefabricated Vertical drains in soft clay accelerate the primary consolidation of clay since they bring about rapid dissipation of excess pore water pressure. Therefore, the structures or Embankments can be put to use earlier than it would be possible otherwise. The accelerated rate of gain in shear strength of clay enables the loads to be applied more rapidly than would otherwise be possible.

The effectiveness of Prefabricated Vertical drains depends mainly on the engineering properties of soils, namely, soil permeability and coefficient of consolidation and their variations in space and time. They are, however, ineffective inorganic soils and highly stratified soils.

For installation, PVD is placed into steel mandrel and the mandrel is pushed into the ground to the determined depth with a mast mounted on back hoe. Anchor plate is attached to the wick material to hold it in place as mandrel is removed. Then the PVD is cut off a little above the ground (Fig-2.7). Top of PVD drain are connected to granular sand blanket to allow the pore water to flow out.

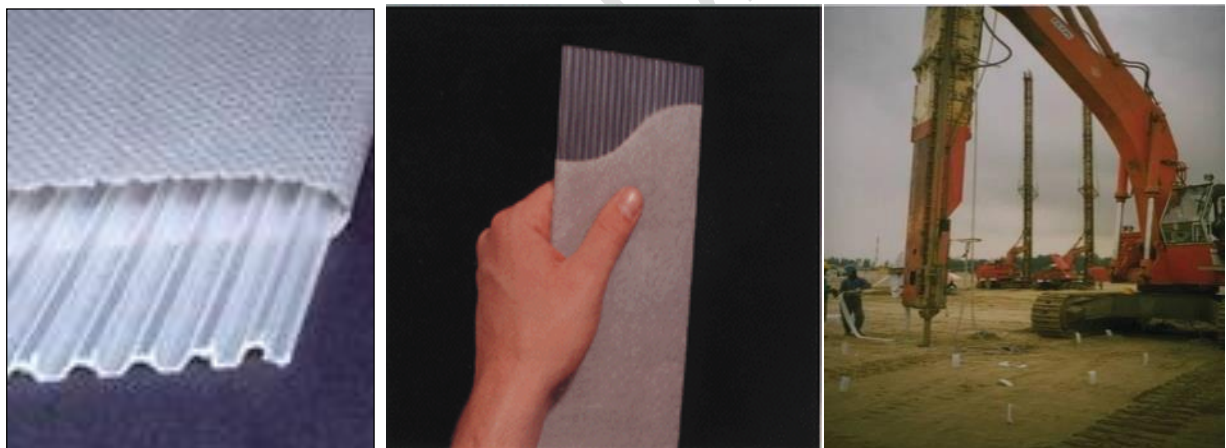


Fig-2.7: PVDs and their Installation

2.4.4 Geosynthetic encapsulated Stone column:

When stone columns are installed in soft clays, over a period of time, the gaps in the stones are filled by soft clays which decrease the load carrying capacity and lead to increase in the vertical deformation. Also, soft clay can provide a limited lateral pressure. To overcome this problem, the idea of placing a Geosynthetic (geotextile/geogrid) encasement around the granular material has been developed recently. By this, the granular material that wants to expand sideways is not only restricted by the cohesive soil, but also by the Geosynthetic reinforcement (Fig-2.8). The encapsulation in geosynthetics makes stone column more ductile than normal stone column. The

specifications of geogrid and geotextile included in Appendix-C will not be applicable in this case. It can be suitably designed with suitable type of geosynthetics.

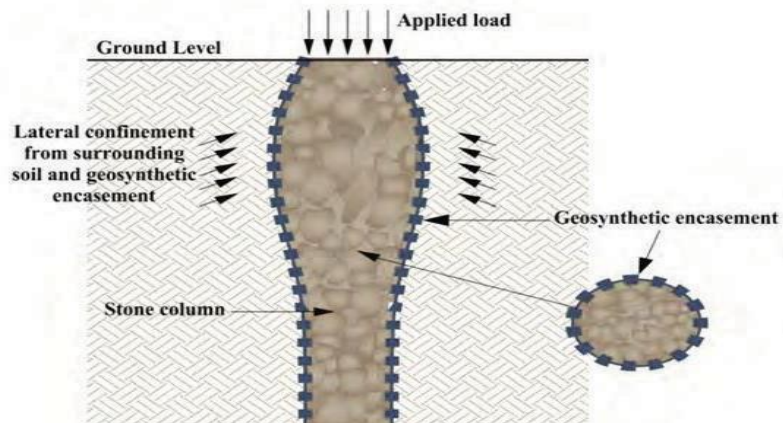


Fig-2.8: Geosynthetics Encapsulated Stone column

Note: All the above methods are suggestive in nature and final methodology to be adopted will depends on site condition and topography, soil type, drainage condition etc.

CHAPTER-3
DESIGN OF FORMATION & SPECIFICATIONS FOR FORMATION LAYERS

3.1 General

Formation comprises of Blanket and, Prepared subgrade/Subgrade. Depending upon techno-economic considerations, it can be Single layer or Two-layer construction as shown in Fig-3.1 & 3.2 below. For construction of a new line, it is important to ensure that the track bed layers (Blanket/Prepared subgrade/Subgrade) have the appropriate mechanical characteristics and are of adequate thickness. For Indian Railway Formation, it has been stipulated & described in Para 3.10 of this Chapter.

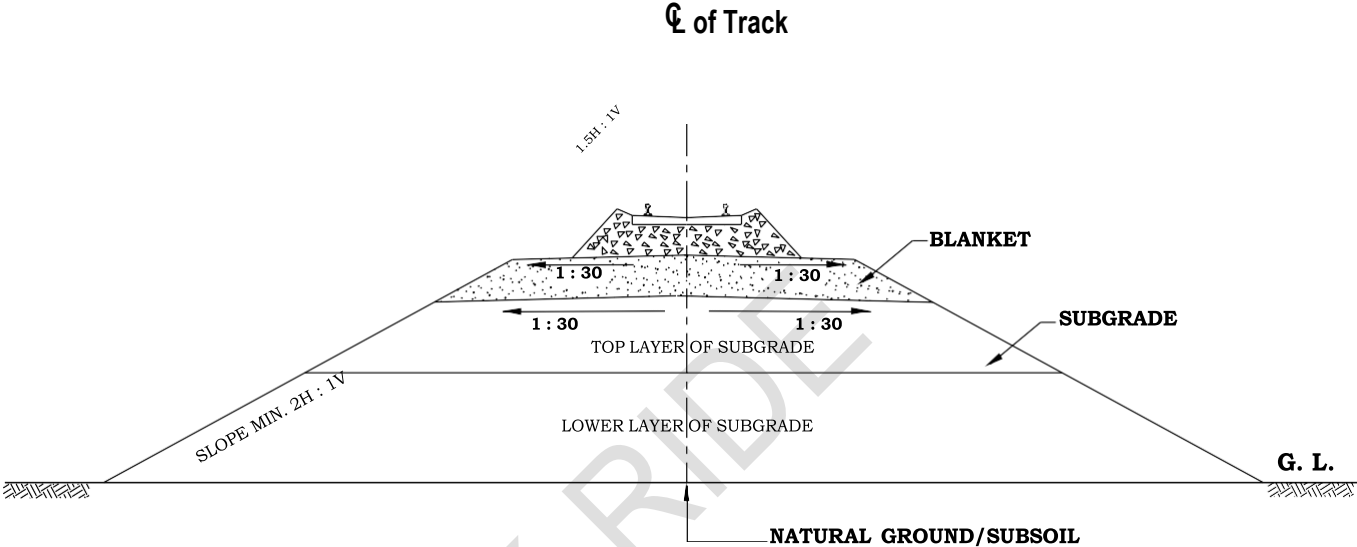


Fig-3.1: Single layer construction

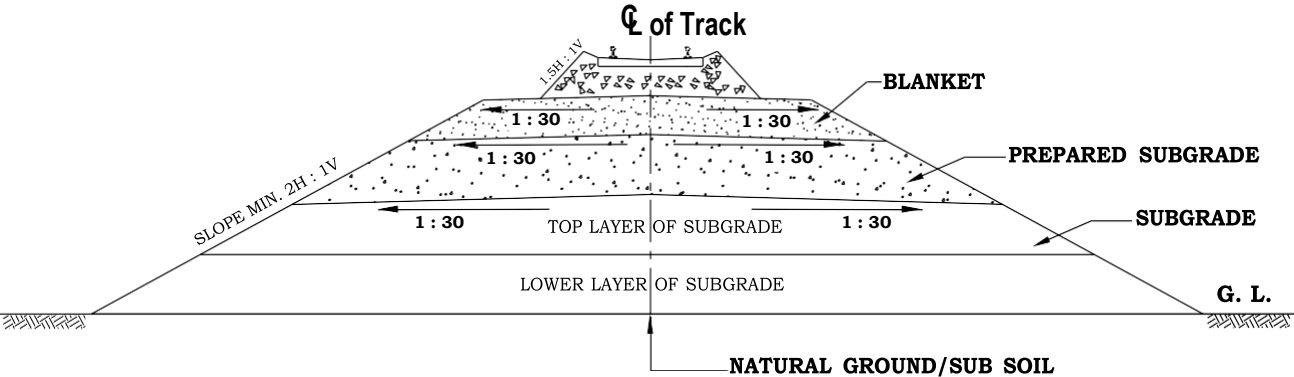


Fig-3.2: Two layer construction

3.2. Pressure on Formation and sub-soil

As good design practice, typical values for the maximum pressure on formation at bottom of ballast should not exceed 0.3MN/m^2 or 3 kg/cm^2 , and the pressure on sub-soil should not exceed 0.1MN/m^2 or 1 kg/cm^2 generally.

3.3 Top Width of Formation

- a) It should be adequate enough to accommodate tracks laid with concrete sleepers and standard ballast section (minimum 35cm depth) and have minimum cess width of 90cm on either side.
- b) Additional Width of formation will have to be provided to cater for increase in extra widening of ballast shoulder and extra clearances required on curves.

It shall be regulated/provided in accordance with extant instructions as per Indian Railway Schedule of Dimensions (IRSOD) & Indian Railway permanent Way manual (IRPWM).

3.4 Cross Slope of Formation

Top of formation should have a cross slope of 1 in 30 from centre of formation towards both sides for single line/multiple line in new construction. In case of doubling or multiple line construction work in existing lines, the cross slope of 1 in 30 should continue from the edge of existing formation towards cess/drain side (single slope) to avoid any stagnation of water between two tracks. However, if the cross slope of existing embankment is steeper than 1 in 30 due to any reason, the configuration of 1 in

30 cross slope shall be maintained in the new line while ensuring proper drainage conditions at the same time so as to avoid any stagnation of water in between tracks, by adopting appropriate measures as per site conditions.

Further elaboration on drainage is given in **Chapter 6 for Execution of Earthwork**.

3.5 Erosion Control System

The design should provide for a suitable and cost-effective erosion control system considering soil matrix, topography and hydrological conditions. Further elaborations given in **chapter-8 (Erosion control of slopes)**.

3.6 Borrow Pits

It will be necessary to keep borrow pits sufficiently away from the toe of the embankments as far as possible at the extreme of Railway land but normally not less than 3m plus height of the embankment to prevent base failures due to lateral escapement of the soil. Existing borrow pits, close to the toe of bank may be filled or its depth should be taken into account in analysing slope stability of the bank.

3.7 Soils to be normally avoided

- a) There are some soils, which are normally unsuitable for construction of formation as listed below:
 - i) Organic clays, organic silts, peat, chalks, marl, dispersive soils and soil containing soluble material (e.g. rock salt or gypsum).
 - ii) Poorly graded sand and gravel with $C_u < 2.0$, should not be used to safeguard against

liquefaction. Generally, most liquefiable soils as falling in gradation zone as indicated in the Fig-L1 of Appendix-L & having coefficient of uniformity, $C_u < 2$ shall not be used. (Reference Sketch given in Appendix-L).

- iii) Clays and Silts of high plasticity (CH & MH) in top 3m of Embankment.
 - iv) Shales and soft rocks which become muddy after coming into contact with water.
- b) There may be some typical situations in construction of formation & cuttings, where it is not possible to avoid conditions as given below, for economical or any other reason, then Railway may decide special investigations and other measures to formulate suitable scheme of construction.
- i) Cuttings passing through unsuitable soils as defined in para 3.7 (a).
Construction of embankment on subsoil of unsuitable types of soils

3.8 Blanket Layer

3.8.1 Need and functions of Blanket Layer

- a) It reduces traffic-induced stresses to a tolerable limit (i.e. threshold stress) on the top of subgrade, thereby, prevents subgrade failures.
- b) It prevents penetration of ballast into the subgrade and also prevents upward migration of fine particles from subgrade into the ballast under adverse conditions, during service. This prevents mud pumping by separating the ballast and subgrade soil.
- c) It results in increased track modulus and thereby reduces the track stresses & deformations.
- d) It facilitates drainage of surface water and reduces moisture variations in subgrade, thereby reducing track maintenance problems.
- e) It facilitates dissipation of excess pore water pressure developed in subgrade on account of cyclic loading and leads to increase in shear strength of subgrade soil.

3.8.2 Blanketing Material

It is difficult to get natural blanket material. Normally, the blanket material shall be produced mechanically by crushing the stones and/or by mixing, naturally available materials using suitable equipment/plants like pug mill, wet mix plant, crusher etc. However, if naturally available material conforms to the specifications, the same can also be used. The type of blanket material to be used whether natural or manufactured (mechanical crushing and/or blending) may be indicated clearly before start of the work and should be indicated in tender document. Some Typical methods used for mechanised production of blanket material are given in **Appendix-A**.

Decisions to use natural blanket material or manufactured blanket material shall be taken on the basis of site conditions or final location survey report.

3.8.3 Requirement of Blanket Layer

- a) The provision of blanket layer shall not be needed when formation/earth fill embankment have:
- i) Rocky beds except those, which are very susceptible to weathering e.g. rocks consisting of shale and other soft rocks, which become muddy after coming into contact with water.
 - ii) Soils conforming to specifications of Blanket layer as given in Table 3.3 to 3.6.
- b) For other conditions, the system of layered construction of embankment (Single layer/ Two layer) shall normally be followed.

3.9 Soil Quality

For Design of Railway Formation, the soils for their use in Indian Railway Embankment have been grouped based on percentage of fines present in the soil, as given below:

Description of Soil Quality Class

Description w.r.t. Fine-Particles (size less than 75 micron)	Soil Quality Class,
Soils containing fines > 50 %	SQ1
Soils containing fines from 12% to 50%	SQ2
Soils containing fines < 12%	SQ3

3.10 Specifications and Thickness of Formation Layers:

- (A) The Railway Formation may be constructed with Single Layer System or Two Layer System based on availability of local soils/materials and on economic considerations. The thickness of the prepared sub-grade and blanket layer has been rationalized based on UIC-719R calculation for ballast cushion of 350 mm. The specifications and thickness of Blanket layer, Prepared subgrade, Subgrade (Top Layer & Lower layer) and Sub-Soil are tabulated for Single layer system and Two-layer system for 25T and 32.5T Axle load as below:-

Table-3.1: For 25 T Axle Load

Sl. No.	Soil type Category in Sub-grade	Prepared Sub-grade		Recommended Blanket Thickness(mm)	Remarks
		Soil Type	Thickness (mm)		
1.	SQ1	SQ1*	--	550	Single layer
2.	SQ1	SQ2	500	400	Two layer
3.	SQ1	SQ3	500	300	Two layer
4.	SQ2	SQ2*	--	400	Single layer
5.	SQ2	SQ3	350	300	Two layer
6.	SQ3	SQ3*	--	300	Single layer

* Subgrade soil is continued up to blanket layer

Table-3.2: For 32.5 T Axle Load

S. No.	Soil type Category in Sub-grade	Prepared Sub-grade		Recommended Blanket Thickness (mm)	Remarks
		Soil Type	Thickness (mm)		
1.	SQ1	SQ1*	--	700	Single layer
2.	SQ1	SQ2	500	550	Two layer
3.	SQ1	SQ3	500	450	Two layer
4.	SQ2	SQ2*	--	550	Single layer
5.	SQ2	SQ3	350	450	Two layer
6.	SQ3	SQ3*	--	450	Single layer

* Subgrade soil is continued upto blanket layer

(B) Formation for 25T axle load

Table 3.3: Specification and Thickness of Formation Layers for 25T axle load:Single layer system

Layers	Specification	Thickness
Blanket	i) $C_u > 7$ and C_c between 1 and 3. ii) Fines (passing 75 microns) :3% to 10% iii) Minimum soaked CBR value ≥ 25 , (Soil compacted at 100% of MDD * in Lab) iv) Los Angeles Abrasion value $< 40\%$ v) Field Compaction :Min. 100% of MDD * infield trial vi) Minimum $E_{v2}^{**} = 100$ MPa vii) Size gradation – within specified range (as table-3.7) or should lie more or less within enveloping curves (as Fig-3.8) viii) Filter criteria (***) Optional) should be satisfied with sub-grade layer as given below: Criteria-1: D_{15} (blanket) $< 5 \times D_{85}$ (sub-grade) Criteria-2: D_{15} (blanket) > 4 to $5 \times D_{15}$ (sub-grade) Criteria-3: D_{50} (blanket) $< 25 \times D_{50}$ (sub-grade)	30 cm over SQ3 sub-grade 40 cm over SQ2 sub-grade 55 cm over SQ1 sub-grade
Sub-grade Top Layer	SQ1/SQ2/SQ3 soil SQ1 soils (To be used only with dispensation of PCE/ CAO) i) For SQ2/SQ3 soil, CBR ≥ 6 (soil compacted at 98% of MDD *) ii))For SQ1 Soil, CBR $>$ or equal to 4 soil compacted at 98% of MDD*	100 cm

Lower layer (fill)	iii) Field Compaction : Min. 98% of MDD * iv) Minimum E_{v2} = 45 MPa (for SQ1) 60 MPa (for SQ2/SQ3) SQ1/SQ2/SQ3 soil (+) i) $CBR \geq 3$ (soil compacted at 97% of MDD *) ii) Field Compaction : Min. 97% of MDD *	As per Embankment height
Ground Soil/Sub-soil Strata	i) Undrained Cohesion of soil (c_u) > or equal 25 KPa (only for soils having particles finer than 75 micron exceeding 12%) ii) E_{v2} (determined from PLT) > or equal 20 MPa iii) N (determined from SPT) > or equal 5 Ground Improvement is required, if any of the above parameters not complied with	--

* MDD mentioned in the above table

(a) For determination of CBR - MDD achieved in Lab

(b) For field compaction - MDD achieved in field compaction trials which should not be less than 98% of MDD in lab.

** E_{v2} is Modulus of deformation (Para 2.0 of Appendix-H)

*** With the application of Non-woven Geotextile as a separator layer below the blanket, filter criteria will not be required or mandatory.

+ No dispensation of PCE/CAO required for use of SQ1 soil in Lower layer (fill) of Subgrade.

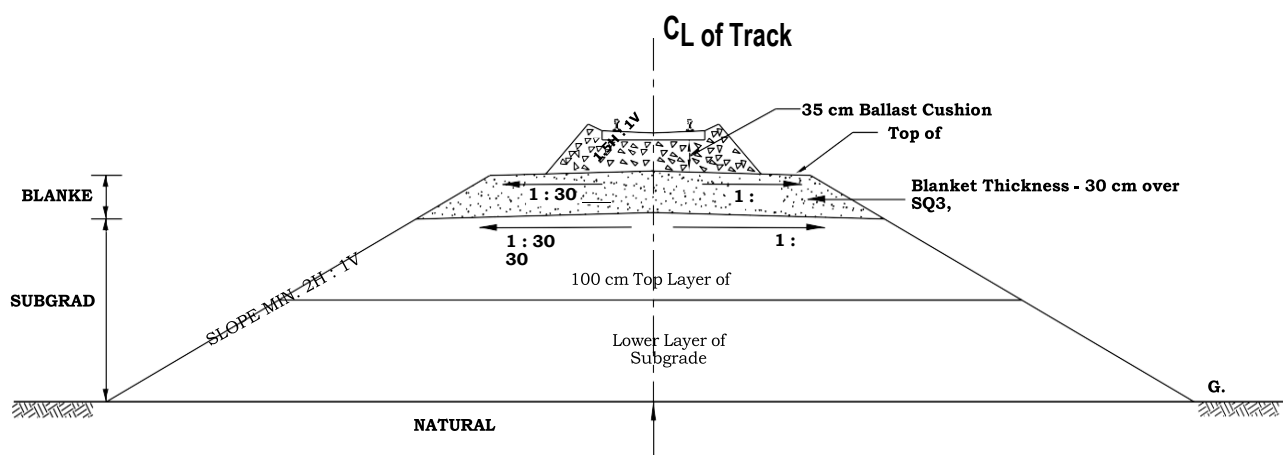


Fig-3.4: Track Formation for 25 T Axle Load (Single layer system)

Ground Soil/Sub-soil Strata	i) Undrained Cohesion of soil (c_u) \geq 25 K3D (RQO\ IRU soils having particles finer than 75 micron exceeding 12%) ii) E_{v2} (determined from PLT) \geq 20 MPa iii) N (determined from SPT) \geq 5 Ground Improvement is required, if any of the above parameters not complied with	--
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* MDD mentioned in above table

- For determination of CBR - MDD achieved in Lab,
- For field compaction - MDD achieved in field compaction trials which should not be less than 98% of MDD in lab.

** E_{v2} is Modulus of deformation (**Para 2.0 of Appendix-H**)

*** With the application of Non-woven Geotextile as a separator layer below the blanket, filter criteria will not be required or mandatory.

+ No dispensation of PCE/CAO required for use of SQ1 soil in Lower layer (fill) of Subgrade.

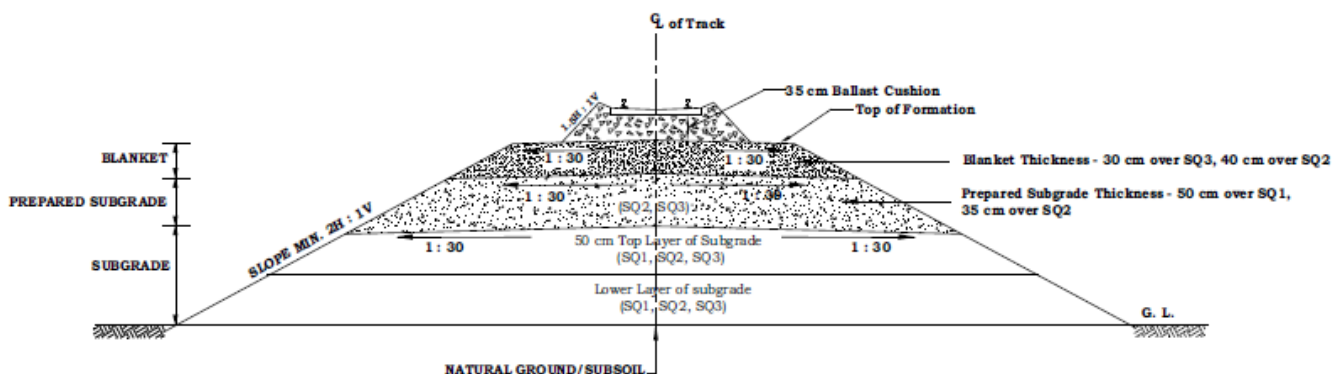


Fig-3.5 Track Formation for Two layer system (for 25 T Axle load)

(C) Formation for 32.5T Axle load

Table 3.5: Specification and Thickness of Formation Layers for 32.5T axleload:
Single layer system

- a) For determination of CBR - MDD achieved in Lab,
- b) For field compaction - MDD achieved in field compaction trials which should not be less than 98% of MDD in lab.

** Ev2 is Modulus of deformation (**Para 2.0 of Appendix-H**)

*** With the application of Non-woven Geotextile as a separator layer below the blanket, filter criteria will not be required or mandatory.

+ No dispensation of PCE/CAO required for use of SQ1 soil in Lower layer (fill) of Subgrade.

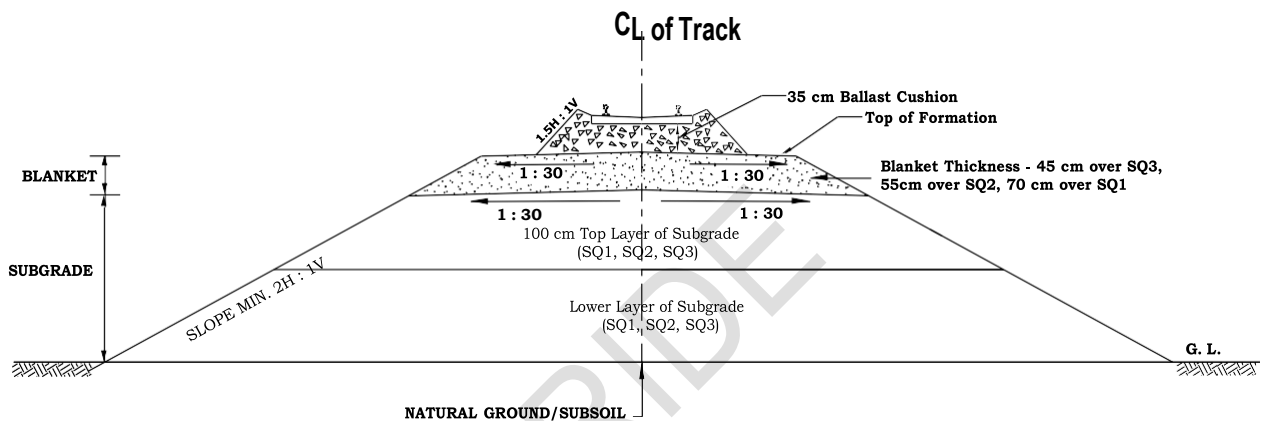


Fig-3.6: Track Formation for single layer system (for 32.5 T Axle load)

Table 3.6: Specification and Thickness of Formation Layers for 32.5T axleload: Two layer system

Layers	Specification	Thickness
Blanket	i) $C_u > 7$ and C_c between 1 and 3. ii) Fines (passing 75 microns) :3% to 10% iii) Size gradation – within specified range as given in Table 3.7 or should lie within enveloping curves as given in Fig. 3.8 iv) Los Angeles Abrasion value < 40% (v) Minimum soaked CBR value ≥ 25 (Soil compacted at 100% of MDD* in Lab.) (vi) Field Compaction: 100% of MDD* in field trial (vii) Minimum $E_{v2}^{**} = 120$ MPa (viii) Filter Criteria (***) Optional should be satisfied with subgrade layer, as given below: Criteria–1: $D_{15}(\text{blanket}) < 5 \times D_{85}(\text{prepared sub-grade})$ Criteria–2: $D_{15}(\text{blanket}) > 4 \times D_{15}(\text{prepared sub-grade})$ Criteria–3: $D_{50}(\text{blanket}) < 25 \times D_{50}(\text{prepared sub-grade})$	45cm over SQ3 prepared subgrade 55cm over SQ2 prepared subgrade
Prepared Subgrade	SQ2/SQ3 Soil i) $CBR \geq 8$ (soil compacted at 98% of MDD) ii) Field Compaction : Min. 98% of MDD* iii) Plasticity index ≤ 12 iv) Minimum $E_{v2} = 60$ MPa	50 cm over SQ1 fill 35 cm over SQ2 fill
Subgrade Top layer	SQ1/SQ2/SQ3 Soil (SQ1 soils (To be used only with dispensation	50 cm
Lower layer (fill)	of PCE/ CAO) i) $CBR >$ or equal to 5 (soil compacted at 97 % of MDD*) for SQ2/SQ3 soil ii) $CBR >$ or equal to 4 , for SQ1 (Soil compacted at 97 % of MDD*) iii) Field Compaction : Min. 97% of MDD* iv) Minimum $E_{v2}^{**} = 30$ MPa (for SQ1 soil) 45 MPa (for SQ2/SQ3) SQ1/SQ2/SQ3 Soil (+) i) $CBR >$ or equal to 3 ,(soil compacted at 97 % of MDD*) ii) Field Compaction : Min. 97% of MDD*	As per Embankment height
Ground Soil/Sub-soil Strata	i) Undrained Cohesion of soil (c_u) greater than or equal to 25 KPa	--

	<p>(only for soils having particles finer than 75 micron exceeding 12%)</p> <p>ii) E_{v2} (determined from PLT) > or equal to 20 MPa</p> <p>iii) N (determined from SPT) > or equal to 5</p> <p>Ground Improvement is required, if any of the above parameters not complied with</p>	
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* MDD mentioned in above table

- a) For determination of CBR - MDD achieved in Lab,
- b) For field compaction - MDD achieved in field compaction trials which should not be less than 98% of MDD in lab.

** E_{v2} is Modulus of deformation (**Para 2.0 of Appendix-H**)

*** With the application of Non-woven Geotextile as a separator layer below the blanket, filter criteria will not be required or mandatory.

+ No dispensation of PCE/CAO required for use of SQ1 soil in Lower layer (fill) of Subgrade.

K-RIDE

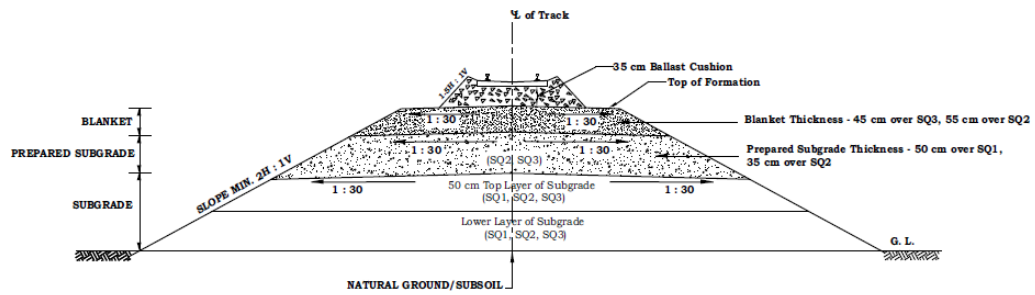


Fig-3.7: Track Formation for Two layer system (for 32.5 T Axle load)

Table-3.7: Gradation Percentage of Blanket Material

SL	IS Sieve Size	Percent Passing (by weight)
1.	40 mm	100
2.	20 mm	80 – 100
3.	10 mm	63 – 85
4.	4.75 mm	42 – 68
5.	2 mm	27 – 52
6.	600 micron	13 – 35
7.	425 micron	10 – 32
8.	212 micron	6 – 22
9.	75 micron	3 – 10

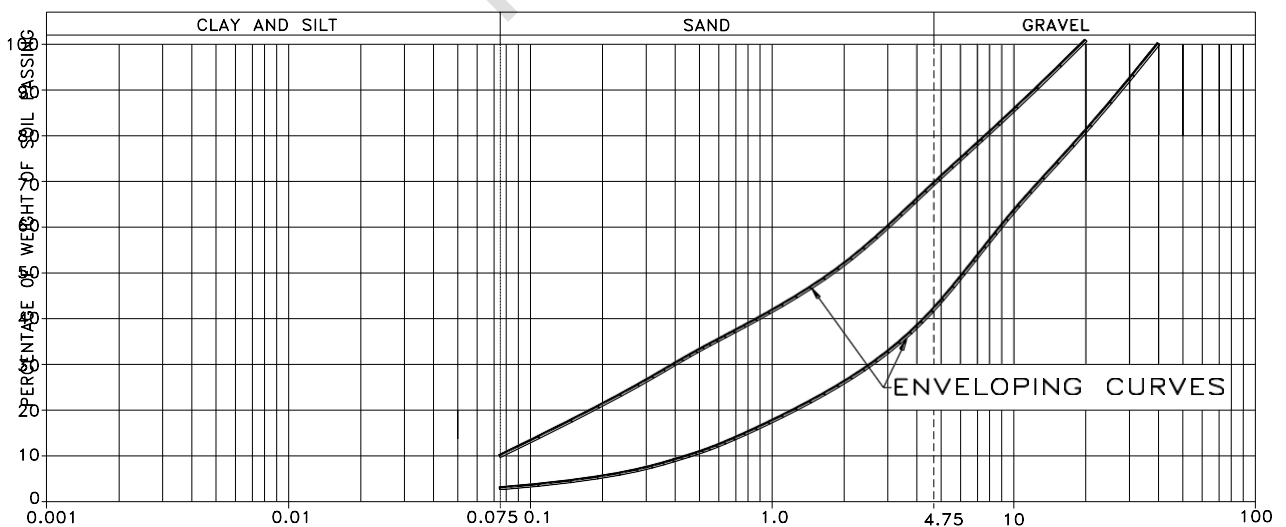


Fig-3.8: Enveloping Curves for Blanket Material

- (C) When the subgrade/prepared subgrade is of SQ1 or SQ2 category soil (in table 3.3 to 3.6), a suitable non-woven geo-textile layer may be used as “separator layer” on the top of subgrade to prevent upward migration of the fines from subgrade/prepared subgrade causing contamination of blanket layer on top of it and also to prevent penetration of coarse particles of layer on top of subgrade into soft/fine grained particles of sub-grade below. Specifications of Non-Woven Geotextile to be used as “separator layer” given in APPENDIX-C.
- (D) Design of formation, including adoption of single layer or two layer system, and use of SQ1 soil (in top layer of subgrade) as given in above paras shall be decided by PCE/CAO (Con) on the basis of soil investigation.

In case of the projects being executed by PSUs, the powers of PCE/CAO shall be exercised at appropriate level of authority as nominated by CMD/MD of the PSU.

- (E) In case of cutting also, blanketing shall be provided as required & as specified in this Para 3.10, based on the type of soil just below the blanket.

3.11 Height of Embankment and Formation Layer thickness:

- i) Minimum height of embankment above ground level or highest flood level (HFL) whichever is higher should not be less than **one meter** to ensure proper drainage and avoid trespassing.
- ii) Total required thickness of formation layers as specified in **Para 3.10** for blanket, prepared sub-grade & Subgrade-Top Layer, should be provided/ensured uniformly in embankment/cutting for effective stress dispersal.
- iii) The specification of soil strata below the ground level (GL) must be ascertained from the results of soil exploration.
- iv) For effective stress dispersal, required total uniform thickness of formation layer (Blanket, Prepared sub-grade & Subgrade/Top Layer) shall be ensured in cuttings as well as in embankments, even where embankment height is less than about 1.5m or total uniform required thickness. It is further explained as below:
 - a) **For Embankment (where height of embankment is less than required total uniform thickness):** If the specification of sub-soil meets the required specification of blanket/prepared subgrade/subgrade-top layer, upto required total depth of uniform thickness below ground level, then there will be no need of excavation, else the excavations will be done below ground level as per the requirement, to satisfy the provision of total uniform thickness for effective stress dispersal. Detailed description & few examples are as given in **APPENDIX-B**.
 - b) **For Cutting:** If the specification of sub-soil does not meet the required specification of blanket/prepared subgrade/subgrade-top layer i.e. total required uniform thickness, below the proposed level of excavation in cuttings, the excavation level for cuttings shall be enhanced to the level so as to satisfy the total required uniform thickness requirement. Detailed description & few examples are as given in **APPENDIX-B**.
- v) Suitable drainage arrangement shall be ensured.

CHAPTER-4

APPLICATIONS OF GEOSYNTHETICS IN RAILWAY FORMATION

4.1 General

Geo-synthetic is a generic term which includes different synthetic products used in Geotechnical Engineering applications. Geo-synthetics are available in a wide range of forms and materials.

They can be utilized to solve various issues related to railway roadbed stabilization, like drainage, filtration, reinforcement, separation, erosion control etc. The raw materials used in the manufacturing of Geosynthetics are polymers, which are non-biodegradable.

4.2 Functions of Geo-synthetics

A properly designed Geosynthetic can serve various functions; some of them are as given below

4.2.1 Separation

A Geosynthetic placed at the interface between two dissimilar geotechnical materials (fine and coarse grained soils) functions as a Separator when it prevents intermixing of two soil types to maintain integrity of each material under the applied loads (**Fig-4.1**). Non-woven geotextile layer is commonly used for separation, in Railway formations, and it provides filtration and drainage also.

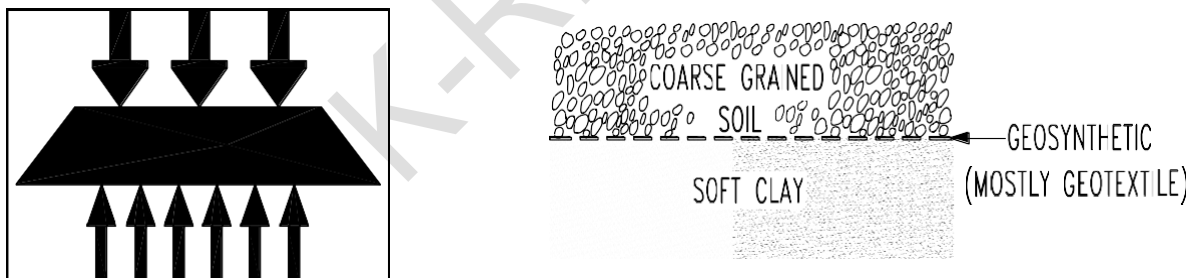


Fig-4.1: Separation

4.2.2 Filtration

In this function, the geosynthetics allows passage of fluids from the soil in either direction while simultaneously prevents the uncontrolled passage of soil particles (**Fig-4.2**). The pore size of the geosynthetic (mostly non-woven geotextile) is chosen to aid against their blocking, binding and clogging. Non-woven geotextile layer is commonly used for filtration in Railway formations and it normally partnered with Separation.

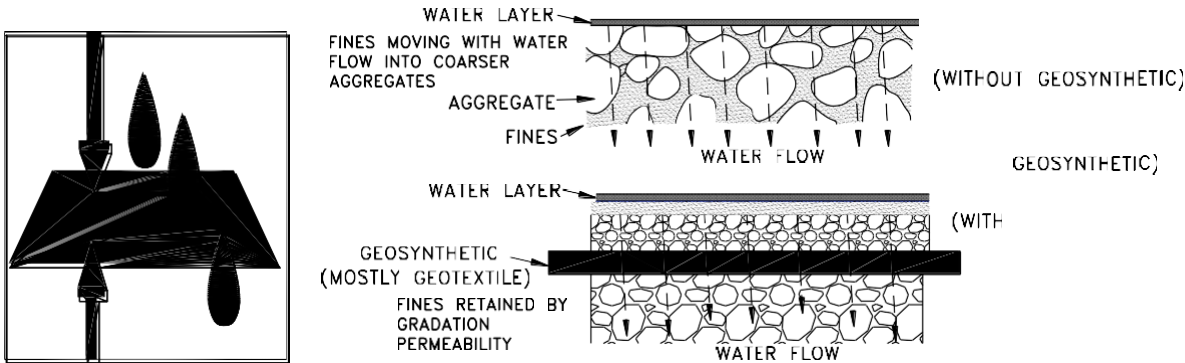


Fig-4.2: Filtration

4.2.3 Drainage

In this function, the Geosynthetic collects the fluid and transports it in its own plane [Fig-4.3 (a) & (b)]. This function is facilitated due to in-plane permeability of the geosynthetic (called “transmissivity”) being far more than permeability across the plane (called “permittivity”). Non-woven geotextile or Geocomposite drains are commonly used for drainage in Railway formations.

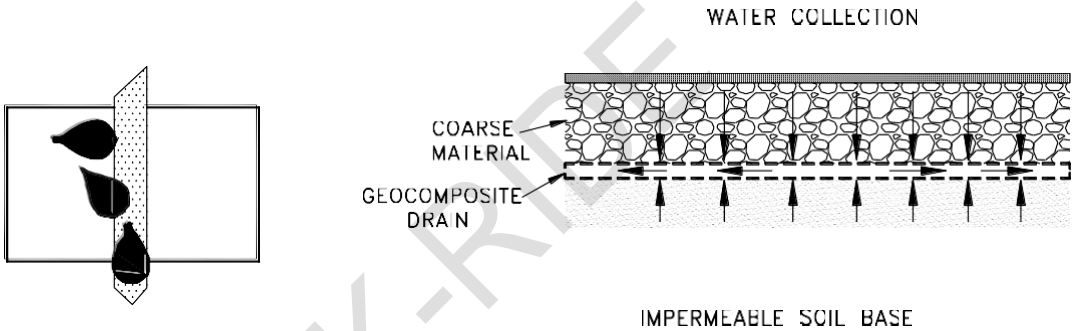


Fig-4.3(a): Drainage in Basal Layer

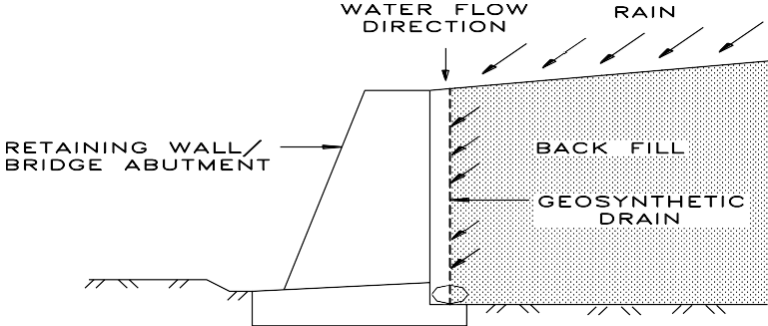


Fig-4.3(b): Drainage behind Bridge Abutment/Retaining Wall

4.2.4 Reinforcement

Geogrid can be used for reinforcement at the bottom of ballast or at the bottom of blanket or within the blanket, which by its reinforcing/interlocking mechanism forms a semi rigid mat that helps in reducing the stresses on the layer below. This can be used to reduce the required blanket thickness.

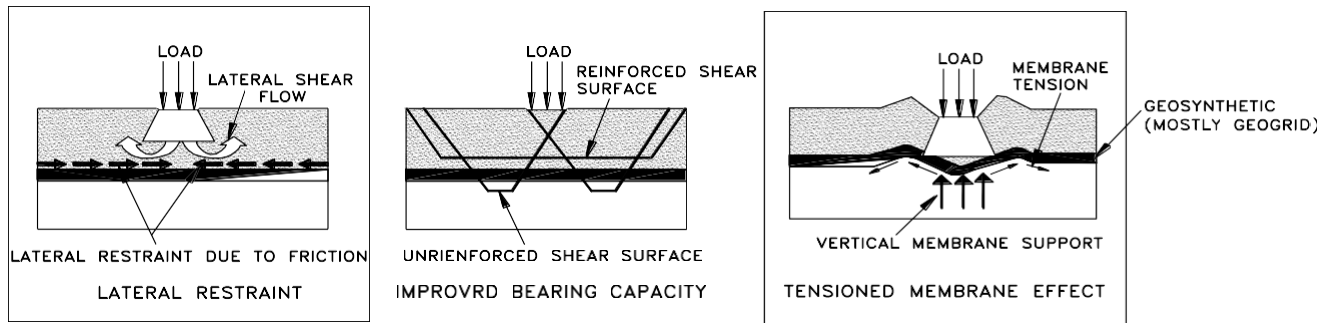


Fig-4.4: Reinforcement of Layers in Embankment

4.3 Types of Geosynthetics

There are various types of Geosynthetics, as under:

- i) Geotextiles
- ii) Geogrids
- iii) Geonets
- iv) Geomembranes
- v) Geocomposites
- vi) Geocell &
- vii) Others

Geosynthetics which are/can be used in Railway formations are described in brief, as under:

4.3.1 Geotextile

Geotextiles are planar and permeable members which are manufactured from synthetic fibers, yarns, filaments, tapes etc. The polymers used in manufacturing geotextiles are Polypropylene, Polyester, High Density Polyethylene and Polyamide (nylon) or a combination thereof, but a large majority of geotextiles are made from Polypropylene.

Generally two types of geotextiles are used commonly, as given below:

(i) Woven Type**Fig-4.5 : Woven Geotextiles**

These geotextiles are woven by interlacing two or more sets of yarns, fibers, filaments, tapes or other elements (Fig-4.5). These threads are generally woven straight and parallel to each other. Woven textiles exhibit high tensile strength, high modulus, high permeability and low elongation.

(ii) Non-woven Type

Non-woven geotextiles are manufactured in the form of sheet or web of directionally or randomly oriented fibres (Fig-4.6), produced by mechanical and/or thermal and/or chemical bonding. Non-woven geotextiles have high permeability and high elongation characteristics. In Railway application it acts as a separator, drainage material, and filter.

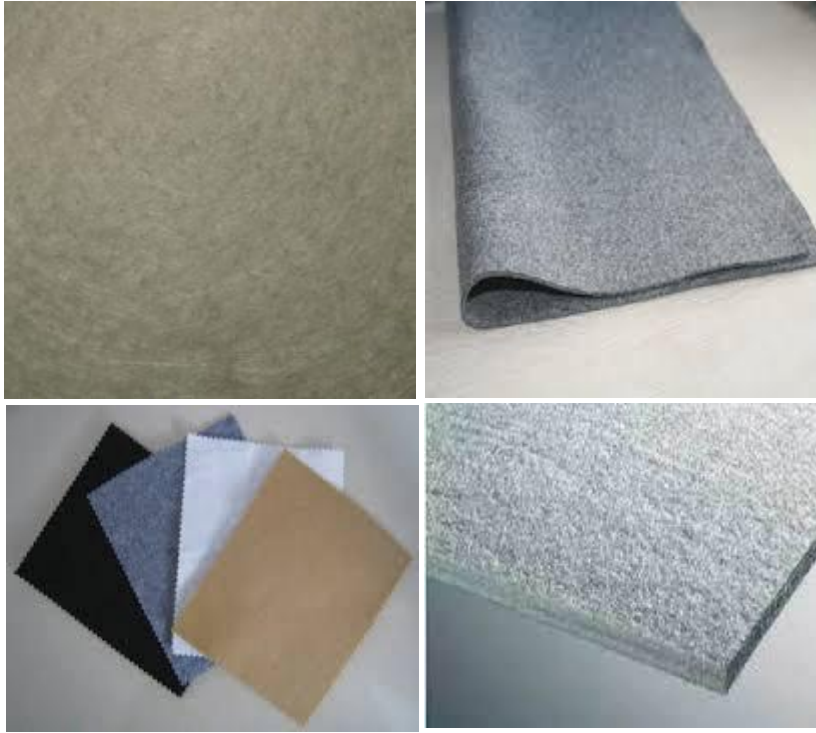


Fig-4.6 : Non-woven Geotextiles

4.3.2 Geogrid

Geogrid is a planar, polymeric structure consisting of a regular open network of integrally connected tensile elements, which may be linked by extrusion, bonding or interlacing. They have an open grid like configuration with large apertures between individual ribs. The key feature of all geogrids is that the apertures are large enough to allow soil communication, or strike through, from one side of the geogrid to the other. Geogrids have relatively high strength, high modulus and low-creep- sensitive polymers. Geogrids provide uniform distribution of loads over a larger area by increasing stiffness of base, as the same resists flexural deformation.

Woven types of geogrids are manufactured by weaving together polypropylene coated polyester fibers into longitudinal & transverse ribs and joining the crossovers by knitting or intertwining before protecting the entire unit by a subsequent coating (Fig-4.7). Extruded types of geogrids are produced by extruding polymers and by stretching uniaxially or biaxially extruded integral structure (Fig-4.8). Bonded geogrid is produced by bonding, usually at right angles, two or more sets of strands or other elements (Fig-4.9).



Fig. 4.7 Woven Geogrid



Fig. 4.8 Extruded Geogrid

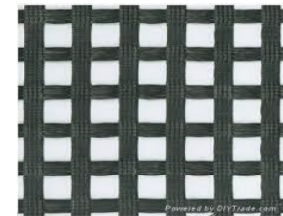


Fig. 4.9 Bonded Geogrid

Following types of geo-grids are generally available in the market:

- (i) **Geogrid with one axis:** Also known as mono-oriented geogrids, it is a planar grid, which possesses a much higher strength in one direction than in the other direction (**Fig-4.10**).
- (ii) **Geogrid with two axes:** Also known as bi-oriented geogrids, it is a planar grid, which possesses similar strength in both ortho direction i.e. longitudinal & transversal (**Fig-4.11**).



Fig-4.10 Geogrid with 1 axis



Fig-4.11 Geogrid with 2 axes



Fig-4.12 Geogrid with 3 axes

- (iii) **Geogrid with three axes:** A recent addition to the geogrid family, this product is having ribs in triangular pattern or other shapes. These geogrids are manufactured from a punched polypropylene sheet oriented in multiple, equilateral directions to form triangular apertures. (**Fig-4.12**).

4.3.3 Geocomposite

Geocomposite a generic name used to define a geosynthetic product consisting of a combination of two or more geosynthetic materials. The application areas of geocomposites are numerous and growing steadily. The geocomposites used for Raiwlay formations, are as following:

(i) Geocomposite Drain

Geocomposite drains, consisting of a geonet bonded with non-woven geotextile layer(s) on one or both sides are used for drainage from a basal layer in case of embankments and for drainage behind retaining walls and/or bridge abutments.

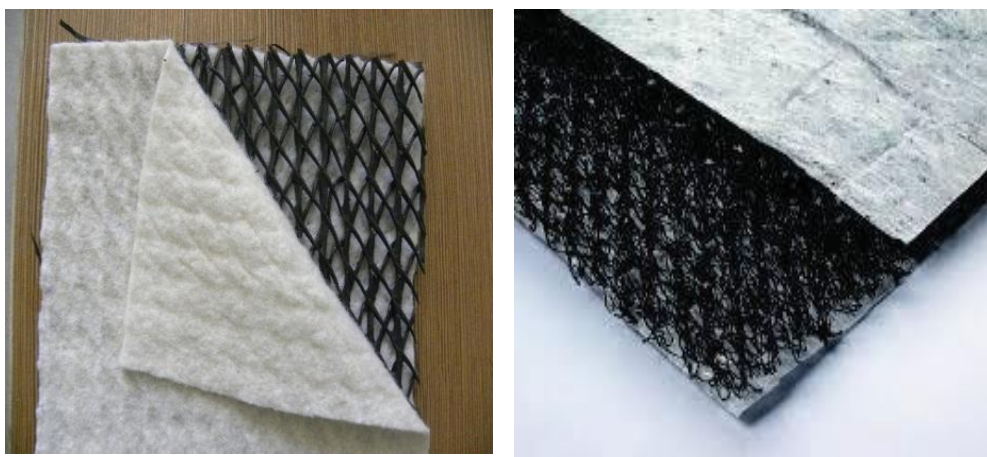


Fig-4.13 Typical Geocomposite Drains

(ii) Prefabricated Vertical Drains (PVD)

Prefabricated Vertical Drains (PVDs) are a geocomposites consisting of a synthetic filter jacket surrounding a plastic core. Normally they are manufactured in rolls of 200-300 m length and are inserted into ground to required depths using special drain stitcher rigs.

4.3.4 Geocell

Geocell is a three dimensional honeycomb like cellular structure, consisting of a regular open network of synthetic strips, linked by extrusion or adhesion or other methods.

4.4 Scope of Use of Geosynthetics In Railway Embankments

The decision on use of geosynthetics shall be taken based on the techno-economic considerations for every site of work, with the approval of PHOD in Open Line and Construction departments of Zonal Railways and equivalent officer in PSUs.

Considering the various functionalities provided by the geosynthetics, they have been used or can be used for following applications related to Railway Embankments:

- a) Construction of new Embankment with fine grained soils
- b) Ground Improvement in case of soft sub-soils
- c) Construction of new Embankment over soft subsoil
- d) Reduction in thickness of blanket layer
- e) Rehabilitation/Strengthening of weak/unstable formation
- f) Drainage behind Bridge Abutment/Retaining Wall.

4.4.1 Construction of new Embankment with fine grained soils

As given in Para 3.10, a non-woven Geo-textile layer is required to be used as "separator layer" in the following cases:

- (a) Below blanket layer, if SQ2 soil is used in prepared sub-grade in two layersystem.
- (b) Below blanket layer, if SQ1 or SQ2 soil is used in sub-grade in single layersystem.

RDSO has developed the Specification for Non-woven geotextile to be used as separator/filtration in Railway formation. The specifications have been issued to Zonal Railway/PSU's for trial application initially so as to improve upon the specifications based on its satisfactory performance, before its general adoption.

Specification of Non-woven Geotextile to be used as separator /filtration in Railway formation (Specification No. RDSO/2018/GE: IRS-0004- Part-I, March 2019) is given in **APPENDIX -C**.

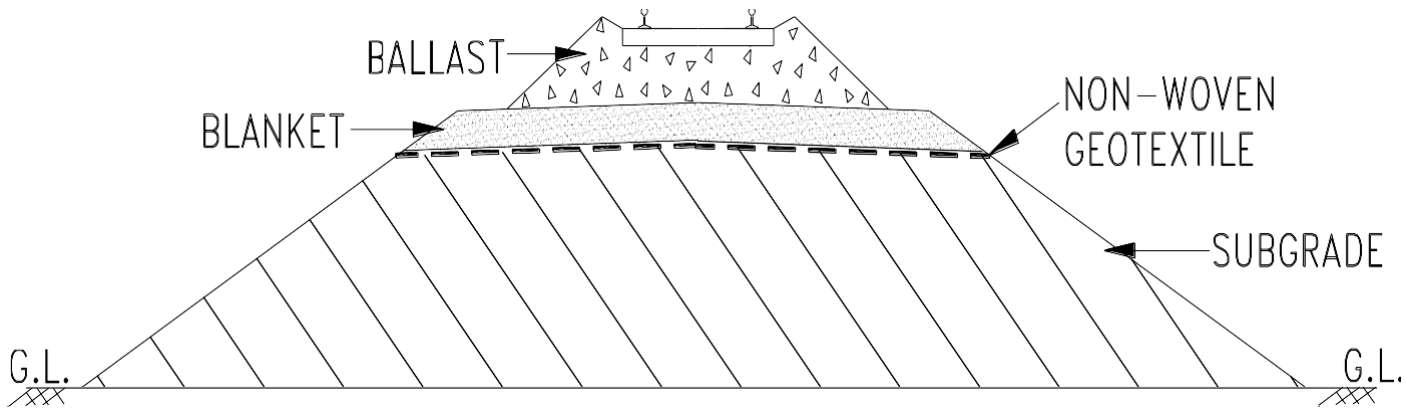


Fig-4.14 (a): Use of non-woven geotextile for fine grained soil(In Single Layer System)

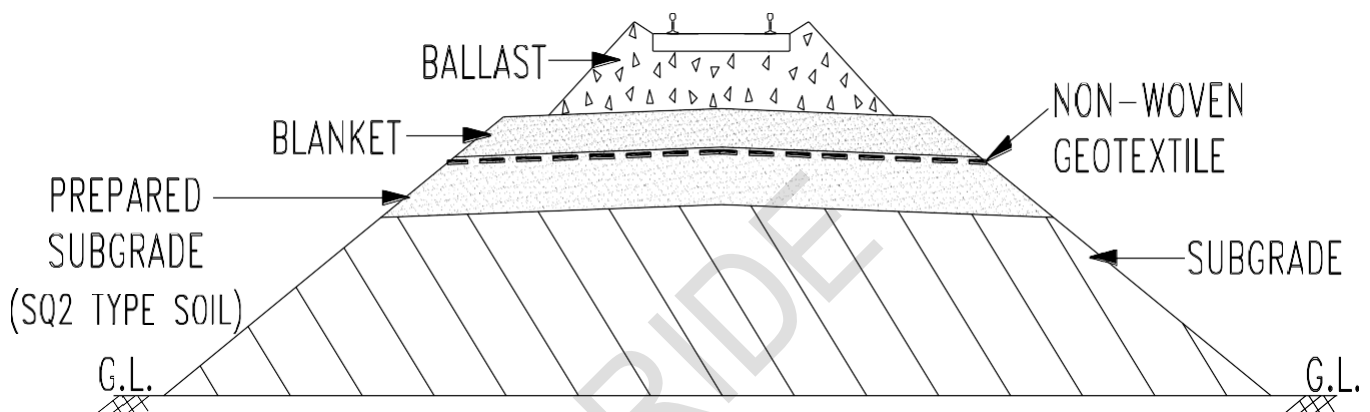


Fig-4.14 (b): Use of non-woven geotextile for fine grained soil(In Two Layer System)

4.4.2 Ground Improvement in case of soft sub-soils

For construction of embankment over soft sub-soils (which are mostly soft clays), the sub-soil/ground has to be improved for –

- a) Reducing the consolidation time (which otherwise can be very long spanning months/year) & associated settlement so that bank can be constructed in faster time; and
- b) To increase the bearing capacity/ shear strength of the sub-soil so that the bank constructed over it is stable.

For faster consolidation & associated settlement, Prefabricated Vertical Drain (PVD) can be used. To improve the load support capacity of soft subsoil, Geocell is another form of Geosynthetics which is used as a basal mattress in embankments for ground improvement. For detailed description, **Chapter-2 (Suitability of Subsoil & Ground Improvement Techniques)** can be referred.

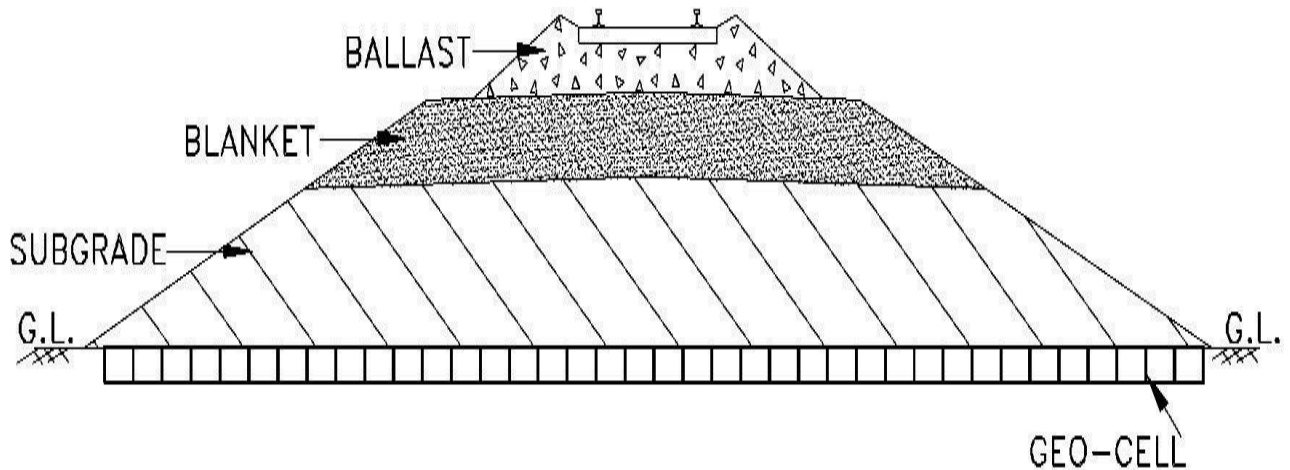
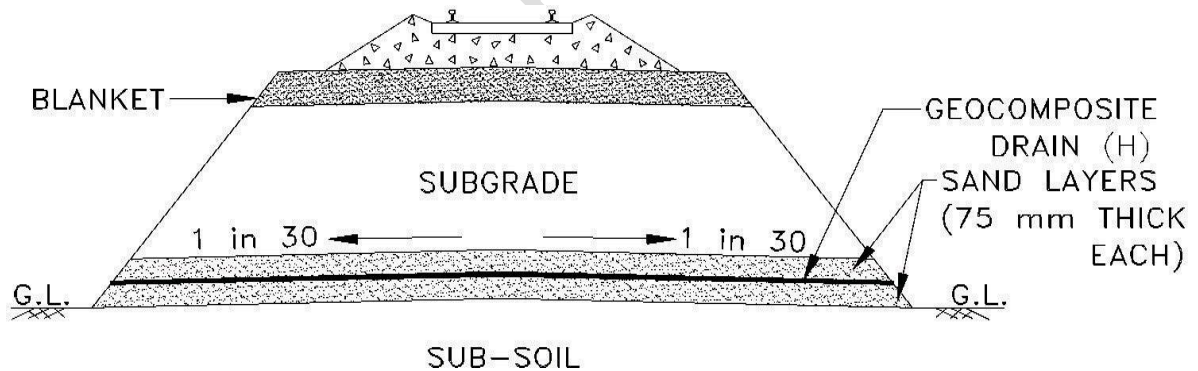


Fig-4.15: Use of Geocell as basal mattress for Ground improvement in soft subsoil

4.4.3 Construction of Embankment over soft subsoil

In case of embankments over weak/fine grained sub-soils (which are mostly soft clays) and having water table at higher level, it is a good practice to provide a “separator-cum-drainage layer” of Geocomposite drain layer, sandwiched between two layers of sand of about 75mm thickness (**Fig-4.16**), at the ground level to provide adequate drainage path for the water coming from sub-soil (reducing excess pore water pressure in embankment and thereby increasing its’ stability) and to prevent fouling of subgrade by the fine grained subsoil. Alternatively, a 1000mm thick sand layer can be provided. Its thickness may be varied depending on the bank height, characteristics of sub-soil and water table. The sand layer to be used in both the cases should be clean medium to coarse sand with minimum



permeability of the order of 10^{-5} m/second.

Fig-4.16: Use of Geosynthetic (Geocomposite drain-horizontal) in embankment over soft subsoil

RDSO has already developed the Specification for Geocomposite Drain (Horizontal) at the base of the Embankment (for embankment height upto 8m). The specifications have been issued to Zonal Railway/PSU’s for trial application initially so as to improve upon the specifications based on its satisfactory performance, before its general adoption.

Specification of Geocomposite Drain to be used at base of the Embankment (Specification No. RDSO/2018/GE: IRS-0004- Part-II, March 2019) is given in **APPENDIX -C**.

4.4.4 Reduction in thickness of blanket layer

To reduce the thickness of the Blanket Layer (which is costly granular material obtained by quarrying or mining) in case of new constructions or for formation rehabilitation, on techno-economic considerations and/or to reduce the adverse impact on environment due to quarrying/mining, geogrid can be used. (Fig-4.17)

RDSO has developed the Specifications for Geogrid to be used as Reinforcement/Stabilisation for Railway Formation. The specifications have been issued to Zonal Railway/PSU's for trial application initially so as to improve upon the specifications based on its satisfactory performance, before its general adoption.

Specifications for Geogrid to be used as reinforcement/stabilisation for Railway Formation (Specification No. RDSO/2018/GE: IRS-0004- Part-III, February 2020) is given in **APPENDIX -C**.

Zonal Railways and Construction units must submit the design of reinforced formation layer to RDSO along with design methodology for use and selection of Geo-grid with minimum specifications as prescribed by RDSO for its approval.

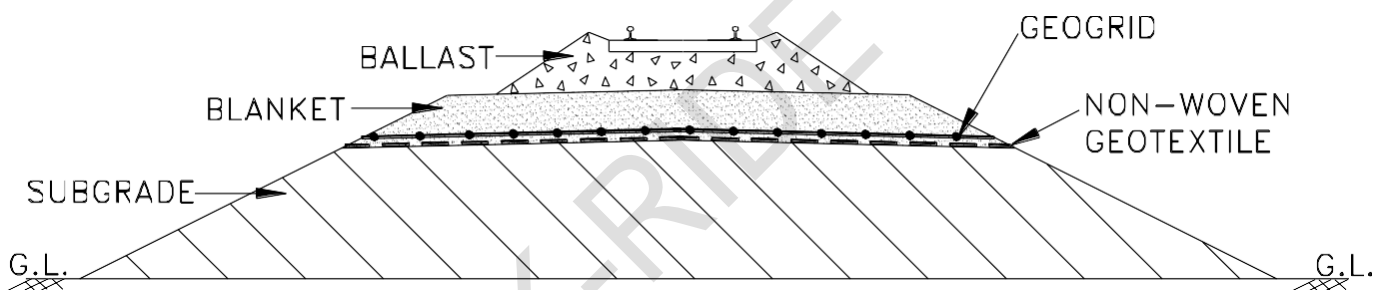


Fig-4.17: Use of geogrid for reduction of blanket layer thicknesses

4.4.5 Rehabilitation/Strengthening of weak/unstable formation

The weak/unstable formations are mostly those formations where subsoil and/or subgrade soil is expansive clay (e.g. Black Cotton Soil). The most significant property of these soils is that when mixed with water they swell considerably, losing their shear strength and on drying they shrink considerably. Because of this swelling and shrinkage, due to ingress of water in rainy season, the track parameters get disturbed and ballast penetrates in the formation. The problems caused by expansive clays can be addressed to a large extent by reducing the ingress of water (during rainy season) by provision of blanket layer of adequate thickness in the top layer of formation. The blanket layer acts as a separator as well as reinforcement layer reducing the pressure on the formation below. In case providing blanket layer of large thickness in running traffic conditions is not possible, its thickness can be reduced with provision of layer(s) of geogrid.

In addition to this by providing a non-woven geotextile, as separator/filtration layer below blanket, will reduce the water from top entering into the sub-grade & also prevents upward migration of fine particles from expansive clays (which are very fine grained) into the top coarse layer.

The preferred method for strengthening/rehabilitation of weak/unstable formations will be provision of a Blanket layer of suitable thickness as detailed above. But in cases where it is not possible to adopt this method, and only shallow depth of formation is considered to be affected/weak, another lesser preferred alternative is laying a separator layer of non-woven geotextile and a reinforcement layer of geogrid over it, just below the ballast along with deep screening work by Ballast Cleaning Machine (BCM), with additional provision in machine for laying of Geogrid/Geotextile. **(Refer Para 10.5, Chapter 10).**

However, before adopting the above method, detailed soil investigation must be done ascertaining the root cause of the formation problem. If the nature of the problems suggests that it cannot be solely rectified by adopting this method, then conventional method of providing blanket layer or other appropriate method as determined from investigation done shall be adopted.

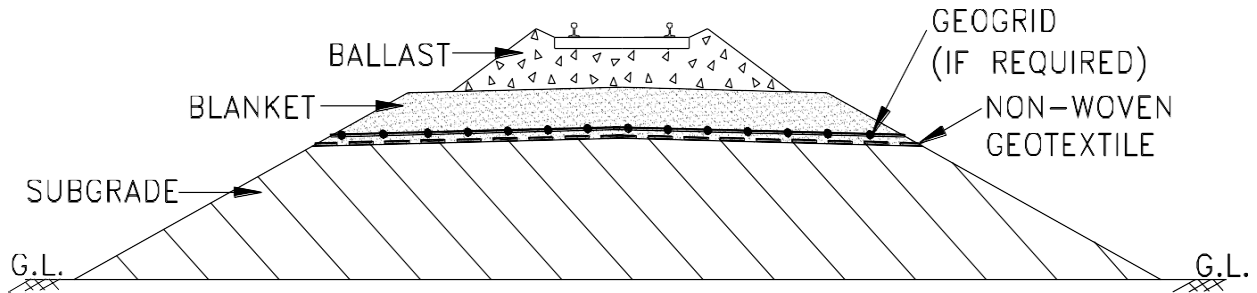


Fig-4.18: Rehabilitation/Strengthening of weak/unstable formation using geogrid & non-woven geotextile

4.4.6 Drainage behind Bridge abutment/Retaining wall

Geocomposite drain (Vertical) can replace the 600 mm thick natural graded filters (consisting of different sizes of boulders and gravels), provided behind bridge abutment and/or retaining walls for drainage, in places where availability of graded filter material is matter of concern. It also eliminates the need for weep holes in bridge abutment and/or retaining walls. The stages in installation of such a synthetic drain are shown in Fig-4.19.

RDSO has developed the Specification for Geocomposite drain (vertical) to be used behind the Bridge Abutment/Retaining wall for drainage purpose. The specifications have been issued to Zonal Railway/PSU's for trial application initially so as to improve upon the specifications based on its satisfactory performance, before its general adoption.

Specification for Geocomposite drains to be used behind Bridge Abutment/Retaining wall (Specification No. RDSO/2018/GE: IRS-0006, March- 2019) is given in **APPENDIX-C**.



Fig 4.19: Installation of Geocomposite Drain

CHAPTER-5

SLOPE STABILITY ANALYSIS

The side slopes of the embankment should be such that they are stable from Slope Stability point of view.

5.1 General

Usually, side slopes of 2:1 would be safe for most of the soils up to Embankment height of 4m. However, this analysis has to be carried out in detail for any height of Embankment in following situations:

- a) When subsoil is soft, compressible & marshy type for any depth.
- b) When subgrade soil (fill material) has very low value of cohesion "C" such that $C'/\gamma H$ (where 'H' is height of Embankment and γ is bulk density of soil) is negligible, i.e., in range of 0.01 or so.

- 5.1.1 In case of embankment of more than 6m height on soft sub-soil, a flatter slope and/or with berm/sub-bank may be required. The same shall be provided as per the results of the slope stability analysis done.
- 5.1.2 In case berm is required to be provided, the minimum width of berm may be kept as 2.0 m, which may be increased as per requirement of rolling equipment, to ensure proper compaction, provision of drain on inner side of berm as required and use of berm as road during maintenance etc. & also fulfilling design requirements.
- 5.1.3 When the highest water table is within $1.5xH$ (H is the height of Embankment), below ground level, then submerged unit weight of soil below water level should be taken.

5.2 Slope in Cutting

In cutting slope, softening of soil occurs with the passage of time, and therefore, long term stability is the most critical, and should be taken into consideration while designing the cuttings.

5.3 Software's for Slope Stability Analysis

This procedure for slope stability analysis manually or with the help of suitable Software like SLOPE/W (of Geo-Studio group), SLIDE (of Roc-Science group) and Slope Stability (of GEO5 group) or equivalent will be adequate for most of the cases. However, in certain situations, further detailed analysis may be required due to the site conditions and the same may be done by an expert consultant.

Manual Slope stability analysis can be carried out using procedure given in **Para 5.4**. A typical worked out example of slope stability analysis is given at **Para 5.8** for guidance.

5.4 Method of slope stability analysis

(Ref:-RDSO's Circular No. GT/SPEC/007/Rev 0/1991 (earlier Circular No. 20 dt.4.9.91) Based on experience gained, especially with the behavior of old embankments and construction of new embankments over soft clays, it has been decided that effective stress analysis shall be adopted for analyzing end-of-construction and long-term stability conditions, adopting realistic values of shear strength and pore water pressure parameters.

5.4.1 Conditions of analysis

Minimum factor of safety should be ensured for the following critical conditions:

- i) In Embankments for **a)** End of construction, and **b)** Long term stability with vitiated spoilt surface drainage such as when ballast is due for deep screening and during monsoon when drains get choked.
- ii) In cuttings, for long term stability with adverse conditions of drainage likely to develop in conjunction with modified sub-surface drainage patterns due to change of topography.

5.4.2 Factor of safety

- i) A factor of safety of 1.4 should normally be adopted against slope failure.
- ii) At the end of construction stage, when pore water pressure dissipates partially, a minimum factor of safety of 1.2 can be allowed to achieve economy but without sacrificing safety for long term – stability. However, a minimum factor of safety of 1.4 must be ensured for the long term-stability.
- iii) Moving train loads need not be considered in the slope stability analysis for Embankments. In case of low height embankments, overstressing zones in soil mass due to live loads would affect the slope stability adversely because the bearing capacity failure mechanism gets mixed up with slope failure mechanism. Hence, minimum FOS of 1.6 should be ensured for slope stability of smaller Embankments of height upto 4m.

5.5 Computation procedure:

Computations shall be done using Bishop's simplified method for determining factor of safety against slips. For designing and checking slopes of Railway embankments and cuttings, stability tables from Table no. 5.3 to Table no. 5.20 as given should be used. These tables were developed by Bishop's and Morgenstern 1960 with extension by O' Conner & Mitchel, 1977 and further by Chandler & Peiris, 1989.

5.5.1 Formula to be used for the computation of factor of safety with Bishop's simplified method is:

$$F.O.S. = m - n \cdot r_u \text{-----} (1)$$

Where: m & n are the stability co-efficient based on $C'/yH, \phi'$, depth factor and assumed slopes. **(See Table no. 5.3 to 5.20)**

C' = effective cohesion

ϕ' = effective angle of internal friction

y = saturated unit weight of soil(s)

H = height of Embankment r_u = pore pressure ratio

D = depth factor

Note: i) Above parameters are explained in Fig. – 5.1

ii) Linear interpolation/extrapolation should be done for intermediate values of m & n

5.5.2 Pore pressure ratio, $r_u = \frac{U}{y} \cdot h$ ----- (2)

Where:

U = pore water pressure

y = bulk density of soil

h = height of soil mass above the point where pore water pressure is being measured

5.5.3 Depth factor, $D = \frac{DH}{H}$ ----- (3)

Where:

DH = total depth from the top of formation to hard stratum of sub-soil H = height of Embankment

a) Determination of Depth Factor:

Work out critical pore pressure ratio (r_{ue}), for depth factors, $D=1.0$ & 1.25 , as given below.

$$r_{ue} = \frac{m_{1.25} - m_{1.00}}{n_{1.25} - n_{1.00}} \text{----- (4)}$$

Where: $m_{1.25}$, $m_{1.00}$, $n_{1.25}$ & $n_{1.00}$ are values of m & n at depth factors of 1.0 & 1.25

b) If $r_{ue} > r_u$ (eq. 2), depth factor, $D = 1.0$

If $r_{ue} < r_u$ (eq. 2), revised r_{ue} will be worked out as $r_{ue} = \frac{m_{1.50} -$

$$m_{1.25}}{n_{1.50} - n_{1.25}} \text{----- (5)}$$

Where: $m_{1.50}$, $n_{1.50}$ etc. are values of m & n at depth factor of 1.50 etc.

ii) If this revised $r_{ue} > r_u$ (eq. 2), then $D = 1.25$

iii) If this revised $r_{ue} < r_u$ (eq. 2), then $D = 1.50$

Thus, depth factor will be taken 1.0 , 1.25 or 1.5 depending upon conditions of r_{ue} with respect to r_u (eq. 2) as worked out from i), ii) & iii)

Note: 1. Maximum value of depth factor is taken equal to 1.5 even if hard strata is not found up to $1.5H$ depth below formation level.

2. r_{ue} is worked out to decide depth factor only. For calculation of FOS, r_u as given in **Table 5.2** will be used.

5.5.4 Determination of Shear Strength ϕ' and pore pressure parameters of sub-soils and embankment soils for stability analysis shall be done as given in **Fig-5.1 & Table- 5.1**. However, for preliminary design or small projects, ϕ' and r_u values for different conditions can be taken from **Fig-5.2 & Table –5.2**.

5.6 Side Slope of Embankment: Side slopes of Embankments should not be steeper than $2:1$.

5.7 Design Parameters & Computation Tables

Design parameters adopted for slope stability analysis should have the approval of the competent authority at SAG level (i.e. Chief Engineer of Zonal Railway or equivalent). Design calculations for each Embankment profile carried out should be recorded in the Design Register, showing soil parameters & factor of safety as adopted. In case of soft soils, the most critical circle with its center may also be indicated. Computation tables for calculation of 'm' & 'n' factors for different soil parameters are shown from table 5.3 to 5.20.

Fig: 5.1

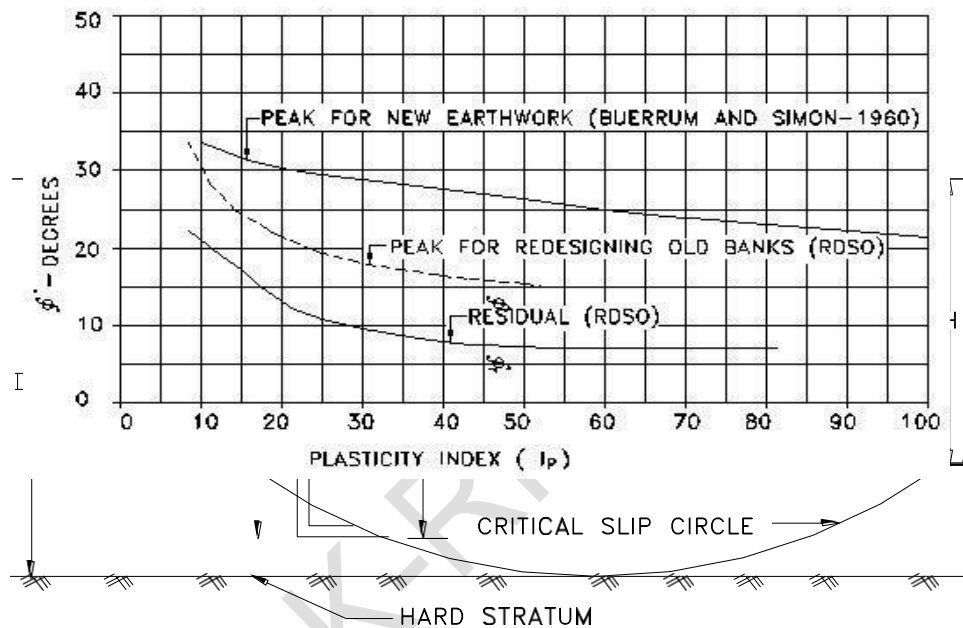
Fig-5.2: Determination of I_p & ϕ for Railway Embankment

Table – 5.1

Determination of shear strength parameters required for subsoil & embankment soil

Subsoil	Embankment
CU – tests on undisturbed samples with pore-pressure measurements in a triaxial apparatus, IS: 2720 (pt. XII)-latest version.	CU – tests on remolded samples made from soils compacted to achieve similar densities at which placement of soil is contemplated during construction in a triaxial apparatus as per IS Specification. IS: 2720 (pt.XII) – latest version.

Note: Peak and residual effective stress parameters from undisturbed samples should be determined both for subsoil and Embankment soil while dealing with old embankments.

Table – 5.2

 r_u Values for Different Conditions

BANK PROFILES	SLOPES					
	2:1	2.5:1	2.75:1	3:1	3.5:1	4:1
	0.25	0.23	0.22	0.21	0.19	0.17
	0.13	0.12	0.11	0.10	0.09	0.08
	0.30	0.27	0.26	0.25	0.22	0.20
	0.15	0.14	0.13	0.12	0.11	0.10
	0.00	0.00	0.00	0.00	0.00	0.00

TABLE –5.3

Stability Coefficients m and n for $C'/yH = 0$ γ

ϕ	Slope 2:1		Slope 3:1		Slope 4:1		Slope 5:1	
	m	n	m	n	m	n	m	n
10.0	0.353	0.441	0.529	0.588	0.705	0.749	0.882	0.917
12.5	0.443	0.554	0.665	0.739	0.887	0.943	1.109	1.153
15.0	0.516	0.670	0.804	0.893	1.72	1.139	1.340	1.393
17.5	0.631	0.789	0.946	1.051	1.261	1.340	1.577	1.639
20.0	0.632	0.728	0.910	1.092	1.213	1.456	1.820	1.892
22.5	0.828	1.035	1.243	1.381	1.657	1.761	2.071	2.153
25.0	0.933	1.166	1.399	1.554	1.864	1.982	2.332	2.424
27.5	1.041	1.301	1.562	1.736	2.082	2.213	2.603	2.706
30.0	1.155	1.444	1.732	1.924	2.309	2.454	2.887	3.001
32.5	1.274	1.593	1.911	2.123	2.548	2.708	3.185	3.311

35.0	1.400	1.750	2.101	2.334	2.801	2.877	3.501	3.639
37.5	1.535	1.919	2.302	2.558	3.069	3.261	3.837	3.989
40.0	1.678	2.098	2.517	2.797	3.356	3.566	4.196	4.362

TABLE -5.4
Stability Coefficients m and n for $C'/yH = 0.025$ & $D=1.00$

ϕ	Slope 2:1		Slope 3:1		Slope 4:1		Slope 5:1	
	m	n	m	n	m	n	m	n
10.0	0.678	0.534	0.906	0.683	1.130	0.846	1.365	1.031
12.5	0.790	0.655	1.066	0.849	1.337	1.061	1.620	1.282
15.0	0.901	0.776	1.224	1.014	1.544	1.273	1.868	1.534
17.5	1.012	0.898	1.380	1.179	1.751	1.485	2.121	1.789
20.0	1.124	1.022	1.542	1.347	1.962	1.698	2.380	2.050
22.5	1.239	1.150	1.705	1.518	2.177	1.916	2.646	2.317
25.0	1.356	1.282	1.875	1.696	2.400	2.141	2.921	2.596
27.5	1.478	1.421	2.050	1.882	2.631	2.375	3.207	2.886
30.0	1.606	1.567	2.235	2.078	2.873	2.622	3.508	3.191
32.5	1.739	1.721	2.431	2.285	3.127	2.883	3.823	3.511
35.0	1.880	1.885	2.635	2.505	3.396	3.160	4.156	3.849
37.5	2.030	2.060	2.855	2.741	3.681	3.458	4.510	4.209
40.0	2.190	2.247	3.090	2.993	3.984	3.778	4.885	4.592

TABLE -5.5
Stability Coefficients m and n for $C'/yH = 0.025$ & $D=1.25$

ϕ	Slope 2:1		Slope 3:1		Slope 4:1		Slope 5:1	
	m	n	m	n	m	n	m	n
10.0	0.737	0.614	0.901	0.728	1.283	0.887	1.288	1.014
12.5	0.878	0.759	1.076	0.908	1.299	1.089	1.543	1.278
15.0	1.019	0.907	1.253	1.093	1.515	1.312	1.803	1.545
17.5	1.162	1.059	1.433	1.282	1.736	1.541	2.065	1.814
20.0	1.309	1.216	1.618	1.478	1.926	1.776	2.334	2.060
22.5	1.461	1.379	1.808	1.680	2.194	2.017	2.610	2.373
25.0	1.619	1.547	2.007	1.891	2.437	2.269	2.897	2.660
27.5	1.783	1.728	2.213	2.111	2.609	2.531	3.193	2.976
30.0	1.957	1.915	2.431	2.342	2.953	2.808	3.511	3.299
32.5	2.139	2.112	2.659	2.585	3.231	3.095	3.841	3.638
35.0	2.331	2.321	2.901	2.841	3.624	3.400	4.191	3.998
37.5	2.536	2.541	3.158	3.112	3.835	3.723	4.563	4.379
40.0	2.753	2.775	3.431	3.399	4.164	4.064	4.958	4.784

TABLE -5.6
Stability Coefficients m and n for $C'/\gamma H \neq 0.05$ & $D=1.00$

ϕ'	Slope 2:1		Slope 3:1		Slope 4:1		Slope 5:1	
	m	n	m	n	m	n	m	n
10.0	0.913	0.563	1.181	0.717	1.469	0.910	1.733	1.069
12.5	1.030	0.690	1.343	0.878	1.688	1.136	1.995	1.316
15.0	1.145	0.816	1.506	1.043	1.904	1.353	2.258	1.567
17.5	1.262	0.942	1.671	1.121	2.117	1.565	2.317	1.825
20.0	1.380	1.071	1.840	1.387	2.333	1.776	2.783	2.091
22.5	1.500	1.202	2.014	1.568	2.551	1.989	3.055	2.365
25.0	1.624	1.338	2.193	1.757	2.778	2.211	3.336	2.651
27.5	1.753	1.480	2.380	1.952	3.013	2.444	3.628	2.948
30.0	1.888	1.630	2.574	2.157	3.261	2.693	3.934	3.259
32.5	2.029	1.789	2.777	2.370	3.523	2.961	4.256	3.585
35.0	2.178	1.958	2.990	2.592	3.803	3.253	4.597	3.927
37.5	2.336	2.138	3.215	2.826	4.803	3.574	4.959	4.288
40.0	2.505	2.332	3.451	3.671	4.425	3.926	5.344	4.669

TABLE -5.7
Stability Coefficients m and n for $C'/\gamma H \neq 0.05$ & $D=1.25$

ϕ'	Slope 2:1		Slope 3:1		Slope 4:1		Slope 5:1	
	m	n	m	n	m	n	m	n
10.0	0.919	0.633	1.119	0.766	1.344	0.886	1.594	1.042
12.5	0.655	0.792	1.294	0.941	1.563	1.112	1.850	1.300
15.0	1.211	0.950	1.471	1.119	1.782	1.338	2.109	1.562
17.5	1.359	1.108	1.650	1.303	2.004	1.567	2.373	1.831
20.0	1.509	1.266	1.834	1.493	2.230	1.799	2.643	2.107
22.5	1.663	1.428	2.024	1.690	2.463	2.038	2.921	2.392
25.0	1.822	1.595	2.222	1.897	2.705	2.287	3.211	2.690
27.5	1.988	1.769	2.428	2.113	2.957	2.546	3.513	2.999
30.0	2.161	1.950	2.645	2.342	3.221	2.819	3.829	3.324
32.5	2.343	2.141	2.873	2.583	3.500	3.107	4.161	3.665
35.0	2.535	2.344	3.114	2.839	3.795	3.413	4.511	4.025
37.5	2.738	2.560	3.370	3.111	4.109	3.740	4.881	4.405
40.0	2.953	2.791	3.642	3.400	4.442	4.090	5.273	4.806

TABLE -5.8
Stability Coefficients m and n for $C'/yH \neq 0.05$ & $D=1.5$

ϕ'	Slope 2:1		Slope 3:1		Slope 4:1		Slope 5:1	
	m	n	m	n	m	n	m	n
10.0	1.022	0.751	1.170	0.828	1.343	0.974	1.547	1.108
12.5	1.202	0.936	1.376	1.043	1.589	1.227	1.829	1.399
15.0	1.383	1.122	1.583	1.260	1.835	1.480	2.112	1.690
17.5	1.565	1.309	1.795	1.480	2.084	1.734	2.398	1.983
20.0	1.752	1.501	2.011	1.705	2.337	1.993	2.690	2.280
22.5	1.943	1.698	2.234	1.937	2.597	2.258	2.990	2.585
25.0	2.143	1.903	2.467	2.179	2.867	2.534	3.302	2.902
27.5	2.350	2.117	2.709	2.431	3.148	2.820	3.626	3.231
30.0	2.568	2.342	2.964	2.696	3.443	3.120	3.967	3.577
32.5	2.798	2.580	3.232	2.975	3.753	3.436	4.326	3.840
35.0	3.041	2.832	3.515	3.269	4.082	3.771	4.707	4.325
37.5	3.299	3.102	3.817	3.583	4.431	4.128	4.112	4.753
40.0	3.574	3.389	4.136	3.915	4.803	4.507	5.343	5.171

Further extensions to the Bishop & Morgenstern slope stability tables

The design charts for the effective stress stability analysis of slopes given by Bishop & Morgenstern (1960) are extended up to $C'/yH=0.15$, $\phi'=20^\circ$ to 40° by Mitchell (1977) and further by Chandler & Peiris (1989).

Table-5.9
Stability Coefficients m and n for $C'/yH \neq 0.075$ & $D=1.00$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n	m	m	n	m	n	m	n
20.0	1.610	1.100	2.141	1.443	2.664	1.801	3.173	2.130
25.0	1.872	1.386	2.502	1.815	3.126	2.259	3.742	2.715
30.0	2.142	1.686	2.884	2.201	3.623	2.758	4.357	3.331
35.0	2.443	2.030	3.306	2.659	4.177	3.331	5.024	4.001
40.0	2.772	2.386	3.775	3.145	4.785	3.945	5.776	4.759

TABLE -5.10
Stability Coefficients m and n for $C'/yH \neq 0.075$ & $D=1.25$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n	m	m	n	m	n	m	n
20.0	1.688	1.285	2.071	1.543	2.492	1.815	2.954	2.173
25.0	2.004	1.641	2.469	1.957	2.972	2.315	3.523	2.730
30.0	2.352	2.015	2.888	2.385	3.499	2.857	4.149	3.357
35.0	2.728	2.385	3.357	2.870	4.079	3.457	4.831	4.043

40.0	3.154	2.841	3.889	3.428	4.729	4.128	5.603	4.830
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TABLE -5.11Stability Coefficients m and n for $C'/yH_f = 0.075$ & $D=1.50$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	1.918	1.514	2.199	1.728	2.548	1.985	2.931	2.272
25.0	2.308	1.914	2.660	2.200	3.083	2.530	3.552	2.915
30.0	2.735	2.355	3.158	2.714	3.659	3.128	4.218	3.585
35.0	3.211	2.854	3.708	3.285	4.302	3.786	4.961	4.343
40.0	3.742	3.397	4.332	3.926	5.026	4.526	5.788	5.185

TABLE -5.12Stability Coefficients m and n for $C'/yH_f = 0.100$ & $D=1.00$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	1.841	1.143	2.421	1.472	2.982	1.815	3.549	2.157
25.0	2.102	1.430	2.785	1.845	3.358	2.303	4.131	2.743
30.0	2.378	1.714	3.183	2.258	3.973	2.830	4.751	3.372
35.0	2.692	2.086	3.612	2.715	4.516	3.359	5.426	4.059
40.0	3.025	2.445	4.103	3.230	5.144	4.001	6.187	4.831

TABLE -5.13Stability Coefficients m and n for $C'/yH_f = 0.100$ & $D=1.25$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	1.874	1.301	2.283	1.558	2.751	1.843	3.253	2.158
25.0	2.197	1.642	2.681	1.972	3.233	2.330	3.833	2.758
30.0	2.540	2.000	3.112	2.415	3.753	2.858	4.451	3.372
35.0	2.922	2.415	3.588	2.914	4.333	3.458	5.141	4.072
40.0	3.345	2.855	4.119	3.457	4.987	4.142	5.921	4.872

TABLE -5.14Stability Coefficients m and n for $C'/yH_f = 0.100$ & $D=1.50$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	2.079	1.528	2.387	1.742	2.768	2.014	3.158	2.285
25.0	2.477	1.942	2.852	2.215	3.297	2.542	3.796	2.927
30.0	2.908	2.385	3.349	2.728	3.881	3.143	4.468	3.614
35.0	3.385	2.884	3.900	3.300	4.520	3.800	5.211	4.372
40.0	3.924	3.441	4.524	3.941	5.247	4.542	6.040	5.200

TABLE -5.15
Stability Coefficients m and n for $C'/yH\gamma = 0.125$ & $D=1.00$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	2.042	1.148	2.689	1.541	3.263	1.784	3.868	2.124
25.0	2.323	1.447	3.062	1.908	3.737	2.271	4.446	2.721
30.0	2.618	1.777	3.457	2.298	4.253	2.810	5.073	3.368
35.0	2.929	2.115	3.880	2.705	4.823	3.407	5.767	4.048
40.0	3.272	2.483	4.356	3.183	5.457	4.060	6.551	4.893

TABLE -5.16
Stability Coefficients m and n for $C'/yH\gamma = 0.125$ & $D=1.25$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	2.054	1.324	2.492	1.579	2.983	1.861	3.496	2.167
25.0	2.377	1.671	2.894	1.993	3.481	2.379	4.078	2.753
30.0	2.727	2.042	3.324	2.431	4.009	2.916	4.712	3.405
35.0	3.110	2.451	3.801	2.928	4.586	3.500	5.414	4.128
40.0	3.542	2.913	4.338	3.494	5.237	4.161	6.207	4.945

TABLE -5.17
Stability Coefficients m and n for $C'/yH\gamma = 0.125$ & $D=1.50$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	2.234	1.545	2.565	1.749	2.963	2.004	3.400	2.287
25.0	2.638	1.972	3.028	2.229	3.500	2.550	4.019	2.913
30.0	3.072	2.425	3.529	2.749	4.083	3.149	4.692	3.598
35.0	3.549	2.923	4.084	3.324	4.727	3.813	5.436	4.362
40.0	4.089	3.485	4.712	3.980	5.456	4.566	6.278	5.226

TABLE -5.18
Stability Coefficients m and n for $C'/yH\gamma = 0.150$ & $D=1.00$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	2.261	1.170	2.895	1.448	3.579	1.806	4.230	2.159
25.0	2.536	1.462	3.259	1.814	4.052	2.280	4.817	2.765
30.0	2.836	1.791	3.657	2.245	4.567	2.811	5.451	3.416
35.0	3.161	2.153	4.098	2.721	5.137	3.408	6.143	4.117

40.0	3.512	2.535	4.597	3.258	5.782	4.083	6.913	4.888
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TABLE -5.19Stability Coefficients m and n for $C'/yH_f = 0.150$ & $D=1.25$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	2.229	1.334	2.701	1.600	3.225	1.873	3.780	2.182
25.0	2.560	1.692	3.107	2.015	3.724	2.384	4.363	2.769
30.0	2.909	2.065	3.542	2.464	4.262	2.941	5.995	3.406
35.0	3.295	2.475	4.018	2.946	4.846	3.534	5.697	4.129
40.0	3.728	2.938	4.556	3.509	5.498	4.195	6.490	4.947

TABLE -5.20Stability Coefficients m and n for $C'/yH_f = 0.150$ & $D=1.50$

ϕ'	Slope 2:1m		Slope 3:1		Slope 4:1		Slope 5:1	
	n		m	n	m	n	m	n
20.0	2.394	1.550	2.748	1.756	3.174	2.020	3.641	2.308
25.0	2.798	1.978	3.212	2.237	3.711	2.561	4.259	2.924
30.0	3.236	2.441	3.718	2.758	4.293	3.156	4.931	3.604
35.0	3.715	2.940	4.269	3.333	4.938	3.819	5.675	4.364
40.0	4.255	3.503	4.896	3.983	5.667	4.569	6.517	5.228

5.8 Design Examples for Calculation for Slope Stability Analysis**Example 1****Design Data**

- Height of Embankment = 6 m (Given)
- Effective cohesion, $C' = 8.2 \text{ kN/m}^2$ (Measured in lab.)
- Effective angle of shear resistance, $\phi' = 25^\circ$ (Measured in lab.)
- Saturated density of soil, $\gamma_{\text{sat}} = 21.53 \text{ kN/m}^3$ (Calculated from lab test results)
- Pore pressure ratio, $r_u = 0.25$ (For Side Slope 2H: 1V on new construction)-Ref. table-5.2.

- Value of $C' / yH = 8.2 / 21.53 \times 6 = 0.063$

There is no direct table for this value therefore linear interpolation would be required between values of C' / yH of 0.05 & 0.075.

- For $C' / yH = 0.075$ (as 0.063 is more closer to 0.075 than 0.05), $\phi' = 25^\circ$ and Side Slope = 2H:1V
 - For $D = 1.00$; from table – 5.9m = 1.872 & n = 1.386
 - For $D = 1.25$; from table – 5.10m = 2.004 & n = 1.641

3. To decide depth factor, r_{ue} will be computed as:
- $$\begin{aligned} r_{ue} &= \frac{m_{1.25} - m_{1.00}}{n_{1.25} - n_{1.00}} \\ &= \frac{2.004 - 1.872}{1.641 - 1.386} \\ &= 0.52 > 0.25 (r_u) \end{aligned}$$

Hence $D = 1$ will be considered as more critical (Ref. Para 5.5.3-b)

4. Therefore, $FOS = m - n * r_u$ will be calculated for the value of $C' / yH = 0.063$ at $D = 1.00$ as follows:

- (i) From table 5.6, FOS (for $C' / yH = 0.05$) = $1.624 - 1.338 \times 0.25 = 1.289$
- (ii) From table 5.9, FOS (for $C' / yH = 0.075$) = $1.872 - 1.386 \times 0.25 = 1.525$
- (iii) Linear interpolation for $C' / yH = 0.063$

$$\begin{aligned} FOS &= (1.525 - 1.289 / 0.075 - 0.05) \times (0.063 - 0.05) + 1.289 \\ &= 1.41 > 1.4 \end{aligned}$$

Hence, the side slope of 2H: 1V is safe.

Example 2

Design Data

- Height of Embankment = 10m (Given)
- Effective cohesion, $C' = 10.5 \text{ kN/m}^2$ (Measured in lab.)
- Effective angle of shear resistance, $\phi' = 20^\circ$ (Measured in lab.)
- Saturated density of soil, $\gamma_{sat} = 22 \text{ kN/m}^3$ (Calculated from lab test results)
- Pore pressure ratio, $r_u = 0.25$ (For Side Slope 2H:1V on new construction) Ref. table-5.2

$$\text{Value of } C' / yH = 10.5 / 22 \times 10 = 0.048$$

There is no direct table for this value therefore linear interpolation would be required between values of C' / yH of 0.025 & 0.05.

- For $C' / yH = 0.05$ (as 0.048 is more closer to 0.05 than 0.025), $\phi' = 20^\circ$ and Side Slope = 2H:1V
 - For $D = 1.00$; from table – 5.6m = 1.380 & $n = 1.071$
 - For $D = 1.25$; from table – 5.7m = 1.509 & $n = 1.226$
 - To decide depth factor, r_{ue} will be computed as:
- $$\begin{aligned} r_{ue} &= \frac{m_{1.25} - m_{1.00}}{n_{1.25} - n_{1.00}} \\ &= \frac{1.509 - 1.380}{1.226 - 1.071} \\ &= 0.66 > 0.25 (r_u) \end{aligned}$$
- Hence $D = 1$ will be considered as more critical (Ref. Para 5.5.3-i)

3. Therefore, $FOS = m - n * r_u$ will be calculated for the value of $C' / yH = 0.048$ at $D = 1.00$ as follows:

(i) From table 5.4, FOS (for $C' / yH = 0.025$) = $1.124 - 1.022 \times 0.25 = 0.868$

(ii) From table 5.6, FOS (for $C' / yH = 0.05$) = $1.380 - 1.071 \times 0.25 = 1.112$

- (iii) Linear interpolation for $C' / yH = 0.048$

$$FOS = (1.112 - 0.868 / 0.05 - 0.025) \times (0.048 - 0.025) + 0.868$$

$$= 1.09 < 1.4$$

Hence, the side slope of 2H: 1V is unsafe.

4. Therefore, FOS will be calculated for the Side Slope = 3H: 1V and the value of $C' / yH = 0.048$, $\phi' = 20^\circ$ remains the same. (Pore pressure ratio will be changed to $r_u = 0.21$ for the Side Slope = 3:1, from table -5.2)

5. For $C' / yH = 0.05$, $\phi' = 20^\circ$ and Side Slope = 3:1

a) For $D = 1.00$; from table – 5.6m =
1.840 & $n = 1.387$

b) For $D = 1.25$; from table – 5.7m =
1.834 & $n = 1.493$

c) Calculate r_{ue} to decide depth factor. $r_{ue} =$

$$\frac{m_{1.25} - m_{1.00}}{n_{1.25} - n_{1.00}}$$

$$= \frac{1.834 - 1.840}{1.493 - 1.387}$$

$$= -0.05 < 0.25 (r_u)$$

Therefore, workout r_{ue} for $D = 1.25$ & 1.50

d) For $D = 1.50$; from table – 5.8m =
2.011 & $n = 1.705$

- e) Calculate r_{ue} again.

$$r_{ue} = \frac{m_{1.50} - m_{1.25}}{n_{1.50} - n_{1.25}}$$

$$= \frac{2.011 - 1.834}{1.705 - 1.493}$$

$$= 0.83 > 0.25 (r_u)$$

Hence $D=1.25$ will be considered as more critical.

6. Therefore, $FOS = m - n * r_u$ will be calculated for the value of $C' / yH = 0.048$ at $D = 1.25$ as follows:

(i) From table 5.5, FOS (for $C' / yH = 0.025$) = $1.618 - 1.478 \times 0.21 = 1.308$

(ii) From table 5.7, FOS (for $C' / yH = 0.050$) = $1.834 - 1.493 \times 0.21 = 1.521$

(iii) Linear interpolation for $C' / yH = 0.048$

$$\begin{aligned} \text{FOS} &= (1.521 - 1.308 / 0.050 - 0.025) \times (0.048 - 0.025) + 1.308 \\ &= 1.50 > 1.4 \end{aligned}$$

Hence, the side slope of 3H: 1V is safe.

K-RIDE

CHAPTER-6

EXECUTION OF EARTHWORK

6.1 General

Before taking up of actual execution of work, detailed drawings need to be prepared for the entire length of the project to give alignment, formation levels, formation width at ground level, cross sections of catch water drains & side drains, cross section & levels of subgrade, blanket levels, etc. to facilitate smooth execution at site. Execution of work has to be carried out in a systematic manner so as to construct formations of satisfactory quality which would give trouble free service.

6.2 The activities and adoption of good practices involved in execution of earthwork are covered under following headings

- i) Preliminary works
- ii) General aspects
- iii) Compaction of earth work
- iv) Sandwich Construction of Embankments with Cohesive Soils
- v) Placement of Back-Fills on Bridge Approaches and Similar Locations
- vi) Drainage Arrangement in Embankment/Cutting
- vii) Finishing and Blanketing
- viii) Setting up of GE lab at Construction Site
- ix) Maintenance of Records

6.2.1 Preliminary Works

A. Preparation of Natural Ground

Preparation of natural ground surface may be carried out as follows:

- (i) **Site clearances:** Full formation width at ground level plus additional extra width of 1 m on both sides should be cleared of all obstructions viz. vegetation, trees, bushes, building, fences, abandoned structures etc. and thereafter it should be dressed and leveled. Depressions if any should be filled with suitable soil duly compacted. Finally, the leveled surface should be properly compacted by mechanical means to get a leveled and uniform ground surface.
- (ii) **When Embankment is constructed on Ground having steep slope,** then the ground surface should be suitably benched so that new material of embankment gets well bonded with the existing ground surface.

Surface drainage shall be constructed, wherever required, so as to maintain the natural water drainage facilities and limit the introduction of water into the earthworks.

B. Setting out of Construction Limits

Centerline of the alignment (@200 m c/c or so) and full construction width should be demarcated with reference pegs/dug belling about 90 cm away from proposed toe of the embankment. Care should be taken not to disturb the pegs during construction. Pegs should be preferably painted for identification.

c. Selection of Borrow Area

- (i) Borrow area should be selected sufficiently away from the alignment, as far as possible at the extreme of Railway land but normally not less than 3 m plus height of the Embankment to prevent base failure due to lateral escapement of the soil.
- (ii) Borrow area should be selected for soil suitable to be used in construction. Embankment is to be constructed normally with soil available in nearby area, with properly designed slope. However, there are some soils, which are normally unsuitable for construction of formation & hence it is to be normally avoided (as described in Para 3.7 of Chapter 3).

6.2.2 General Aspects

- (i) A field trial for compaction on a test section shall be conducted on fill material to assess the optimum thickness of layer and optimum number of passes for the type of roller planned to be used to arrive at desired density. It optimizes compaction efforts of earthwork while achieving desired level of density based on lab tests. Procedure for field compaction trials is given in para 6.2.3 below.
- (ii) If the soil has less than required moisture content, necessary amount of water shall be added to it either in borrow pits or after the soil has been spread loosely on the Embankment. Addition of water may be done through flooding or irrigating the borrow areas or sprinkling the water on the Embankment through a truck mounted water tank sprinkling system. Use of hose pipes for water need to be avoided.
- (iii) If the soil is too wet, it shall be allowed to dry till the moisture content reaches acceptable level required for the compaction.
- (iv) Placement moisture content of soil should be decided based on the field trial and site conditions. The objective should be to compact near OMC to achieve uniform compaction with specified density in the most efficient manner.
- (v) Clods or hard lumps of soil of the borrow area shall be broken to 75 mm or lesser size before placing on Embankment.
- (vi) Each layer should be compacted with recommended type of roller upto required level of compaction, commencing from the sides, before putting the next upper layer.
- (vii) Extra embankment width of 500mm on either side shall be rolled/compacted to ensure proper compaction at the edges. The extra soil should be cut and dressed mechanically to achieve regular side slope and the slope shall be compacted with 6-8 passes of slope compactors (10-20 ton capacity). Details of some of the slope compactors are annexed at **Appendix-E**.
- (viii) Backfill behind abutments: To avoid differential settlement in the approaches of bridges, compaction should be carried out with the help of vibratory plate compactors.

- (ix) In areas susceptible to flooding, the sides of an Embankment (except approach bank of bridges) should be protected with a layer of rockfill or stones with an intermediate granular layer upto 1 m above HFL. For other conventional methods of Erosion Control of slopes in such cases, Para 8.3.1 of Chapter 8 of this document shall be referred to.

6.2.3 Compaction of Earthwork

Performance of the Embankment would depend to large extent on the quality of compaction done during execution.

A. Advantages of Compaction

- (i) Compaction is the process of increasing the density of soil by mechanical means by packing the soil particles closer together with reduction of air voids and to obtain a homogeneous soil mass having improved soil properties. Compaction brings many desirable changes in the soil properties as follows:
- a) Helps soils to acquire increase in strength in both bearing resistance and shear strength.
 - b) Reduces compressibility, thus minimizing uneven settlement during service.
 - c) Increases density and reduces permeability, thereby reducing susceptibility to change in moisture content.
 - d) Reduction in Erodibility.
 - e) Results in homogenous uniform soil mass of known properties.
 - f) Reduction in frost susceptibility in cold regions
- (ii) However, while compaction of earthwork is a necessary condition to achieve a stable formation, it does not help in checking against the following causes which needs to be taken care during the design of embankment or cutting:
- a) Excessive creep or slipping of slopes.
 - b) Swelling and shrinkage characteristic of soils due to variation in moisture content because physio-chemical properties of a soil do not change on compaction.
 - c) Mud pumping at ballast - soil interface.
 - d) Settlements due to consolidation of embankment and subsoil that can occur even for a few years after construction of the embankment.

B. Factors Affecting Compaction in the Field

Compaction of a particular soil is affected by moisture content, compacting effort, type of roller etc as explained below:

a. Compacting Effort:

In modern construction projects, heavy compaction machinery is deployed to provide

compaction energy. Types of machinery required are decided based on the type of soil to be compacted. The method of compaction is primarily of four types i.e. kneading compaction, static compaction, dynamic or impact compaction and vibratory compaction. Different type of actions is effective in different type of soils such as for cohesive soils, Sheepsfoot rollers or pneumatic rollers provide the kneading action. Silty soil can be effectively compacted by Sheepsfoot roller/pneumatic roller or smooth wheel roller. For compacting sandy and gravelly soil, vibratory rollers are most effective. If granular soil has some fines, both smooth wheeled and pneumatic rollers can be used.

b. Moisture Control:

Proper control of moisture content in soil is necessary for achieving desired density. Maximum density with minimum compacting effort can be achieved by compaction of soil near its OMC (Optimum Moisture Content). If natural moisture content of the soil is less than the OMC, a calculated amount of water should be added with sprinkler attached to the water tanker and mixed with soil by motor grader for uniform moisture content. When soil is too wet it is required to be dried by aeration to reach up to OMC.

c. Soil Type:

Type of soil has a great influence on its compaction characteristics. Normally, heavy clays, clays and silts offer higher resistance to compaction, whereas, sandy soils and coarse grained or gravelly soils are amenable for easy compaction. Coarse-grained soils yield higher densities in comparison to clay. A well-graded soil can be compacted to higher density.

d. Thickness of Layer:

Suitable thickness of soil of each layer is necessary to achieve uniform compaction. Layer thickness depends upon type of soil involved and type of roller, its weight and contact pressure of its drums. Normally, 200 – 300 mm layer thickness is optimum in the field for achieving homogenous compaction.

e. Number of Passes:

Density of soil will increase with the number of passes of roller but after optimum number of passes, further increase in density is insignificant for additional number of passes. For determination of optimum number of passes for given type of roller and optimum thickness of layer at a predetermined moisture content, a field trial for compaction is necessary.

C. Field Compaction Trial

a. General

Field compaction trial is carried out to optimize compaction efforts of earthwork while achieving desired level of density based on Lab tests (Heavy compaction test, IS:2720 (Part-8) and Relative Density Test, IS:2720 (Part - 14). Type of roller to be used for compaction has to be decided depending on the type of soil to be compacted in execution of earthwork.)

b. Determination of compaction efficiency

The increasing trend of density with increase in number of passes of a compactor tends to diminish gradually and a 'diminishing return stage' is reached. This will determine the type of compactor, optimum thickness of layer, corresponding water contents and number of roller passes.

c. Methodology for conducting field compaction trial includes following steps:

Step 1: Construct a test ramp about 20-30m long, 10-12m wide & 0.15m thick on one end & 0.55m on other end, preferably at the construction site, over a level ground surface clear of bushes, depressions etc. under nearly identical conditions as shown in **Appendix-D (Fig-D1)**.

Step 2: Divide the ramp equally into the desired number, say, four segments, longitudinally of about 2.5m width (more than width of roller). Each strip will be used for conducting trials at specific moisture content, viz. OMC (Lab test value), OMC $\pm 4\%$ and (PL - 2%) etc.

Note: Experience shows that most suitable water content falls within a small range of 3% below to 1% above the OMC for most of the soil.

Step 3: Start a compaction trial on the first segment at a particular moisture content (Step 2).

Step 4: Fix four number of sampling points on this strip at locations where layer thickness of about 225, 300, 375 & 450 mm are to be obtained after rolling. **Appendix-D (Table-D4)**.

Step 5: Collect samples around the sampling points (Step 4). Determine moisture content by any suitable standard method

Step 6: Compare the moisture content with that of the relevant desired moisture content (Step-3).

Step 7: Wait for natural drying if moisture content is on higher side or sprinkle appropriate amount of water uniformly followed by ploughing etc. and leave for 5 to 30 minutes depending on type of soil, in case the moisture content is on lower side (Step 3).

Step 8: Determine moisture content once again at sampling points before rolling. Observations of determination of moisture content are recorded as per **Appendix-D (Table – D2)**.

Step 9: Roll the strip and measure the dry density (by any standard method) of the soil after every two passes commencing from four roller passes. The observations are recorded as per **Appendix-D (Table–D3)**.

Note: Measurement of dry density and moisture content are taken after removing the top 5 cm layer of earth with least possible disturbance. If the layer thickness is small, density ring should be used.

Step 10: Carry out testing on each strip at different specific moisture content as for the first strip explained above. Compile the results of trial of all strips as per **Appendix-D (Table–D3)**.

Step 11: From these test results, two sets of graph are plotted:

First set of graphs: Dry density v/s number of roller passes for each water content and layer thickness. For each layer, there would be four (depending on range of moisture content chosen) curves for different moisture content. **Appendix-D (Fig-D2)**.

Second set of graphs: Maximum dry density v/s moisture content for each layer thickness. **Appendix-D (Fig-D3)**.

Step 12: Second set of graphs will give field moisture content, maximum attainable field dry density and optimum layer thickness. From this field values minimum no. of passes of particular roller **Appendix-D (Fig-D2)** are read from the first set of graphs.

D. Compaction Procedures for Different Soils

The Embankments are constructed with locally available soils provided it fulfils the specified requirements. Procedure of compaction to be adopted will depend on the type of soil being used in construction. General guidelines to deal with compaction of various types of soils for attaining optimum dry density/relative density at minimum effort have been briefly given as under:

i) Compaction of Cohesionless Gravely and Sandy Soil

Sandy & gravely soils should be compacted with vibratory rollers. If fines are less in these types of soils, it can be compacted with minimum number of passes of vibratory rollers without strict control of moisture to achieve desired Relative Density. With higher percentage fines, sandy and gravely soils need to be brought to OMC level to get effective compaction. Uniformly graded sand and gravel are difficult to be compacted. Top layer of sand and gravel remains loose in vibrating compaction. Therefore, in final pass the roller should move smoothly without vibration. Dry densities obtained in field trials normally should be around MDD/ specified Relative Density as obtained from laboratory tests and should form the basis for specification and quality control.

ii) **Compaction of Silty - Clayey Soils**

Silty soil is a fine-grained soil. These can be plastic or non-plastic depending upon the clay content in it. Silts and fine sands with high water content have a tendency to undergo liquefaction under vibrating rolling due to the pore water pressure generated by mechanical work. Silty soils can be compacted satisfactorily near about OMC either with smooth rollers or vibratory rollers. Vibratory roller will give high degree of compaction and higher lift. Compaction of silty clays will have to be handled in a manner similar to clays.

iii) **Compaction of Clays**

a) Water content plays a very important role in compaction of clays. Main objective of compacting predominantly clays is to achieve uniform mass of soil with no voids between the lumps of clays. If moisture content is too high, roller tends to sink into the soil and if too low the chunks would not yield to rolling by rollers. Appropriate water content i.e. OMC of the soil is in the range of about plastic limit plus two percent. Sheep foot rollers are most effective in breaking the clods and filling large spaces.

b) Thickness of layer should not be more than depth of feet of roller plus 50mm.

iv) In case of such soils, the MDD and OMC, as determined in the Laboratory may not be very relevant and therefore achievable MDD and practicable moisture content at which such soils can be compacted effectively should be determined by conducting field trials.

v) **Selection of Compacting Equipment:** The performance of roller is dependent mainly on the type of soil used in construction. Guidelines on selection of compacting equipment are given in **Appendix-F**. Vibratory rollers which can be used in static as well as dynamic mode with plain & pad drum are now being manufactured by reputed Indian Companies also. Salient features of some of the models are given in **Appendix-E**.

vi) **Use of Construction Equipments for Execution of Earthwork**

Any manual methods of construction cannot achieve the desired quality of earthwork. It would be necessary to deploy modern equipment such as earthmover, motor graders, scraper, dumpers, mobile water sprinklers, vibratory rollers, sheep foot rollers etc. as per need, on all projects, so that the quality of work is as per laid down standards. It would be desirable to maintain records of work done by various equipment at a particular site to assess the output and quality control.

6.2.3 Sandwich Construction of Embankments with Cohesive Soils

Sandwich type of construction may be adopted for construction of Embankments with cohesive soils having very low permeability (less than or equal to 10^{-2} cm/sec.) (As given in Fig-6.1) and where height of the embankment is greater than 3m. In such situations, a layer of coarse sand ($C_u > 2$) of about 20 to 30 cm thick should be provided at embankment height intervals of 2 to 3m. **Fig- 6.1** given below

provide Guidelines for sandwich construction for different heights to improve the factor of safety against slope failure, drainage and dissipation of pore water pressure. It is desirable to have a bottom layer of coarse sand in all cases where soils of low permeability are used even for depths upto 3m. However, before adopting such construction, it may be necessary to carry out a detailed technical study along with economics of sandwich construction, depending on site conditions and availability of material, if required, in consultation with RDSO.

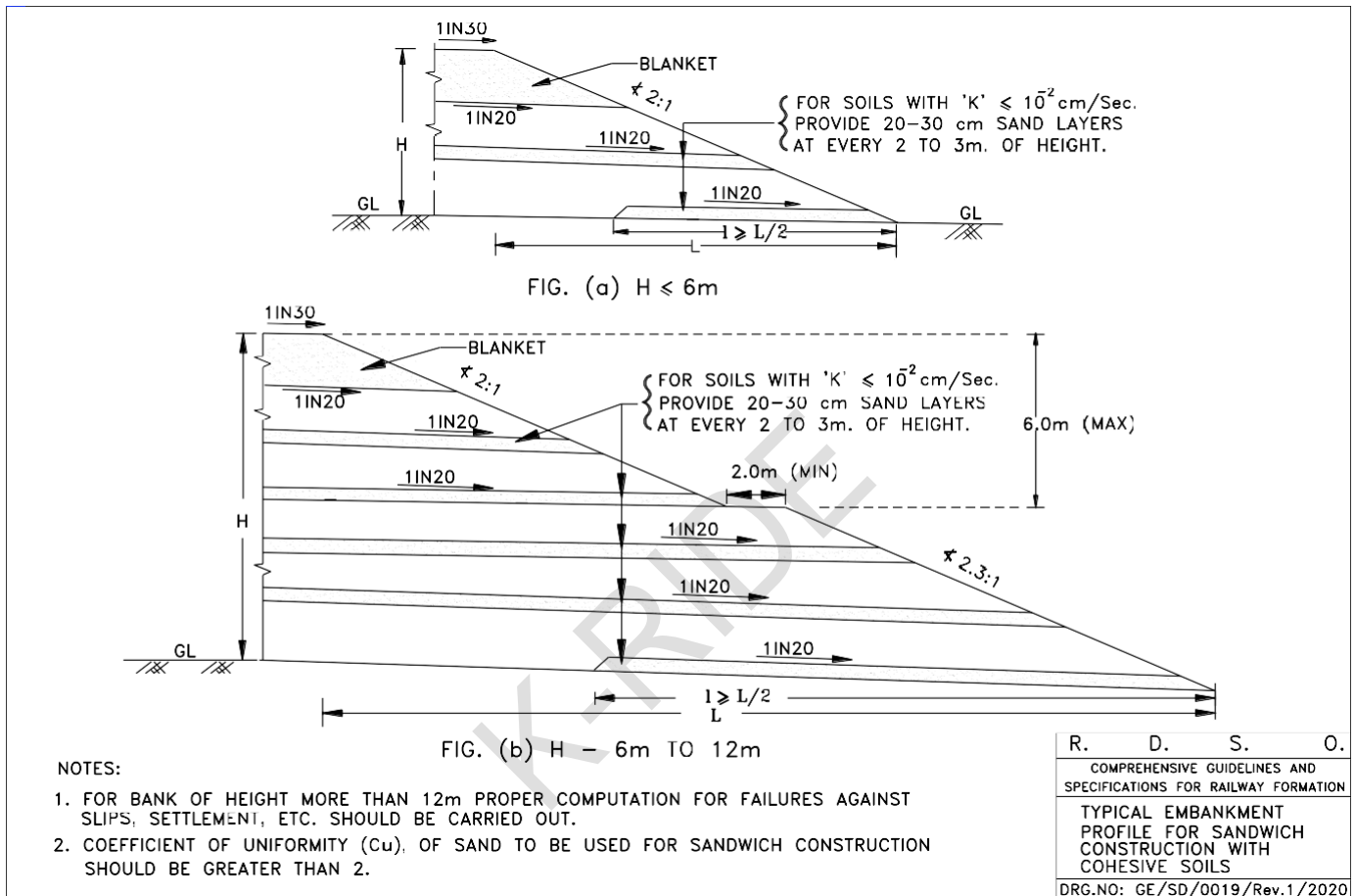


Fig-6.1 Typical embankment profile for sandwich construction with cohesive soil

6.2.4 Placement of Back-Fills on Bridge Approaches and Similar Locations

- The back fills resting on natural ground may settle in spite of heavy compaction and may cause differential settlements, vis-a-vis, abutments, which rest on comparatively much stiffer bases. To avoid such differential settlements, while on one hand it is essential to compact the back fill in the properly laid layers of soil for Settlements within tolerable limits so that Coefficient of subgrade reaction should have gradual change from approach to the bridge.
- Back-fills on bridge approaches shall be placed in accordance to Para 7.5 of Bridge Substructure code (including latest correction slips). Sketch for details given in **Fig-6.2** below.

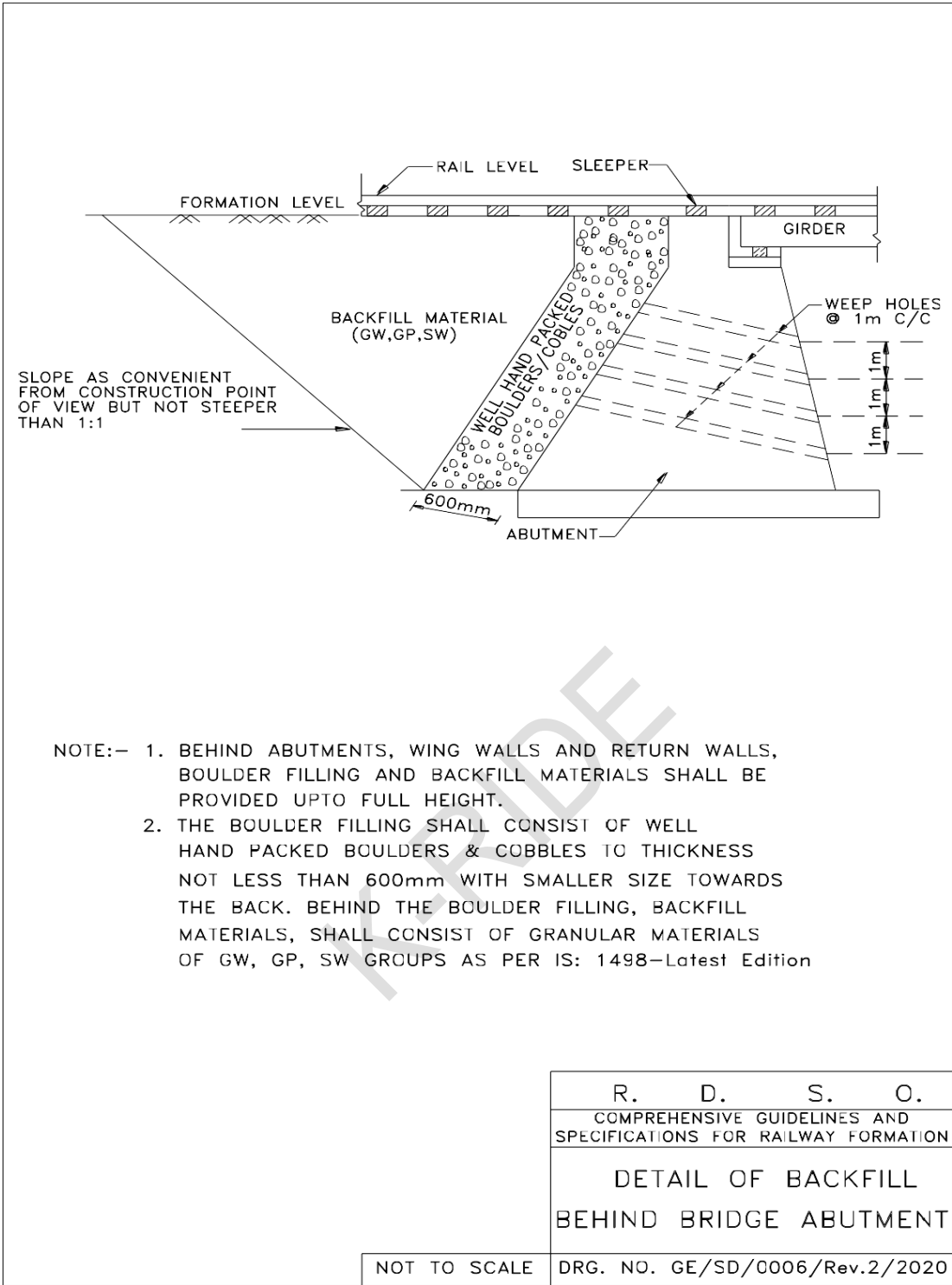


Fig-6.2 Details of backfill behind bridge abutment

- iii) Fill material being granular and sandy type soil, therefore need to be placed in 150mm or lesser thick layers and compacted with vibratory plate compactors.
- iv) While placing backfill material benching should be made in approach Embankment to provide proper bonding.
- v) Geocomposite drain (vertical) can replace the natural graded filters (consisting of 600mm thick boulders/cobbles etc. as shown in Fig 6.2 above), provided behind bridge abutment and/or retaining walls for drainage in places where availability of graded filters is matter of concern. Detailed elaboration is given in Appendix-C.

6.2.5 Drainage Arrangement in Embankments and Cuttings

Drainage is the most important factor in the stability of embankment/cutting in railway construction. Effective drainage of the rainwater in the monsoon season is very important to safeguard embankment/cutting from failure. Railway formation is designed for fully saturated soil condition. However, Stagnation of water for long time on formation is not desirable. Therefore, the drainage system should be efficient enough to prevent stagnation and allow quick flow of water. Some guidelines on this aspect are given as follows:

i) Drainage of Embankment:

In embankment cross slope is provided to drain out surface water. Therefore, normally here is a need of side drains in case of embankment.

Top of formation should have a cross slope of 1 in 30 from centre of formation towards both sides for single line/multiple line in new construction. In case of doubling or multiple line construction work in existing lines, the cross slope of 1 in 30 should continue from the edge of existing formation towards cess/drain side (single slope) to avoid any stagnation of water between two tracks. However, if the cross slope of existing embankment is steeper than 1 in 30 due to any reason, the configuration of 1 in 30 cross slope shall be maintained in the new line while ensuring proper drainage conditions at the same time so as to avoid any stagnation of water in between tracks, by adopting various measures as per site conditions.

In case of double line construction, central drain between the tracks should be avoided to extent possible (even if it means resorting to additional earthwork to facilitate flow of water) as it is not only difficult to construct but also difficult to maintain for continuous vibrations caused by moving traffic, problem in proper curing of concrete etc. Only in very rare situations, when drainage of water is not possible without construction of drain, suitable arrangements for construction of drain with pre-cast concrete channel/ subsoil drains along with proper outfall should be made. If the distance between adjacent tracks is large enough, suitable slopes should be provided in the ground to make rain water flow in a natural manner. Wherever, there is level difference between two adjacent tracks, suitable non-load bearing dwarf walls may be constructed to retain earth.

ii) Drainage in Cuttings

- a) **Side Drains:** In case of cuttings, properly designed side drains of required water carrying capacity are to be provided. If height of the cutting is less (say up to 4m), normally only side drains on both sides of the track are to be provided. In case of deep cuttings, catch water drains of adequate water carrying capacity are also required along with side drains. A typical sketch of side drain and catch water drain is given in **Fig- 6.3** below. It is to be noted that blanket material is to be placed like fill/embankment and top of side drains has to remain below the bottom of blanket material.

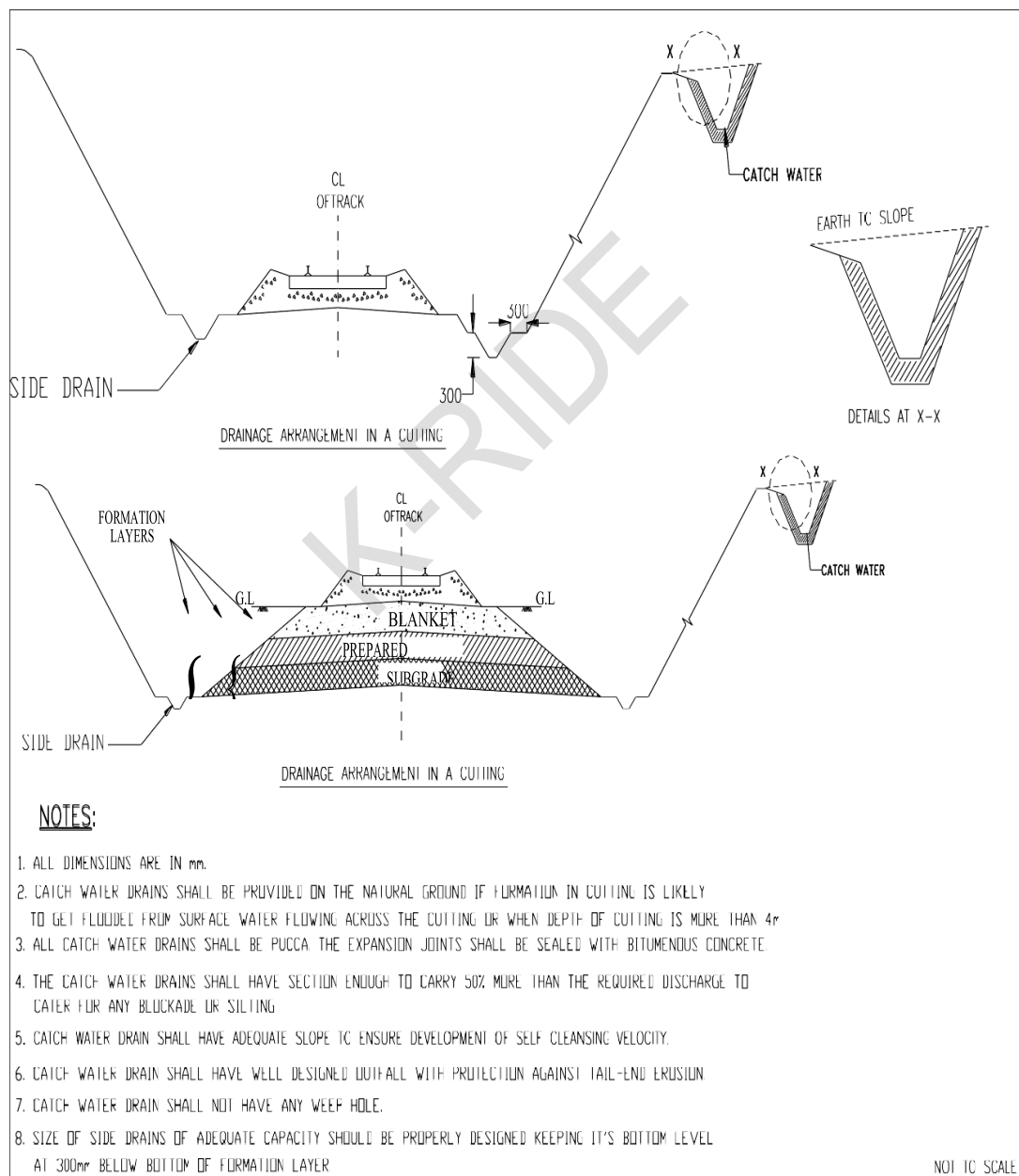


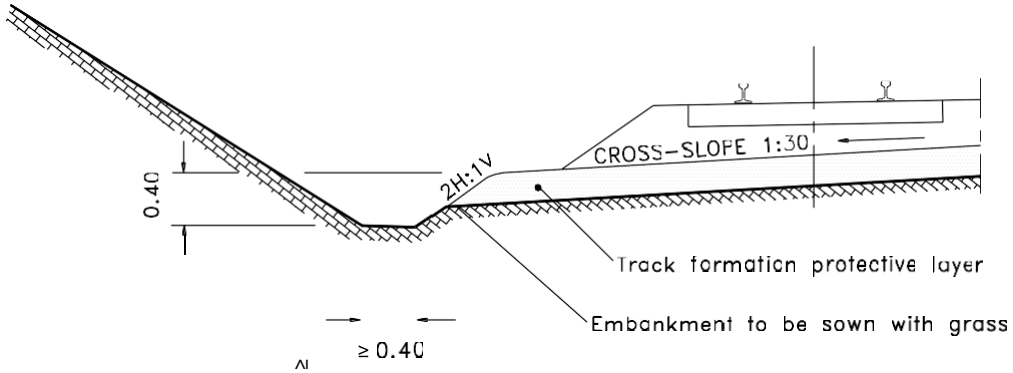
Fig-6.3: Arrangement of drainage in cutting

- b) **Catch Water Drains:** Surface water flowing from top of hill slope towards the track in huge quantities needs to be controlled. It is also not possible to allow water from the hillside to flow into the side drains, which are not designed for carrying such huge quantity of water. Therefore, it is essential to intercept and divert the water coming from the hill slopes; accordingly, catch water drains are provided running almost parallel to the track. Depending on site condition, water from the catch water drains may require to be diverted by sloping drains and carrying across the track by means of culvert. In some of the situations, depending on topography of top of cutting, there may be requirement of construction of net of small catch water drains which are subsequently connected to main catch water drain so that there is no possibility of water stagnation/ponding upto distance approximately three times depth of cutting from its edge. Catch water drains should be made pucca/lined with impervious flexible material locally available.
- c) **Considerations in Design of Catch Water Drains:** These should be properly designed, lined and maintained. If catch water drains are kuchha/ broken pucca drains, water percolates down to the track through cracks, dissolving the cementing material resulting into instability in the cuttings. Catch water drains should be located slightly away (as per site conditions) from the top edge of cutting and water flow should be led into the nearby culvert or natural low ground. Some additional salient features to be observed are as follows:
- i) Catch water drains shall have adequate slope to ensure development of self-cleansing velocity.
 - ii) Catch water drains shall not have any weep hole.
 - iii) The expansion joints, if provided, shall be sealed with bituminous concrete.
 - iv) Regular inspection and maintenance work, specially before onset of monsoon, should be carried out to plug seepage of water.
 - v) Catch water drains shall have well designed out fall with protection against tail end erosion.

Though capacity and section will depend on terrain characteristics, rainfall etc. but following parameters are important for design of catch water drains:

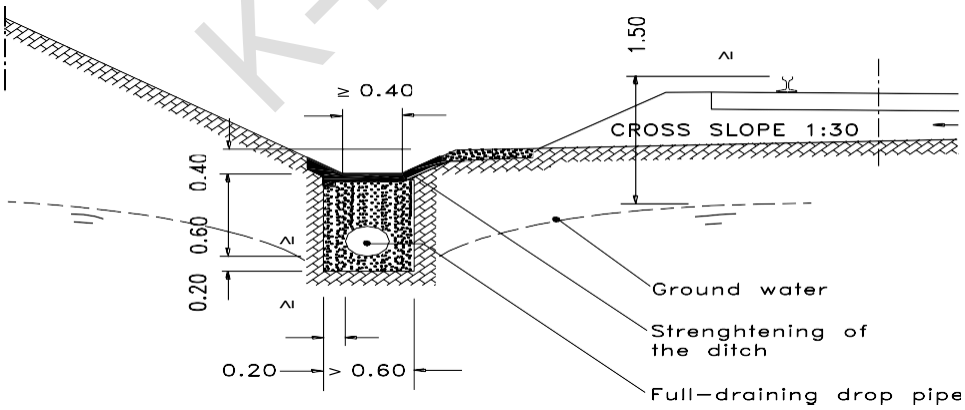
- i) Intensity and duration of rainfall.
 - ii) Catchment area- shape, size, rate of infiltration etc.
 - iii) Velocity of flow which should satisfy the Manning's formula
 - iv) Minimum gradient of drain should be about 1 in 300.
 - v) Normally catch water drains should be of trapezoidal cross section.
 - vi) The catch water drain should not be given gradient more than about 1 in 50 (but in no case more than 1 in 33) to avoid high water velocity and possibility of washout of lining material. Rugosity coefficient should be about 0.03.
- b) Alignment plan, longitudinal section and soil survey records of catch water drain should be updated from time to time as per development in the area of influence.
 - c) Stable slopes and adequate drainage arrangements in cutting areas should be provided as per details given in 'Guidelines for Cuttings in Railway Formations - No. GE: G-2, August 2005'.

iii) **Other Drainage Systems:** Open Drainage system typical as shown in Fig-6.4 below, will facilitate collection of rainwater from embankment, cuttings and side of cuttings and lead it away. Sub-soil Drain System typical as shown in Fig-6.5 below are installed where the groundwater level has to be lowered (from depth < 1.5 m below the rail top), where the soil surrounding the track formation has to be drained or where percolating and layer water has to be drained away.



(All Dimensions of side drain in 'm')

Fig-6.4: Open Longitudinal Drain at Toe of Formation



(Dimensions of side drain in 'm')

Fig-6.5: Sub-soil Longitudinal Drainage System

6.2.6 Finishing and Blanketing

- i) Providing Camber/Cross Slope below Blanketing: Top of the formation should be finished to desired cross slope of 1 in 30. Cross slope should be within 1 in 28 to 1 in 30. Camber may be checked at site through use of a cross-section camber board.
- ii) Once the top surface of the formation has been finished to proper slope and level, movement of material vehicle for transportation of ballast, sleepers etc. should be avoided, these movements will cause development of unevenness, ruts on the surface which will accumulate water and weaken the formation.
- iii) Provision of Blanket Layer: The specifications for the material to be used as Blanket and thickness of blanket layer shall be as per relevant provisions given in **Chapter 3**.

6.2.7 Setting up of GE lab at Construction Site

A well-equipped Geo-technical Engineering (GE) Field Laboratory shall be set up at all construction projects connected with new lines, doubling and gauge conversion works as well as, where rehabilitation of failing formation is being undertaken. Number of such GE labs to be established on a particular project/work site should be so decided that all quality control checks can be performed effectively. The field lab should be manned adequately by trained officials & staff capable of carrying out required investigation, soil testing and quality control at site.

- i) Aspects to be looked after by field GE lab are as under:
 - a) To ensure that the quality of supplied soil and blanket material conforms to the accepted limits of gradation, classification, plasticity, etc.
 - b) To evaluate methods of compaction by conducting tests in connection with field trials.
 - c) To exercise moisture and density control as the earthwork proceeds in layers rolled with the suitable equipment.
- ii) Field lab shall be equipped with minimum equipment as listed in **Appendix-K**, to facilitate the following minimum tests:
 - a) Gradation Analysis-Sieve and Hydrometer.
 - b) Atterberg's Limits - Liquid Limit & plastic Limit
 - c) Optimum Moisture Content (OMC), Maximum Dry Density (MDD) and Relative Density.
 - d) Placement moisture content & in-situ Density.
 - e) CBR test

6.2.8 Maintenance of Records

At the work site, details of works along with materials being used are to be properly recorded so that work of satisfactory quality can be achieved which can also be verified at later stage. Records are also required to develop completion drawings and other details, which would become permanent records of the section and could be helpful in future to plan developmental activities and remedial measures if need be

CHAPTER-7

QUALITY CONTROL OF EARTHWORK

7.1 General

Quality of execution of formation earthwork shall be controlled through exercise of checks on the borrow material, blanket material, compaction process, drainage system, longitudinal & cross sectional profiles of the finished embankment. The details of quality control procedure are as follows:

7.2 Quality Control test on Construction Material

This is required to ascertain the suitability of the material for construction of Embankment and to decide the OMC/MDD and other relevant tests, which becomes the quality control inputs. Quality control tests are required to be conducted on borrow material as well as on blanket material.

7.3 Suitability tests at source

7.3.1 Borrow Material (Embankment fill as well as prepared subgrade)

- a) Following specific tests to be conducted on borrow Material
 - i) Sieve analysis
 - ii) Hydrometer analysis
 - iii) Consistency limits
 - iv) CBR test
 - v) Test for organic content in soil
 - vi) Crumb test, double hydrometer test, pin hole & chemical test - for Dispersive soil only
 - vii) OMC/MDD

Fill material proposed to be used either from Railway land or from outside would have to be assessed for its suitability as well as to decide thickness of the blanket layer after conducting soil classification and other relevant tests as per site requirement. On the basis of the tests, areas for borrow material, especially from outside the Railway land, need to be earmarked. Once the material has been found fit for use as fill material for Embankment, further lab tests, to assess OMC, MDD/ Relative Density, need to be conducted.

In case, slope stability analysis, as explained in **Chapter - 5** is required, triaxial shear test will also need to be done to find effective shear strength parameters.

- b) **Frequency of Testing:** The frequency of testing before laying for borrow material should be as detailed in **table 7.2**

Note: It would be in the interest of the execution agency to have frequent tests conducted at source/manufacturing point on his own to judge the suitability of the material to avoid any complication at a later stage. However the final acceptance of the borrow material should be at the site before laying.

7.3.2 Blanket Material: The source(s) of blanket material needs to be identified based on the final location survey report, tests & studies conducted and conformity to the Specification as stipulated in **Table 3.3 to 3.6.**

- a) **Method of Test:** Blanket material should be tested as per IS: 2720 (Part 4) to plot particle size distribution curve, so as to assess its suitability. It would be necessary to carry out wet analysis to assess the actual percentage of fines.
- b) **Frequency of Tests:** The frequency of testing at site before laying for blanket material should be as detailed in **Table 7.2.**
- c) Following tests/checks are to be conducted
 - i) Sieve analysis and hydrometer analysis to determine C_c , C_u & percentage fines
 - ii) CBR test
 - iii) Los Angeles Abrasion value,
 - iv) Filter criteria, as required
 - v) Gradation Analysis,
 - vi) Check for conformity with enveloping curves

Note: It would be in the interest of the execution agency to have frequent tests conducted at source/manufacturing point on his own to judge the suitability of the material to avoid any complication at a later stage. However the final acceptance of the blanket material should be at the site before laying.

7.4 Quality Control Checks on Finished Earthwork

7.4.1 Compacted Earth: Degree of compaction of each layer of compacted soil should be ascertained by measurement of dry density/Relative Density of soil at locations selected in specified pattern. The method of sampling, frequency of tests, method of tests to be conducted and acceptance criteria to be adopted are as under

a) Method of Sampling

- i) Various methods of selection of sample points for checking the field dry density are in practice. These methods **are shown in Fig-7.1.** The sampling method should be such that the effectiveness of compaction for the entire area of compacted earthwork can be judged properly. The Engineer in-charge should specify the sampling method depending on the site conditions.
- ii) For each layer, a minimum of one sample at a predetermined interval along the centerline of the alignment would be taken in a staggered pattern so as to attain a minimum frequency of tests as given in the note below **table 7.2.** For subsequent layer, the stagger should be such that the point of sampling does not fall vertically on the earlier sampling points of the layer immediately below. The process of sampling is explained in **Fig-7.1** for guidance. Additional sampling points can be taken, as considered necessary.
- iii) In case of embankment widening, sampling should be done at an interval of minimum 200 metres on the widened side(s) of Embankment.

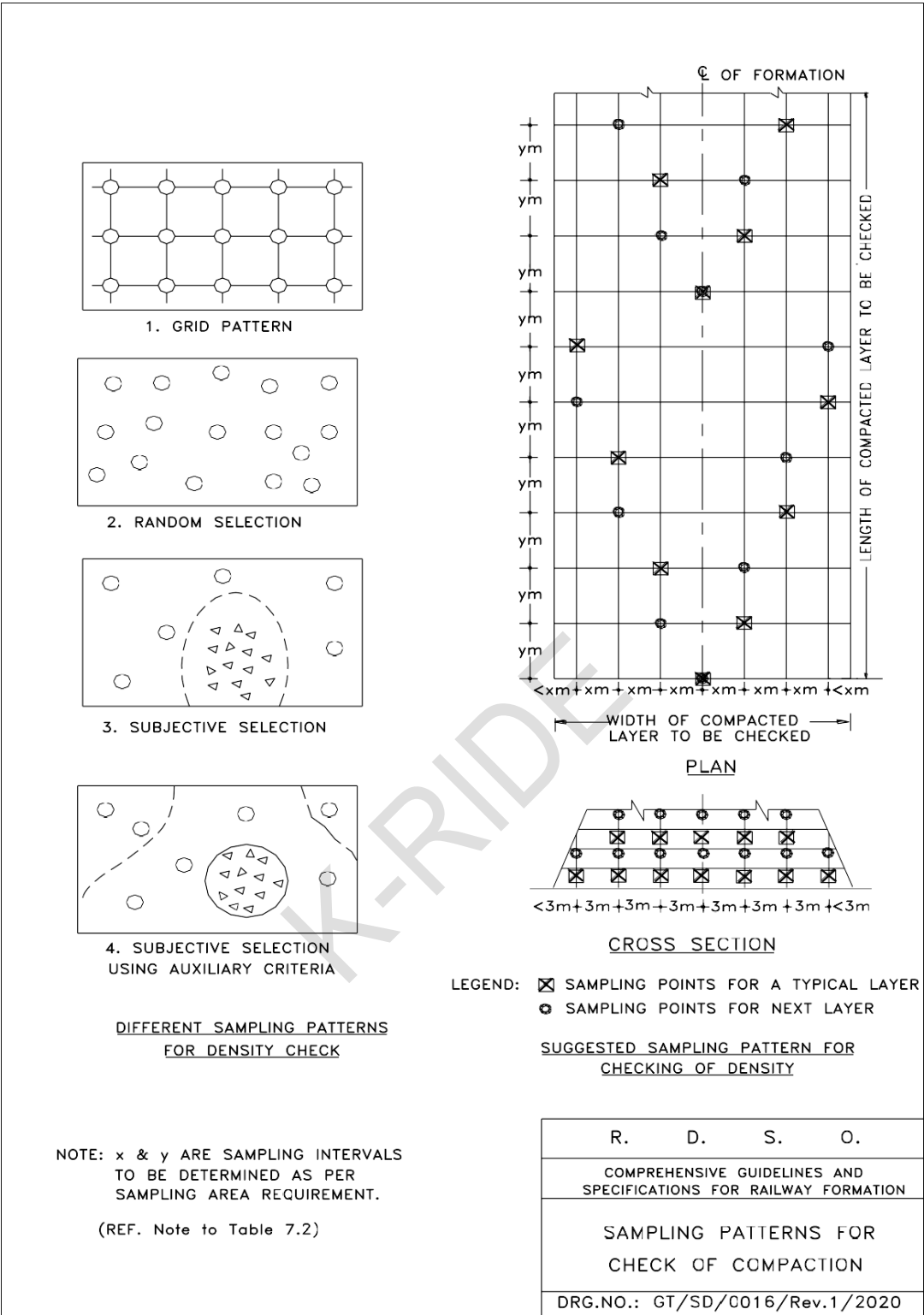


Fig-7.1: Sampling pattern for compaction check

b) Methods of In-situ Dry Density Measurements:

Any of the following methods could be adopted as per the requirements at site.

Table-7.1

Method of measurement	Procedure of test	Parameters to be measured	Remarks
i) Sand Replacement Method	As per IS-2720 (Part 28) - latest version	In-situ Dry Density Moisture Content	May be adopted for all type of soils
ii) Core Cutter Method	As per IS-2720 (Part 29) - latest version	-do-	In some of the coarse-grained soils (with little fines) taking core cutter samples is difficult. In such cases, a sand replacement method may be used for density measurement.
iii) Nuclear Moisture Density Gauge	As per Appendix-H	a) Bulk density b) Moisture Content c) Dry density d) Degree of compaction	It is a faster Method and should be widely used for large construction projects.

c) Acceptance Criteria

- i) Coarse grained soils which contain fines passing 75 micron IS Sieve, up to 5 percent should have the Density Index (Relative Density) a minimum of 70% as obtained in accordance with IS: 2720 (Part 14) – 1983 (Reaffirmed 2015).
- ii) In field compaction trial, the maximum attainable dry density should not be less than 98% of MDD value as obtained by Heavy Compaction Test (IS: 2720 (Part 8) – (Reaffirmed 2015) in the laboratory. In case, there are difficulties in achieving 98% of the MDD values as obtained by Laboratory test, in the field trials, the same may be relaxed up to 95% of MDD with the specific approval of Chief Engineer/Construction, recording reasons for such relaxation. The level of compaction to be achieved in field, as a percentage of MDD value achieved in field compaction trial, for various layers shall be as per Table 3.3 to 3.6 of Chapter 3. In case of PSU, existing provision of Equivalent authority for acceptance criteria shall continue.
- iii) During widening of embankment in case of gauge conversion and rehabilitation of unstable formation, compaction of earthwork should be minimum 95% of MDD as obtained by Laboratory test as per Heavy Compaction Test (IS: 2720 Part 8 – 2013) or 70% Relative Density for Coarse grained soils which contains fines (passing 75 micron IS Sieve) up to 5 percent (IS: 2720 (Part 14) –1983 (Reaffirmed 2015).

7.4.2 Deformation Modulus (E_{v2}) measurement

It is a parameter expressing the deformation characteristics of a soil. It is calculated taking values from the load settlement curve obtained from the second cycle of loading in the Plate Load Test (Details given in **Appendix-H**). It is to be determined in the field on top of each formation layer i.e. at top of compacted Blanket layer/Prepared sub-grade/Subgrade- Top & Lower layer in accordance with DIN: 18134-2012.

7.4.3 Frequency of Tests

The frequency of testing at finished earthwork should be as specified in the Table 7.2 given below.

7.5 Qualifying and Quality assurance Tests

Qualifying tests as part of pre-selection of good earth for Blanket, Prepared sub-grade, Subgrade is required to be carried out. Also quality of execution of formation earthwork shall be controlled through exercise of checks on the borrow material, blanket material, compaction process to ensure good quality construction. The quality control procedures are summarized in **Table-7.2** below:

Table-7.2: Summary of quality control tests in Borrow material/ finished earthwork

Item/ Material	Parameter to be determined	Location of sampling for quality control	IS Code Ref. (Latest version)	Frequency of test	Acceptance Criteria
(i) Borrow material					
(a)Subgrade/ Prepared Subgrade	(i) Soil classification	At site before laying	IS: 1498	At least one test at every change of subgrade/ prepared- subgrade material subject to minimum of one test for every 5000 cum.	Soil should not be "unsuitable type" as given in Para 3.7 and should conform 3.10 for 25T/32.5T Axle load of Chapter 3
	(ii) CBR		IS: 2720-Part-16		
	(iii) Plasticity Index (Prepared Subgrade)		IS: 2720- Part- 5		
	(iv) OMC & MDD		IS: 2720 – Part-8		
(b)Blanket material	(i) Gradation	At site	IS: 2720- Part-4	Minimum one test for every 500 cum or part thereof	
	(ii) Cc & Cu				
	(iii) Fines				

	(passing 75 μ)			
	(iv) Abrasion value	before laying	IS:2386 – Part-4	
	(v) CBR		IS: 2720-Part- 16	
	(vi) Filter criteria		IS:2720 – Part-4	
	(vii) OMC & MDD		IS: 2720 –Part-8	
	(viii) γ_{max} & γ_{min} (Determined in Relative Density test If fines are upto 5%)		IS:2720-Part-14	

K-RIDE

(ii) Finished earthwork					
(Subgrade /Prepared Subgrade/ Blanket)	(i) Ev ₂	Top of final finished surface of Blanket/ Prepared subgrade & Subgrade	DIN 18134 – 2012	One test per Km (*)	Acceptance Criteria as specified in Para 3.10 of Chapter 3
	(ii) Compaction	Every compacted layer	IS: 2720 (Part-28/29) or NMDG(as per Procedure issued by RDSO	As per note given below	
	(iii) Density Index (Relative Density if fines are upto 5%)	Every compacted layer	IS: 2720 – Part-14		Minimum 70%

* Additionally this test can also be done by third party (i.e. IIT, NIT, Govt. Labs or any NABL approved Lab) having testing facilities, to cross check the results achieved at site. Frequency of testing in this case shall be decided/approved at the level of Chief Engineer (Con). In PSUs, frequency of such tests shall be decided as per existing delegations for testing.

Note: Frequency of Tests: Density check would be done for every layer of compacted fill/blanket material as per following minimum frequency:

- i) At least one density check for every 30 m length for blanket layers and top one metre of prepared subgrade/subgrade along the alignment in a staggered pattern of each compacted layer.
- ii) At least one density check for layers other than as specified in(i) above, every 500 m² or 75 m c/c whichever occurs earlier along the alignment in a staggered pattern of each compacted layer.
- iii) In case of important bridge approaches (100 m length on either side), at least one density check for every 25 m length shall be adopted.

7.6 Formation Level: Finished top of sub-grade level may have variation from design level by ± 25 mm and finished top of blanket layer may also be permitted to have variation from design level by plus 25 mm only. The ballast should be placed only on level formation without ruts or low pockets.

7.7 Cross Slope: Cross slope should be within 1 in 28 to 1 in 30.

7.8 Side Slopes: Side slope should be 2H: 1V or flatter as per design.

7.9 Formation Width: Formation width should not be less than the specified width.

7.10 Quality Control Records: At least, following records of quality control as per proforma given in **Appendix- D & G** needs to be maintained.

- i) Characteristics of borrow materials as per proforma **No. G-1**.
- ii) Quality of blanket materials as per proforma **No. G-2**.
- iii) Field compaction trial computation sheet details as per **Table D-4 of Appendix-D**.
- iv) Quality of compaction of earthwork including blanket material as per proforma no. **G-3** for core cutter method & proforma no. **G-4** for sand replacement method.
- v) Quality of material and its compaction for backfill behind bridge approaches etc. as per proforma no. **G1, G2, G3 & G4**.
- vi) Details of machineries engaged in execution of earth work including its output as per proforma decided by field engineers.

7.11 Setting up of GE Lab at Construction/Rehabilitation Site

A well-equipped Geo-technical Engineering (GE) Field Laboratory shall be set up at all construction projects connected with new lines, doubling and gauge conversion works as well as, where rehabilitation of failing formation is being undertaken. (Details are given in Para 6.2.8 of Chapter 6).

7.12 Certification for quality of earthwork

Certification for quality of earthwork in formation in respect of new lines, Gauge Conversion and Doubling projects etc. will be done by Executive authority at SAG level (i.e. CE/Con of respective projects). CE/Con will submit details for certification of quality of earthwork to CRS as per RDSO checklist.

7.13 Checklist for certification of quality of earthwork

Checklist for certification of quality of earthwork in Railway projects was issued by RDSO vide letter no RS/G/95/Main, dated: 11.06.2004. This Checklist has been revised and placed at Appendix –M.

7.14 Special design problems related with construction of formations

Any special design problems related with construction of formations may be referred to RDSO for guidance and advice, if required.

CHAPTER-8

EROSION CONTROL OF SLOPES

8.1 General

Exposed sloping surface of embankment/cutting experiences surficial erosion caused due to the action of exogenous wind and water resulting into loss of soil, leading to development of cuts, rills/gullies adversely affecting the cess width, soil matrix, steepening of slopes etc. which depends on type of soil, climatic condition topography of area etc.

8.2 Selection of Erosion control method

The following points may be considered while adopting suitable method for erosion control on soil slopes:

- i) Developing vegetation cover would be the best method to prevent soil erosion. This may be attempted by using 'Simple Turfing Method'.
- ii) At locations where a simple turfing method cannot ensure vegetation cover, natural fibre based netting can be adopted to support vegetation growth.

When the site is located in a drought prone area and it is difficult to sustain green cover throughout the year, geogrids can be adopted to provide long term protection.

- iii) Where vegetation cover alone is insufficient and soil surface needs to be protected in the absence of vegetation cover in certain patches, root reinforcing geosynthetic systems (3-D mats) can be used. Depending upon the duration for which protection needed (short term - 2 to 3 years or for longer term), either natural fibre based or polymer based 3-D mats can be adopted. For slope heights more than 5 m, root reinforcing systems would be better suited.
- iv) Organic mulch application (either manually or by using hydro seeding/hydro-mulching) can be adopted to aid simple vegetative turfing. By using hydro seeding/hydro-mulching method, inaccessible and near vertical slopes can be successfully vegetated and hydro seeding method can be used in combination with nettings/ mats to make them even more effective.

8.3 Erosion control method

The Erosion Control methods which have been suggested below are for guidance purpose and application of these methods depends on techno-economic, topographical, climatic and other considerations.

Erosion control measures are commonly classified in following categories:

- i) Conventional non-agronomical system,
- ii) Bio-technical system,
- iii) Engineering system, and
- iv) Non-conventional hydro-seeding/hydro-mulching system.

Most common methods used are the Bio-technical and Engineering System. However, appropriate method needs to be decided depending on site conditions.

8.3.1 Conventional Non-agronomical System

This method is best utilized against seepage, erosion by wave action etc. Soil bank or slopes exposed to constant concentrated flows, currents or waves does not support vegetation and needs to be protected by this system. For the slopes having inundation or continuous flooding for many days, slope protection system as indicated can be adopted as per site condition.

- i) Stone pitching on the slope to be protected.
- ii) Retaining walls, toe-walls or break walls and sheet piles that are placed in such a way to form a barrier between the shore and the waterfront.
- iii) Gabion & revet mattresses, manufactured as per IS 16014, filled with stones of specified size and provided on slopes.
- iv) Geotextile Bags - Bags made from geotextile material, which are filled with sand/suitable type of soil and are kept on the slopes in place of stone pitching.

With this system in place, water can seep in and out of the bank or slope, but the force of water is resisted by the non-agronomical system in place discussed above. To prevent possibility of any piping action in this system, traditionally a graded filter layer between bank soil and non-agronomical system is used. Geotextile can also be used in place of traditional filter layer with specific hydraulic and soil retention properties. (Chapter-5 in 'IRC: 56- For Different Methods to Prevent Soil Erosion' may be referred to.)

Note: The sides of an Embankment (except approach bank of bridges) shall be protected upto 1 m above HFL (except for case-ii). For approach bank of bridges, 'Indian Railways Bridge Manual' shall be followed.

8.3.2 Bio-Technical Solution

In this system, vegetation is provided on exposed slopes. It is suited for soil with some clay fraction. It consists of preparing a slope area by grading it for sowing seeds or planting root strips of locally available creeping grass. The root goes upto 50 to 75mm deep into the slopes serving as a soil anchor and offering added resistance to erosion.

This technique has some limitations such as in case of highly erodible soil or in case of infertile soil or in case soil having absence of initial binding in such cases help from botanists/agronomists may be sought for developing vegetation.

However, some typical deep rooted species of grasses and shrubs suited to different topographical area of our country are given under (table 8.1, 8.2 & 8.3) based on altitude of area and type of soil in (Reference: Recommended Practices Treatment of Embankment and Roadside slopes for Erosion Control, IRC:56- latest version).

Table 8.1 Plains (including altitude upto 1500 m above sea level)

Grasses and Shrubs	
1.	Horticulture grass <i>Cynodon dactylon</i>
2.	<i>Cynodon plectostyrum</i>
3.	<i>Chloris gayana</i>
4.	<i>Saccharum spontaneum</i> Tall Pernicious Deep rooted Perennial
5.	<i>Sachharum munja</i> (Sarkanda)
6.	<i>Ipomea carnea</i> (<i>Bacharum Booti</i>)
7.	<i>Lantana species</i>
8.	<i>Agave Americana</i>
9.	<i>Erythrina indica</i>
10	<i>Prosopis species</i>
11	<i>Casuarina species</i>
12	Goat foot creepers
13	Vetiver grass (<i>vetiveriazizanioides</i>)

Table 8.2 Hills

Grasses and Shrubs	
1	<i>Eragrostis curvula</i> Love Grass (Kumaon -Central Himalaya)
2	<i>Eragrostis superva</i> (Locally known as Babia in Kumaon -CentralHimalayas)
3	<i>Chrysopogon mountanus</i> - Central Himalayas
4	<i>Pennisctum orientale</i> - Central Himalayas
5	<i>Lolium perenne</i> (Rai Grass - H.P. & Kumaon)
6	<i>Poa pratensis</i> (above 1800 m)
7	<i>Imperata cylindrica</i>
8	<i>Robinia pseudoaccadia</i> Cuttings as well as plants
9	Kudzu vine all over upto 2400 m (<i>Pueraria thungbergia</i>)
10	Kikuyu (<i>Pennisetum clandestinum</i>)
11	<i>Jatropha curcas</i>
12	<i>Ficus caric</i>
13	<i>Philendus</i> cuttings
14	Lemon grass (<i>Cymbopogon flexuosus</i>) for use in elevations around 1900 m)

Table 8.3 Selection of species vegetation based on soil type(As per IS 15869)

Sl. No.	Name of Species	Suited for
1	<i>Cyanodon dactylon</i>	For sandy soil
2	<i>Cenchurs ciliaris</i>	Can be used for most type of soil
3	<i>Dichanthium annulatum</i>	For alluvial soil
4	<i>Pennisetum pedicellatum</i>	Sandy loam soil

5	Rochola glabra	Laterite semi-arid soil
6	Stylosanthis gracilis	Alluvial soils having less moisture
7	Pueraria hirsute	Suited to alluvial soils and for the hills in humid climate
8	Pennisetum purpureum	For hill slopes .

8.3.3 Engineering System

In this system, following methods discussed below are normally used. Help from botanists/agronomists may be sought for developing vegetation & determining requirements of soil cover, nutrients or other aspects, wherever required.

i) Jute netting for erosion control:

In this system Geojute is used for erosion problems. Geojute is eco-friendly material made of jute yarn with a coarse open mesh structure and is biodegradable. By using Geojute netting for erosion control the soil particles, seed, grass root slips are held securely in their original locations without being dislodged.

Jute netting is having high water absorbing capacity, which gives full benefit of moisture for growth of vegetation. After the first rainy season, the seeded and sprigged vegetation develops in the entire surface thus, protecting the slopes against erosion. Jute netting has been observed to have a life of about 1 to 2 years in the field, which is sufficient for fully promoting the growth of vegetation cover on the denuded slopes.

Once vegetation growth has been established the purpose of providing jute netting is accomplished. As jute netting is biodegradable, after the end of its life it decomposes and, in the process, adds nutrients to the soil.

For laying, Geojute roll is unrolled loosely and evenly on slope and then anchored at shoulder i.e. at the top and at the toe i.e. at bottom. It shall be ensured that there is proper contact between the jute mat and surface of the slope by use of steel nails or other appropriate anchorage pins on slope surface at suitable distance, to secure it against displacement. Watering facilities should be ensured during the initial period of sowing if the work is undertaken during non-monsoon period.

For details about use of Jute Geo-textiles (JGT), their technical specifications and laying methodology etc., RDSO Guidelines titled "Guidelines for application of Jute Geo-textiles in Railway Embankment and Hill Slopes" No. RDSO/2007/GE: G-0008, Feb-2007 may be referred.



Fig-8.1 (a): Slope erosion control using Geo jute

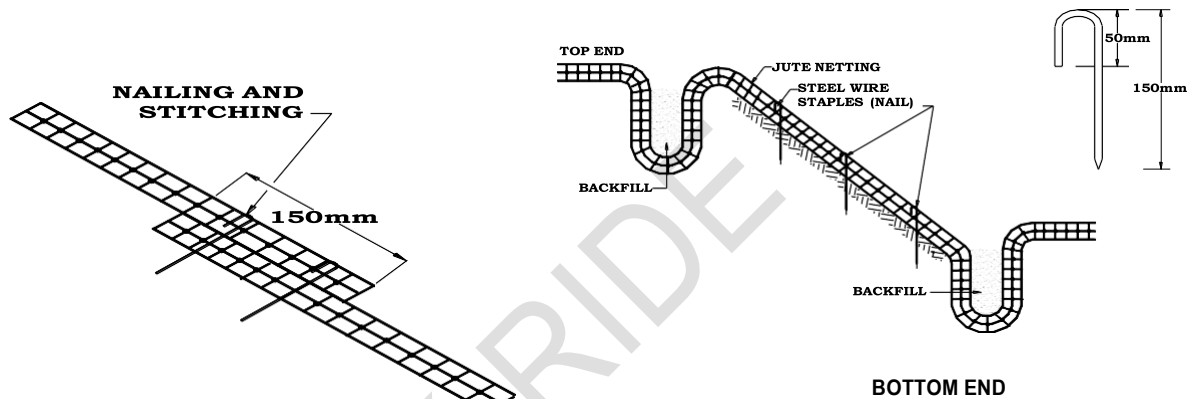


Fig - 8.1: (b) Overlapping Of Jute Netting

Fig - 8.1: (c) Placement of Jute Netting

ii) Coir netting for erosion control

Coir netting (also known as 'Coir Bhoovastra') is another type of biodegradable material which can be effectively used in a manner similar to jute netting. Coir nettings degrade much slower than jute nettings (expected field life of about 2 to 3 years) and thus provide protection to the slopes for a longer time than jutenettings.

Coir is also resistant to saline water and provides an ecological niche for a rapid re-establishment of the vegetation cover. Coir resembles natural soil in its capacity to absorb solar radiation. This means that there is no risk of excessive heating. In a manner similar to jute nettings, coir netting also breaks up runoff from heavy rains and dissipates the energy of flowing water. Coir also promotes the growth of new vegetation by absorbing water and preventing the top soil from drying out. In coir mats also, proper contact between the mat and surface of the slope by use of steel nails or appropriate anchorage pins on slope surface at suitable distance, to be secured against displacement

However, compared to Jute nettings, drapability of coir netting is lesser and their water absorption capability is also lower than jute nettings. The length of the rolls would be 50 m and width can be between 1 to 4 m. For more details, IS: 15869 'Open weave coir Bhoovastra-Specification' and IS 15872 'Application of Coir Geotextiles (coir woven Bhoovastra) for Rainwater Erosion Control in Roads, Railway Embankments and Hill Slopes-Guidelines' and IRC: 56-latest version may be referred to.



Fig- 8.2 Coir Netting

iii) Erosion Control Using Geogrids Mesh/Netting

Under unfavorable soil & erratic weather conditions, prolonged drought in particular area, where vegetation growth is difficult and ordinary turfing as well as agro based nettings may fail to provide erosion prevention, use of geogrid mesh provides a permanent protection as it is not biodegradable. A synthetic root reinforcement vegetation system using geogrids can achieve high density of grass growth as it reduces the velocity of surface runoff.

For laying geogrid mesh for erosion control, slope area should be dressed with filling of cavities and potholes if any by light ramming. The net should be unrolled ensuring uniform surface contact. Geogrid ends at top and bottom of slopes should be suitably anchored by MS pins & soil filled back, this will act as anchorage. With watering and implementation of grass seed/turf, the roots establish quickly. For more details IRC: 56-latest version may be referred to.

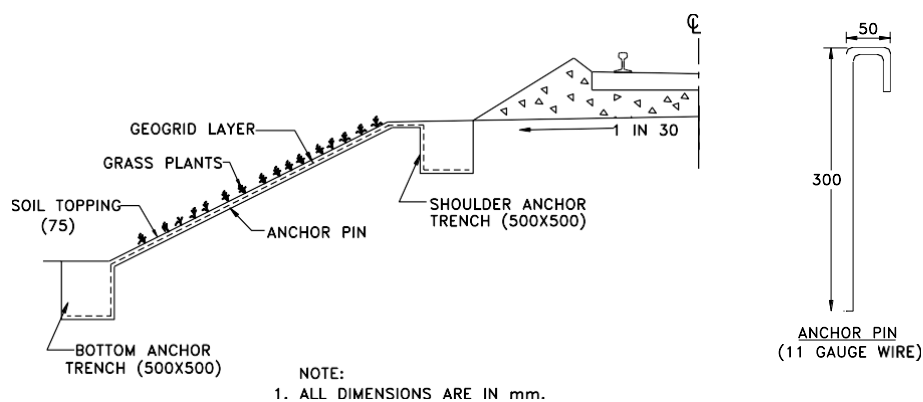


Fig- 8.3 Installation of Geo grid Mesh

iv) Erosion Control Mat/Rolled Erosion Control Products

Relying upon vegetation growth alone may be sometimes very unpredictable and unreliable as it may be extremely difficult to achieve 100 percent vegetation coverage, leaving exposed areas vulnerable to erosion. Furthermore, vegetation may sometimes dry up or become diseased, reducing its erosion control capability. Reinforced vegetation using three-dimensional erosion control Mat/rolled Erosion Control Products is another method that is being practiced for enhancing slope stability and erosion control.

The 3-D mat increases the soil's resistance to erosion by providing an environment that enhances the growth of vegetation through the mat. Initially the mat works to shield the soil from washing out before the vegetation has a chance to become established. Then as the vegetation matures, the roots anchor the mat to the soil to provide superior soil reinforcement strength, capable of handling greater volumes of runoff water and higher flow velocities.

These three-dimensional mats, being multi-filamented materials, have specified thickness. 3-D Mats can also be made using biodegradable natural fibers such as straw, jute, coir or wood shavings (used individually or in combination) stuffed into polymeric or organic nettings on either side to form a mat or blanket-like structure.

Mats which are made using natural fibres are biodegradable due to which they don't provide everlasting protection. Such Mats are used in combination with seed beds to enhance the growth of vegetation.

When geosynthetic mattings (3-D Mats) are made exclusively from polymeric substances, they consist of UV stabilized synthetic fibres and filaments processed into permanent, high strength, three dimensional (3-D) matrices. These products are long lasting. Steel wire mesh is sometimes included in these mats optionally where these mats are required to possess more strength against erosive forces, like steeper slopes or in heavy rainfall areas. For more details IRC: 56-latest version may be referred to.

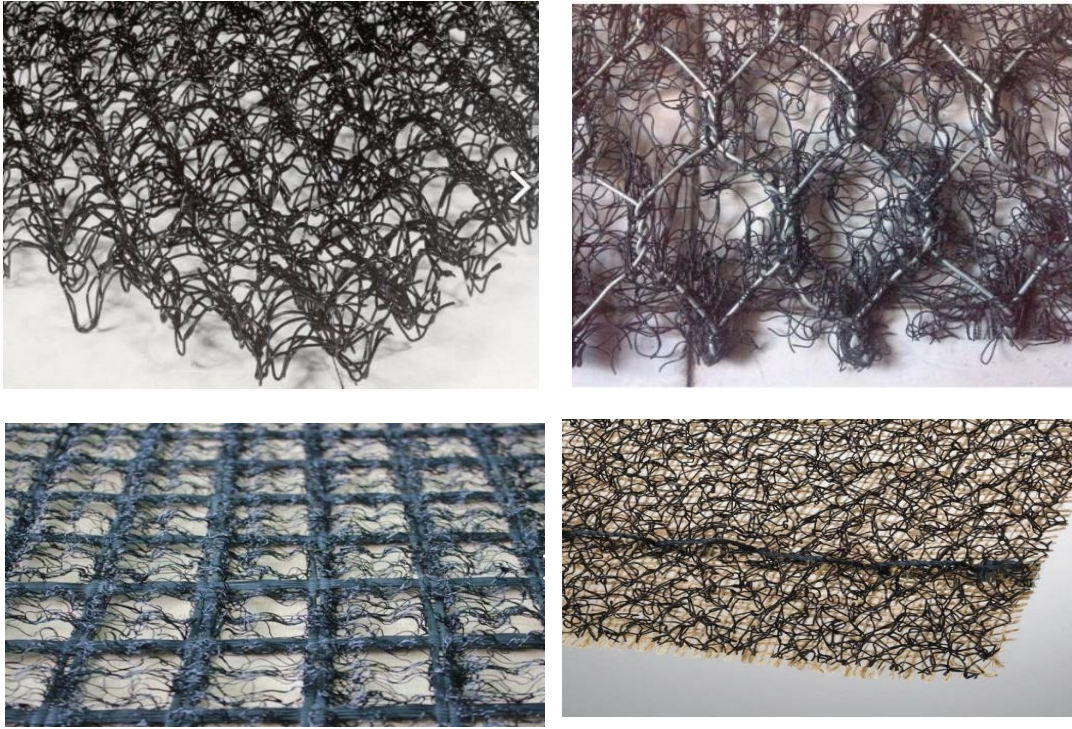


Fig- 8.4 Three Dimensional Erosion Control Mat

v) Non- conventional hydro-seeding/hydro-mulching system

Hydro-seeding/hydro-mulching is a process which can be considered as alternative to sodding. It involves seed application in water-based slurry via a high pressure pump and hoses or a spray gun. The basic ingredients used in this process are water, seeds, fertilizer, mulch, tackifier and bio-stimulant.

Mulch can be made from recycled paper or shredded wood or a mixture of both -wooden mulch breathes while paper mulch forms a protective cover.

Chopped straw cut to a length of 10 to 20 mm can also be used as mulch. Tackifier is required to make this mulch and seed stick to the soil surface to which it is being applied.

Mulch protects the slope until the seed germinates and provides organic nutrients as the vegetation grows. These mixed ingredients are stored in a tank and applied using a pressure pump, on a barren land surface on which vegetation is to be promoted.

Hydro-seeding/hydro-mulching method is especially suited for vertical or near vertical soil slopes (steep slopes) on which 'simple vegetative turfing' or manual application of mulch would not be successful. Hydro-seeding/hydro-mulching jobs are specialized and expensive but for some inaccessible slopes, it offers the only practical method. For more details IRC: 56-latest version may be referred to.



Fig-8.5 Figure showing Hydro-seeding/hydro-mulching on slope

8.4 Protection of Slopes in Cutting

The causes and manifestations of surficial erosion of slopes of embankments and cuttings with soil are almost similar hence erosion control measures can be adopted same as that for embankment. For cuttings in rocks, slope protection measures to be taken as per site condition. RDSO "Guidelines for cuttings In Railway formations" Guidelines No. GE: G-2 (April-2005) may be referred to.

CHAPTER-9

WIDENING OF EMBANKMENT AND RAISING OF FORMATION, INCLUDING CESSREPAIR

9.1 Widening of Embankment

9.1.1 Widening of Embankment for Gauge conversion

- i) Before taking up widening of Embankment for gauge conversion, it should be ensured that remedial measures for unstable formation have been taken.
- ii) All vegetation shall be uprooted and taken away from the site of work. The loose materials removed from the slope should be dumped to form the bottom most layer on the ground in the width to be widened. If required, it shall be supplemented with local granular soil.
- iii) Starting from the toe, benching on the slope at every 30cm height shall be provided on the slope surface as shown in Fig-9.1 below so as to provide proper amalgamation between the old and new earthwork.

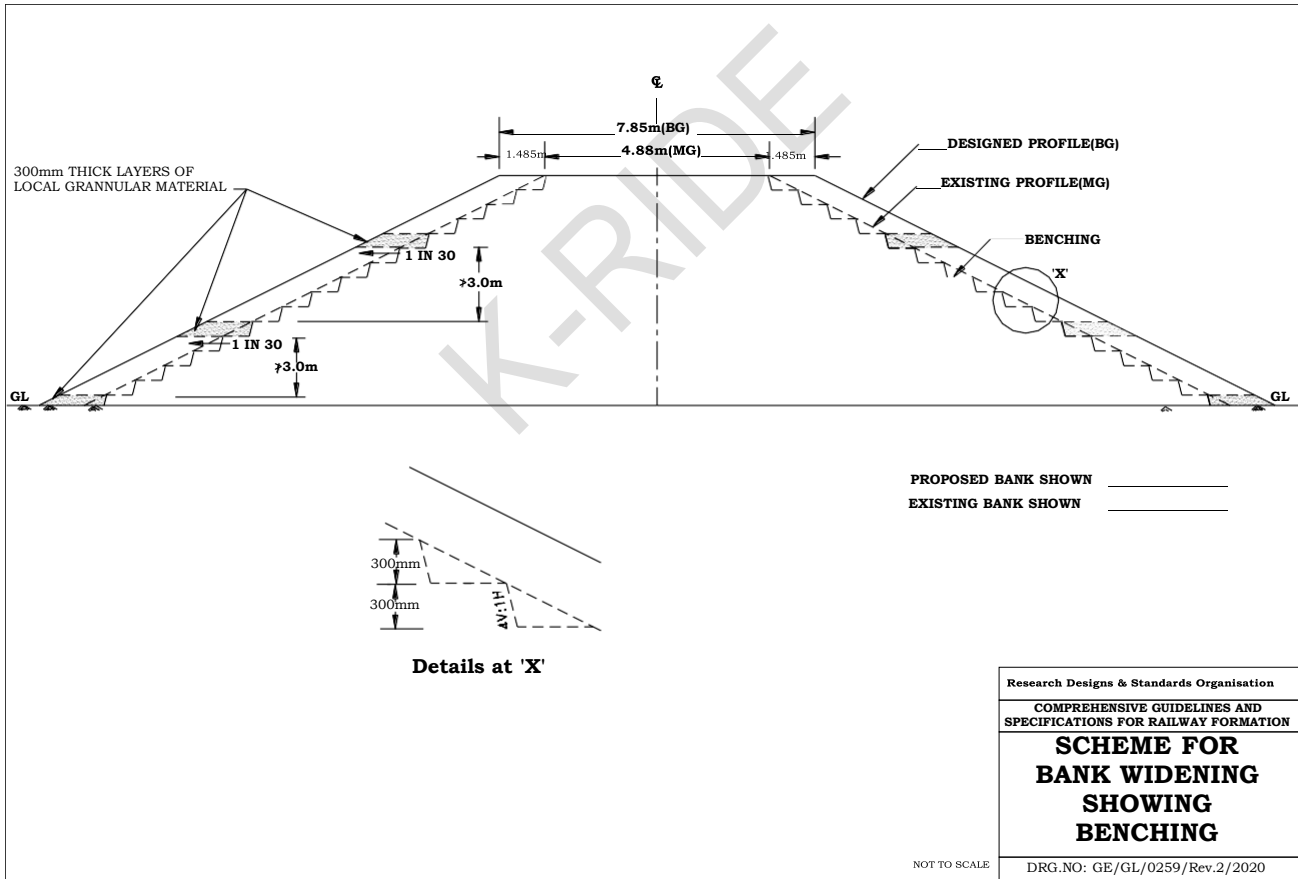


Fig-9.1: Scheme for bank widening showing benching

Earthwork shall be carried out in layers, each layer sloping out 1:30 and compacting it mechanically using vibratory rollers of around 0.9m width (which are available in the market); 6 to 8 passes of such rollers

shall usually suffice to provide the compaction to the specified level. Compaction on slope shall be ensured by using slope vibratory roller of 10-20t. Preferably, this should be a separately payable item.

- iv) The width of each layer of earthwork shall be in excess by 300mm of the designed profile to enable compaction near the edges. The excess width, thereafter, be cut and dressed, so as to achieve the required embankment profile.

In case of widening for gauge conversion, Earthwork shall be completed upto design formation level with due allowance of provision of blanket (as per RDSO specification) on entire formation width i.e. extended portion as well as in existing formation. If blanket layer does not exist on the existing formation, top layer of existing embankment shall be replaced with required depth of blanket layer in pursuance to guideline for fitment of existing formation for running of 25T axle load at 100 kmph (as per details given in **Appendix-I**).

9.1.2 Widening of Embankment for doubling

- i) Before taking up widening of Embankment for doubling, it should be ensured that remedial measures for existing unstable formation have been taken.
- ii) All vegetation shall be uprooted and taken away from the site of work. The loose materials removed from the slope should be dumped to form the bottom most layer on the ground in the width to be widened. If required, it shall be supplemented with local granular soil.
- iii) Starting from the toe, benching on the slope at every 30cm height shall be provided on the slope surface as given in **fig. 9.2**, so as to provide proper amalgamation between the old and new earthwork.

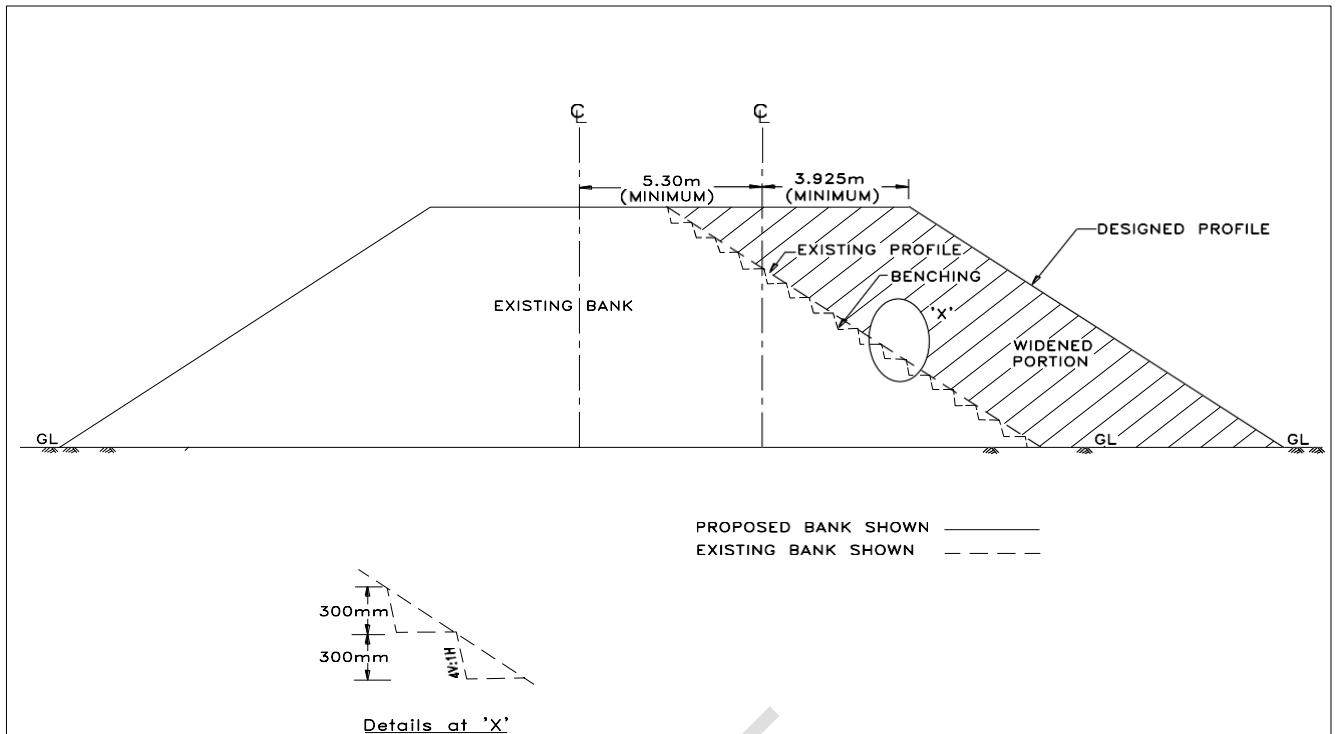


Fig-9.2: Widening of Embankment for doubling

Note 1- In case of existing formation is of minimum 7.85m width, widening is to be done only on one side as indicated in sketch above.

Note 2- In case of widening of existing formation (formation width 6.85 m or below as per previous provisions of IRSOD), the requirement of minimum formation width of 13.16 m & minimum cess width of 900 mm may not be fulfilled on other side of existing embankment which is not widened. In that case, cess width of existing track is to be increased on programmed basis as stipulated in para 9.2. The total formation width i.e. existing plus widened of minimum 13.16m shall have to be ensured as per latest provisions of IRSOD.

Note 3- Additional width of formation on curves should also be accounted for as per relevant provisions of IRSOD/IRPWM.

- iv) In case of doubling with widening of existing embankment, various provisions & methodology for new construction as stipulated in **Chapter 3 & 6**, shall be followed.

Note: Design and construction of any detours (for easing out of existing sharp curves, rebuilding of important bridges etc.) shall be carried out in accordance with provisions of new construction as stipulated in Chapter 3 (Table 3.1 to 3.6).

- v) In case, height of embankment (as per required top level of formation) is less than the required depth of formation layers (Blanket/Prepared sub-grade/Top layer of sub-grade), then also provision

as stipulated for formation layer shall have to be ensured for effective stress dispersal. If required, excavation below ground level will have to be done as given in **Para 3.11 of Chapter 3 & Appendix-B.**

- vi) Suitable drainage arrangement as given in **Chapter 6-Execution of Earthwork** is to be provided.

9.1.3 Raising of Existing Formation

After widening of the embankment to the level of the existing formation, raising shall be done as under:

- i) Raising less than 150mm shall be done with ballast, restricting total ballast cushion to 350mm.
- ii) Raising from 150mm to 1000mm: The existing ballast shall be taken out under suitable speed restriction and raising should be done in suitable steps with the material as per specification of blanket material. After raising to the desired level, clean ballast shall be inserted. Limiting value of 1000mm may be reduced depending on the site conditions.
- iii) Raising of more than 1000mm, shall be done by laying temporary diversion for passage of traffic.

9.2 Widening/Repair of Cess for Open Line maintenance

9.2.1 Introduction

Adequate formation width, ballast profile and cess width/height are required to maintain desired track geometry. Minimum width of cess is needed for following purposes:-

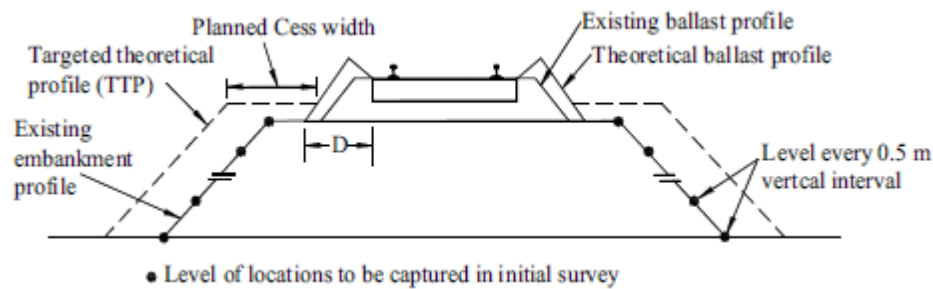
- i) To provide adequate confinement and to minimize track settlement.
- ii) For efficient and safe execution of track maintenance/renewal activities like casual renewal of rails/sleepers
- iii) Welding of rails
- iv) De-stressing of LWR/CWR
- v) Operation/placement/movement of Small track machines.
- vi) Unloading/loading of free rails/rail panels/sleepers and placing them on cess before and after the renewal.

9.2.2 Preliminary works

The work of cess repairs may be planned when the distance of edge of formation, from center of track, becomes less than 3300 mm and the cess width should be made minimum 1200mm during the cess repair work. Cess width for new construction with formation width of 7.85m (single line) is around 1100mm, hence considering additional extra margin for any shrinkage/settlement, 1200mm cess width is required to be provided during cess repair works.

Before undertaking the cess repair work, a detailed field survey should be carried out to plot the existing profile of track including embankment, identification of suitable earth for carrying out cess repair and fixing Targeted Theoretical Profile (TTP) of cess for proposed work. The TTP should include cess width to be made up, proposed raising of cess if any and flattening of side slopes.

- (i) Field survey to plot existing profile of track including embankment
- Longitudinal level of rail at every 30m interval should be recorded along with existing cess level.
 - Cross sectional profile including that of existing embankment should be taken at every 30m. The distinctive points of reference in cross section are rail level, toe of ballast, edge of cess and level at every 50cm interval (vertical height) of slope of embankment.



- The TTP with required longitudinal level of rail and cess at every 30m and also cross section as mentioned in above para should also be plotted. These levels should be recorded by SSE/SE and got approved by ADEN.
 - In case of existence of level crossings, bridges or any other prominent track features, additional cross sections should be drawn based on site specific requirements.
 - Location of Trolley Refuges etc. should also be identified and levels at these locations should be taken in sufficient detail to work out the quantity of earth required.
 - To the extent possible, railway earth if found suitable may be used for cess repairs. The borrow pits should be dug along the edge of the railway boundary, duly ensuring that no borrow pits are dug within $(H+3)$ m distance from the toe of the embankment, where "H" is the height of embankment. In case of non-availability of railway earth, suitable contractor's earth may be used.
- (ii) **Identification of suitable earth**

Soils which are normally unsuitable for construction are stipulated in Para 3.7 of Chapter-3. Barring these, locally available soils of adequate strength can be used.

(iii) **Targeted Theoretical Profile (TTP)**

- In case, track renewal, deep screening, track lifting works are sanctioned, targeted theoretical profile should be finalized taking into account proposed longitudinal level of rail & cess, additional cess width required and sub bank if any required.
- Proposed TTP should be drawn for longitudinal levels of Rail/Cess and at every cross section as taken in Para 9.2.2(i) above should be fixed.
- Proposed rail level, cess level, edge of cess and level at every 50cm vertical interval on slope for TTP should be calculated and plotted.
- Due care should be taken while fixing TTP and must take into account any future proposed lifting to improve track geometry.

- e) On bridge approaches (up to the length of 50m on either side) where height of bank is more than 3m, extra 300mm cess width should be provided in addition to calculated above for cess repaired.
- f) The TTP should also include any additional width of cess or milder slope of embankment or sub-bank requirement based on site conditions and specific requirements with approval of Sr. DEN/DEN in charge of section.

9.2.3 Execution

- a) During earthwork on slopes, benching at the interval of 0.3m (vertical height must be done).

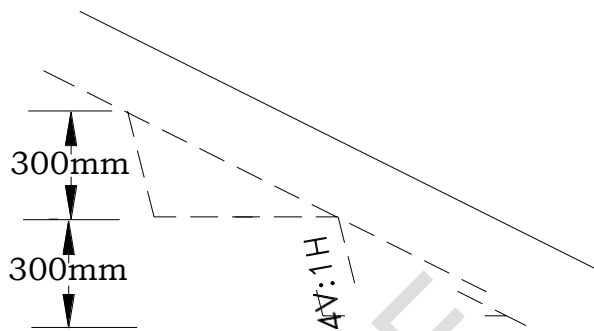


Fig-9.4

- b) Moisture to be added in the earth, to bring it near the Optimum Moisture Content value, shall be calculated and added to the soil. The moisture shall be mixed thoroughly using suitable means.
- c) After the final layer's compaction, the surface of earthwork executed must be as per desired level and slope to the satisfaction of the engineer in charge's representative.
- d) The earthwork shall be done in layers, compacting each layer with 10 passes of small width vibratory rollers. In top layers, where the working of rollers is not practical, suitable plate compactor may be used. After completing the earthwork of full height, the slope may be dressed and compacted with 10 passes of slope vibratory roller/compactor. The compaction on cess and slopes shall be kept as a separately payable item.
- e) For the repair work done on slope(s) of the embankment, suitable erosion control measures shall be adopted.
- f) Levels should be recorded at 30m length after completion of cess repair work and "as done" profiles should be plotted on the same sheets. Payment of cess repairs shall be based on the quantities worked out from the cross sectional calculations.
- g) Any excess repair work done beyond 10 cm of the TTP shall not be paid.
- h) In cess repair work, field measurement of compaction such as density and moisture content may not be insisted upon. Instead, record of compaction done, with machinery used & number of

passes shall be maintained for each layer of earthwork done by concerned SSE, duly checked by ADEN/AXEN.

K-RIDE

CHAPTER-10 FORMATION REHABILITATION

10.1 General

Railway formation may develop instability for reasons of poor bearing capacity of formation, inadequate factor of safety against slope stability, excessive settlement and loss of soil from formation on account of erosion, etc. Existence of one or more of these causative factors may lead to development of others and ultimately leads to instability of formation.

Formation failure due to poor bearing capacity alone or in combination comprises most of the unstable stretches. Increase in axle load & GMT also have a significant effect on adequacy of bearing capacity of formation. Therefore, strengthening of formation against bearing capacity failure is an important rehabilitation work.

10.2 Type of Formation Failure

The railway formation generally fails on account of improper design of embankment profile, lack of compaction of earthwork, poor subgrade material and construction of embankment before consolidation of sub-soil. Once the failure sets in, further deterioration is faster. The main forms of failure are given below:

- i) **Failures of the base or sub-soil strata:** Sub-soil strata may fail in shear or settle excessively and cause:
 - a) Slips,
 - b) Heave beyond toe, or
 - c) Excessive deformation.
- ii) **Failures of the fill material:** Fill material may fail in shear which may cause:
 - a) Slips,
 - b) Bulging or creep of slopes, and
 - c) Excessive deformation.
- iii) **Failure of the formation top:** This is due to poor sub-grade material, which results in ballast penetration, mud pumping and cess heave. This generally occurs during monsoons and the causes of the failures are:
 - a) **Due to strength failure:** This occurs due to low shear strength of top soil causing settlement of track with a consequent heave of cess and ballast penetration.
 - b) **Pumping failure:** This occurs due to presence of liquid slurry below the bottom of the sleeper. This may be formed with fine particles derived from the attrition of ballast, dust and water. Sometimes the residual negative pore pressure developed in the formation soil after the passage of the trains tends to cause softening of the soil and assists slurry formation. This slurry migrates upwards to the underside of the sleeper due to contraction and dilation of the ballast voids with passage of trains. This causes serious track irregularities
 - c) **Due to development of cracks on the formation top during summer months:**
Shrinkage cracks form in highly shrinkable soil during summer through which sometimes ballast enters resulting in the settlement of the track. The situation worsens in the rainy season when water enters into the formation through these cracks and causes swelling,

resulting in frequent cross level variations.

- d) **Due to the formation of gel on the formation top in Thixotropic soils:** Some soils after coming in contact with water assume a gel-like consistency and loose shear strength all together under the load by assuming a liquid like consistency. When the loads are removed, these soils revert back to their original gel-like consistency within a short period of time known as “gelation time”. During the period the topsoil is having liquid-like consistency, there is complete loss of shear strength resulting in penetration of ballast and consequent settlement of track.

10.3 Summary of various probable failures and their remedies

Based on the site investigation and soil testing, the relevant remedial measures should be formulated. Some of the remedial measures suggested for the formation troubles generally encountered are listed below for guidance:

Table 10.1

Sl. No.	Type of problem	Remedial Measures (*)
1.	Inadequate drainage due to high cess, fouled ballast	i) Improving side drainage by lowering the cess and screening of ballast
2.	i) Weak soil at formation top in contact with rain water resulting into mud pumping under trains, ii) Fouling of ballast with subgrade fines, iii) Impaired drainage	i) Improve drainage, ii) Provision of blanket of suitable thickness iii) Laying of Non-woven Geotextile below blanket
3.	i) Strength failure below ballast causing heaving up of cess or in between sleepers, ii) Ballast penetration exceeding 30 cm in formation	i) Provision of blanket of suitable thickness ii) Laying of Non-woven Geotextile below blanket
4.	Seasonal variation in moisture in formation top in expansive soils causing alternate heaving and shrinkage of formation	i) Blanket of suitable thickness, ii) Thickness of blanket may be reduced with provision of Geogrid layer(s). iii) Laying of Non-woven Geotextile below blanket
5.	Gradual consolidation of earth below embankment. (Bank settlement & heaving of soil)	i) Sub-bank may be provided or ii) Prefabricated vertical drain along with sand

	beyond toe)	drain (horizontal) or iii) Stone columns in sub soil.
6.	Creep of formation soil.	Flattening of side slopes with sandwiched construction.
7.	i) Inadequate sides slopes, causing embankment slips after prolonged rains, ii) Longitudinal cracks on cess/slopes	Flattening slopes with provision of berms (slopes analyzed with slope stability analysis) & proper drainage system.
8.	Hydrostatics pressure built up under live loads in ballast pockets containing water causing embankment slips	Draining out of ballast pockets by sandor boulder drain.
9.	Erosion of slope/cess	i) Repair of slope/cess, ii) Provision of turfing, mats etc.
10.	Cut slope failure	i) Adequacy of slope/slope protection measure as required, ii) Provision of adequate drainage arrangement (Side drain/Pucca catch water drain etc. and ensure their proper functioning).

* The above measures suggested are only indicative in nature and final remedial measures shall be decided based on the site investigation, soil testing, past failure history (if any) etc. RDSO's help wherever necessary, may be taken for formulating the remedial measures.

10.4 Identification, inspection of weak formation:

As also defined in IRPWM- For classification of formation requiring treatment, following steps shall be adopted:

- a) **Identification of Weak Formation-** Identification of Weak Formation shall include the following-
- i) Stretches having speed restrictions due to weak formation.
 - ii) Stretches where more than normal track attention is required.
 - iii) Stretches where ballast penetration profile is of 'W' shape and maximum depth Of penetration is more than 30 cm.

In case any of the above conditions are met in the field, then the 4 step action plan given below is to be followed

- b) **Action to be taken for weak formation-** Following 4-step action plan should be adopted for stretches identified as weak formation :

- i) Make the formation width, cess level and side drains strictly in accordance with prescribed profile.
- ii) Carry out shallow screening of ballast section (or deep screening wherever required).
- iii) Ensure no loose or missing fitting.
- iv) Increase the depth of the ballast section to 30cm or even up to 35cm.

If even after adoption of above measures, track maintenance problem persists, then it is a suspect formation and further detailed Geotechnical investigation is to be done for assessing the problem. Based on investigation results, if the formation is classified as Bad Formation then remedial measures for rehabilitation/ Strengthening of bad formation should be taken accordingly.

c) **Site inspection:**

During site inspection of problematic locations, the Pro-forma for reporting details for unstable formation (**Appendix-J**) should be filled up. This should preferably be done before the soil samples and other site details are collected.

The objective of such inspections and investigation is to know the exact cause of the formation problem.

d) **Recommended scheme for soil testing:**

The identified and suspected locations shall be subjected to detailed examination as per symptoms of failures. Recommended scheme of soil exploration and testing is given in **Table-1.1 of chapter-1(Soil Exploration and Survey)**.

10.5 Methods of Formation Rehabilitation

All formation rehabilitation schemes need to be framed by Railways. Help of an expert may also be taken if required. It is the responsibility of executive authority to ensure that formation rehabilitation work is carried out in accordance with rehabilitation scheme and adequate control is exercised in execution. However, RDSO may also be approached to provide consultancy on weak formation, if required.

In general, following points may be kept in view while planning for rehabilitation:

- a) In developing rehabilitation schemes, stretches having similar soil characteristics and Embankment performance should also be included simultaneously.
- b) Cause(s) of instability of formation should be analyzed and accordingly rehabilitation measures formulated. There may be requirement of re-profiling of slope along with laying of blanket and other measures.
- c) Geosynthetics may also be used along with laying of blanket for formation rehabilitation as an alternative, in consultation with RDSO as required.
- d) Method of laying of blanket should be appropriate depending upon site conditions/requirements.

Various probable failures and their possible remedies are listed in **Table-10.1** above. Some of the formation rehabilitation measures which can be adopted are as discussed below:-

- i. By providing blanket layer
- ii. By laying Geogrid and Non-woven Geotextile at the bottom of ballast along with deep screening by BCM
- iii. By cess widening
- iv. Rehabilitation of Unstable slopes
- v. Using Formation Rehabilitation Machines.

10.5.1 By Providing Blanket Layer

The weak/unstable formations are mostly those formations where subgrade soil is expansive clay (e.g. Black Cotton Soil). The most significant property of these soils is that when mixed with water they swell considerably, losing their shear strength and on drying they shrink considerably. Because of this swelling and shrinkage, due to ingress of water in the rainy season, the track parameters get disturbed and ballast penetrates in the formation.

The problems caused by expansive clays can be addressed to a large extent by reducing the ingress of water (during rainy season) by provision of blanket layer of adequate thickness in the top layer of formation. The blanket layer acts as a separator as well as reinforcement layer reducing the pressure on the formation below. In case providing blanket layer of large thickness in running traffic conditions is not possible, its thickness can be reduced with provision of layer(s) of geogrid.

In addition to this by providing a non-woven geotextile as separator/filtration layer below blanket (**Fig-10.1**), it prevents the water from top entering into the sub-grade & also prevents upward migration of fine particles from expansive clays (which are very fine grained) into the top coarse layer.

Various methods for laying blanket in running traffic conditions are covered in Para 10.6.

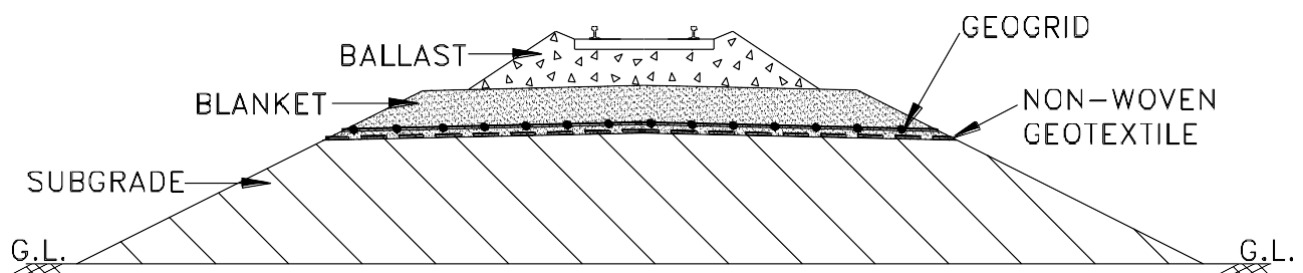


Fig-10.1: Use of Geosynthetic (Geogrid) in formation rehabilitation

10.5.2 By laying Geogrid and Non-woven Geotextile at the bottom of ballast along with deep screening by BCM:

The preferred method for strengthening/rehabilitation of weak/unstable formations will be provision of a Blanket layer of suitable thickness as detailed above. But in cases where it is not possible to adopt this method, and only shallow depth of formation is considered to be affected/weak, another lesser

preferred alternative is laying a separator layer of non-woven geotextile and a reinforcement layer of geogrid over it, just below the ballast as shown in Fig-10.2. This type of laying can be done by Ballast Cleaning Machine (BCM) during deep screening of ballast, by adding suitable attachments with BCM for holding and laying non-woven geotextile & geogrid rolls. During the subsequent deep screening cycles, care should be taken not to disturb about 50-100mm thickness of bottom most layer of ballast, which will not only avoid entanglement of geosynthetics (geogrid and non-woven geotextile) with BCM but this layer will act as a confining layer also for Geosynthetics (geogrid and non-woven geotextile) improving their efficiency.

Non-woven Geotextile, will act as a separator layer preventing ballast getting contaminated with fine grained particles below. The non-woven geotextile also acts a drainage layer, thus assisting in reduction of entry of water into the subgrade, thereby preventing alternative swelling and shrinkage of the expansive subgrade soil due to moisture content variation to some extent. The geogrid layer reduces the imposed stress on the subgrade. In addition to this, the cess/side slopes are attended, if needed, to bring them within the standard profile and erosion protection is done, to prevent entry of water into the subgrade. All these measures combined, will help to address the problem.

However, before adopting the above method, detailed soil investigation must be done ascertaining the root cause of the formation problem. If the nature of the problems suggests that it cannot be solely rectified by adopting this method, then conventional method of providing blanket layer or other appropriate method as determined from investigation done shall be adopted.

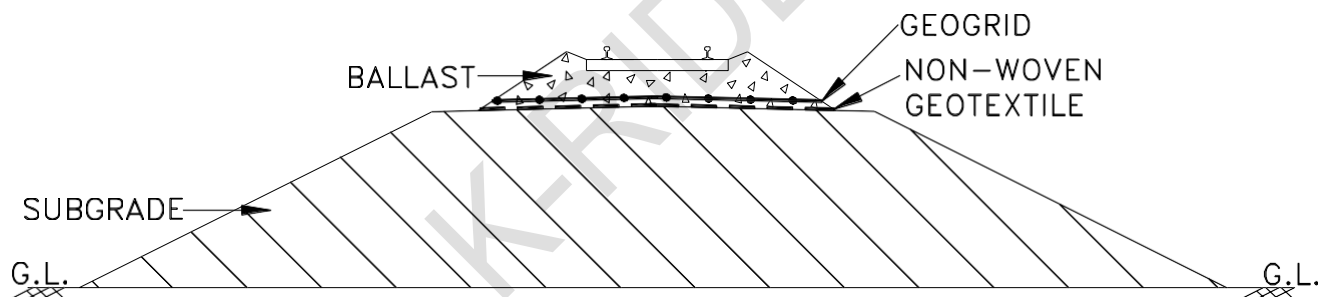


Fig-10.2: Alternative use of Geosynthetic (Geogrid and Non-woven Geotextile) information rehabilitation by BCM



Fig-10.3(a): Insertion of Material under BCM



Fig-10.3(b): Linking of Rolls to BCM

10.5.3 By cess widening

Cess widening is one of the methods for improving the strength of Embankment soil by process of confining as the strength of confined material is higher than unconfined material. For detailed procedure, Para 9.2 of Chapter 9 shall be referred to.

This method was used for 9 km length from km 113 to 122 in Vikarabad – Wadi section of South Central Railway, and results were found to be encouraging, as the number of attentions required to maintain track were reduced substantially and TGI values also improved in this stretch.

10.5.4 Rehabilitation of Unstable slopes

- i) All vegetation shall be uprooted and taken away from the site of work. The loose materials removed from the slope should be dumped to form the bottom most layer on the ground in the width to be widened. If required, it shall be supplemented with local granular soil.
- ii) Starting from the toe, benching on the slope at every 30cm height shall be provided on the slope surface as shown in Fig-10.4 below so as to provide proper amalgamation between the old and new earthwork.

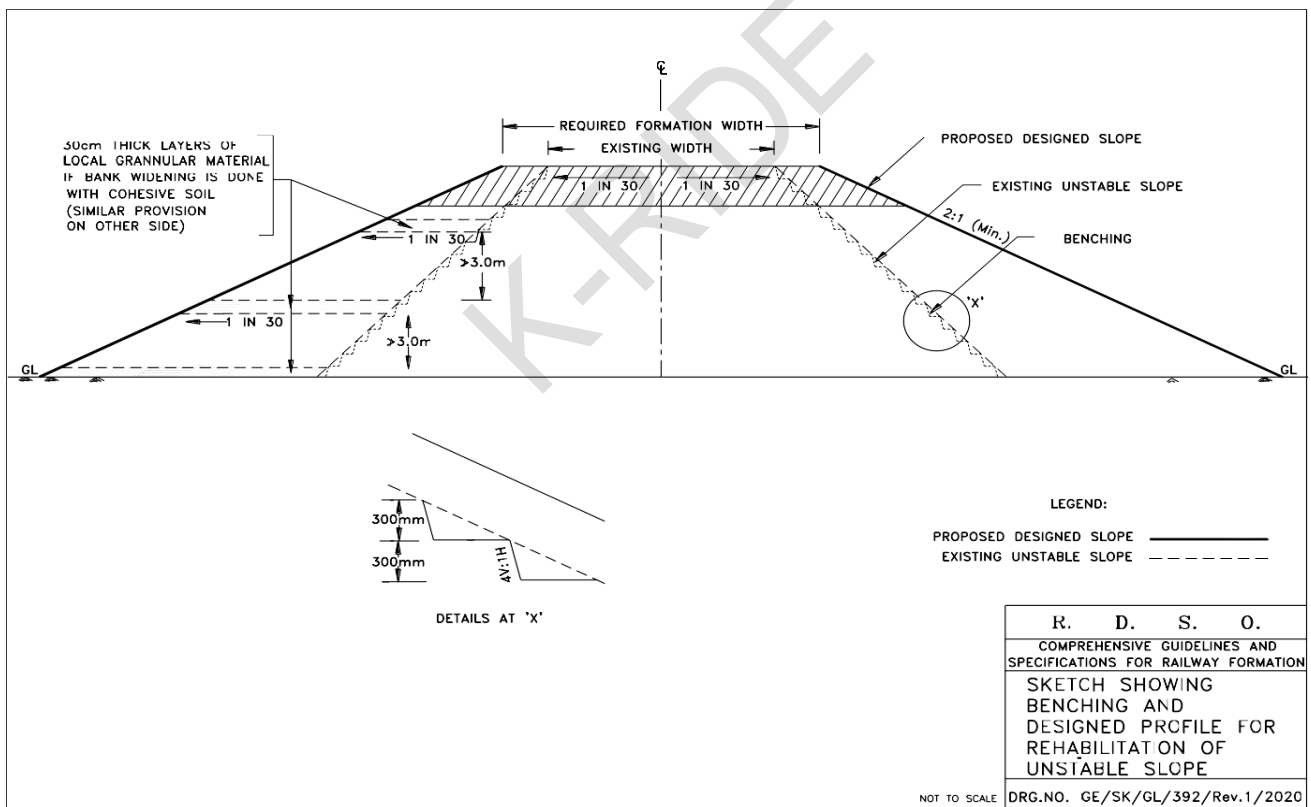


Fig-10.4: Sketch for Rehabilitation of Unstable slopes

Earthwork shall be carried out in layers, each layer sloping out 1:30 and compacting it mechanically using vibratory rollers of around 0.9m width (which are available in the market); 6 to 8 passes of such rollers shall usually suffice to provide the compaction to the specified level. Compaction on slope shall

be ensured by using slope vibratory roller of 10-20T. Preferably, this should be a separately payable item.

- iii) The width of each layer of earthwork shall be in excess by 300mm of the designed profile to enable compaction near the edges. The excess width, thereafter, be cut and dressed, so as to achieve the required embankment profile.
- iv) This para covers slope rehabilitation aspects only. Others measures required as per site condition like, drainage arrangement etc. are to be taken as required.

10.5.5 Formation improvement using Formation Rehabilitation Machines

Nowadays Formation Rehabilitation Machines which are fully mechanized are being utilized for rehabilitation of formation in different World Railway systems. Formation Rehabilitation Machines perform all the necessary tasks such as ballast recycling, leveling, lifting, lining and tamping etc. in one operation without disrupting rail traffic on the adjacent track. A formation protective layer (FPL) is installed in order to raise the load-bearing capacity of the subsoil effectively and sustainably.

All these machines are designed for simultaneous introduction of geotextiles and geogrids.

Important features of Formation Rehabilitation Machines are:

- i) Total excavation can be achieved in one or two passes
- ii) Old ballast is recycled for use as protective layer material
- iii) Automatic control and moisture regulation of the new protective layer material.
- iv) High uniform consolidation performance thus achieving very good quality of protective layer.
- v) Output of the machine ranging from 40 to 80 m/h depending on the thickness of the protective layer.
- vi) On a double track line no hindrance to traffic on the adjacent track.
- vii) Various thicknesses of protective layers up to 50 cm can be inserted in one pass.

Austrian federal Railways having experience of formation rehabilitation machines known as AHM-800R and RPM 2002.

In addition to the measures detailed in above Paras, proper cross slope should be provided and proper turfing or other erosion control measures shall be undertaken on the side slopes to prevent ingress of moisture in the formation from cess and side slopes.

10.6 Methods of Laying Blanket Layer

(a) **Track dismantling method:**

The method consists of dismantling a portion of track under traffic block (4hrs duration) and removal of ballast and weak formation layer and replacement with blanket layer and reconnection of track on ballast.

Execution of work :

i) Before traffic block

Decide longitudinal level & select blanketing material (including required moisture content & density), lay single rails if higher length panels exist, provide ramps on to the embankment for movement of tippers to carry blanketing material etc. & remove shoulder ballast.

ii) During traffic block (about 4 hrs. Duration)

- a) Lift single rail panels and remove balance ballast with excavators.
- b) Excavate formation to required depth with excavator.
- c) Roll the formation providing 1 in 30 cross slopes in one direction.
- d) Spread blanket material to optimum thickness for full formation width + 50 cm on cess side(s) to facilitate compaction.
- e) Compact blanket material (being granular cohesion less & well graded) with vibratory roller to achieve min. 70% relative density (IS code no: 2720 (Pt 14) latest version).
- f) Spread ballast & put back track panels (kept on slope of embankment).
- g) Attend track and allow traffic.

iii) After traffic block

Dress side slopes with suitable erosion control measures if required.

- a) **Progress**
Progress of laying of blanket can be in the range of 100-120m per day. Work can be taken up at more number of sites in shadow block.
- b) **Quality:** There is no constraint in achieving good quality of work.
- c) **Flexibility in execution**
Depth of excavation of formation & lifting of track both can be carried out to the requirement of site. Similarly, any thickness of blanket also can be laid. It can be adopted in any type of track structure, electrified or non-electrified. Only requirement is that the site should be approachable to bring machineries and space available to keep track panel, blanket material etc. Method has been successfully implemented in some Railways like SC Rly.

(b) **Using Formation Rehabilitation Machine:** Details discussed in Para 10.5.5.

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APPENDIX – A

Mechanical Production of Blanket Material

Normally, the blanket material shall be produced mechanically by crushing the stones and/or by mixing, naturally available materials using suitable equipment/plants like crusher or pug mills. Detail of these two methods is given below:

1.0 Crushing Methodology:

In the event of non-availability of natural source of blanket material, depending on the proximity of project site from the parent rock/boulder sources, it may be decided to crush the rock/boulder in order to produce crushed blanket material. Salient features of this methodology are:

- a) Crushed blanket material may be produced as sole product or in conjunction with ballast or any other nominal size.
- b) Trials and permutations of feed speed, crushing cycle, and sieve combinations may be required to arrive at the required particle size gradation.
- c) It is possible to achieve near total produce of desired gradation through production cycle management. Alternately, it may be possible to get by-products of other sizes in the desired proportion and blanket material as main produce or vice-versa.
- d) Optimisation of production rates and costs can be achieved by controlling the output at each sieve stage.
- e) It is ideal to mix the required quantity of water for OMC (accounting for loss/gain of moisture due to weather conditions) at the crusher plant and transport the material in wet condition.

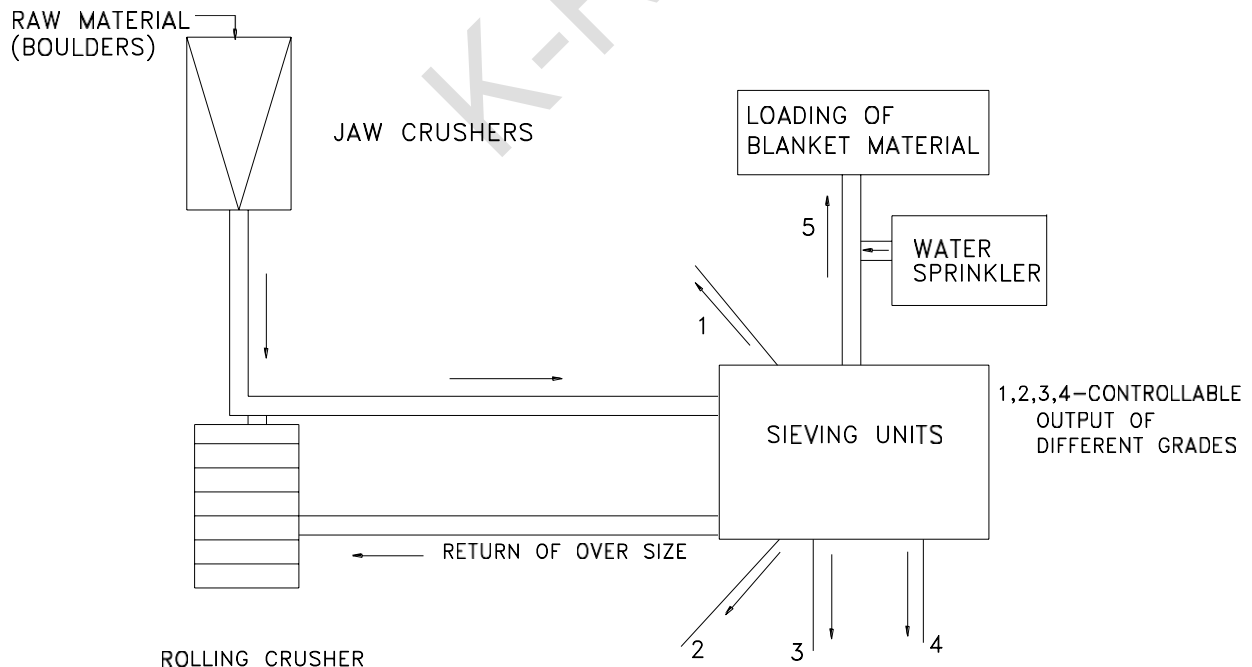


Fig-A1: Schematic Diagram of Manufacture of Blanket Material by Crushers



Fig-A2: General View of Crusher

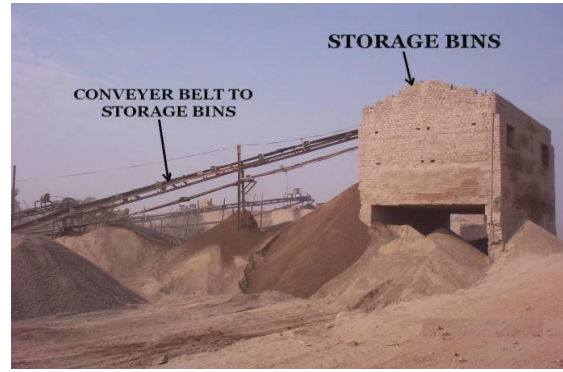


Fig-A3: View of Storage bin

2.0 Blending Methodology :

- (i) Blanket material could be obtained by proper blending of two or more soils or in combination with soils and crushed material like stone chips.
- (ii) Before approving such sources, trials for blending to judge the final product, needs to be done. Detail methodology of blending to be adopted to produce large quantity of blanket material with consistent quality, needs also to be laid down in advance.
- (iii) Blending of either natural or crushed materials in a pre-decided ratio could be adopted.
- (iv) Theoretical and laboratory trials are required in order to establish the desirable ratio of the blending materials. This exercise may be done in advance before finalizing the contracts for such a material.
- (v) The methodology of blending trials is explained below :
 - i) Identify the usable materials/soils.
 - ii) Take equal weight of the soils for sieve analysis.
 - iii) Write down the weight retained at each sieving stage for all the soils.
 - iv) Apportion a percentage component to each soil and work out a theoretical mix.
 - v) Draw particle size distribution curve of the mix to find out desirability of gradation.
 - vi) If not successful, make another trial, and so on.
 - vii) Trials and plotting work can also be done using simple computer programs.

2.1 Mechanical blenders using simple technology are now available in the market. Two types of mechanical blenders are quite common:

- (i) **Drum type blenders:** Drum type machines may involve weigh batching or manual feeding of material. They involve more moving parts. Hence, these machines are both manpower and maintenance intensive. They may pose a problem of segregation of material and as such do not afford any cost advantage either in the short or long run. These may be suitable for small quantities and not for large-scale production as required in construction projects.
- (ii) **Pug mill type blenders:** For continuous production of mix in large quantities, the best way is to feed the aggregates/ soils of pre decided gradation by way of 3 or 4 bins with conveyor belt. The required output grading can be achieved by adjustment of gate openings of bins. The use of pug mill type blenders is found very cost effective, as the manpower involvement is very little and only 4-5 people can run a plant of 100 tph. The pug mill blender consists of:

- i) Four bin aggregate unit
- ii) Pug mill mixer unit
- iii) Water tank and metering system
- iv) Conveyor belts
- v) Storage silos (optional)
- vi) Anti-segregation surge hopper
- vii) Automation and controls

The other important features of this technology are:

- i) Automatic feeding of soils/aggregates under gravity,
- ii) Arrangement for precise control of mixing of water,
- iii) Either direct loading into trucks, or optional storage at plant,
- iv) Availability of domestic manufacturers, and low cost of set up,
- v) Advantage of removal and relocation with ease.

A schematic diagram showing the various arrangements is shown below:

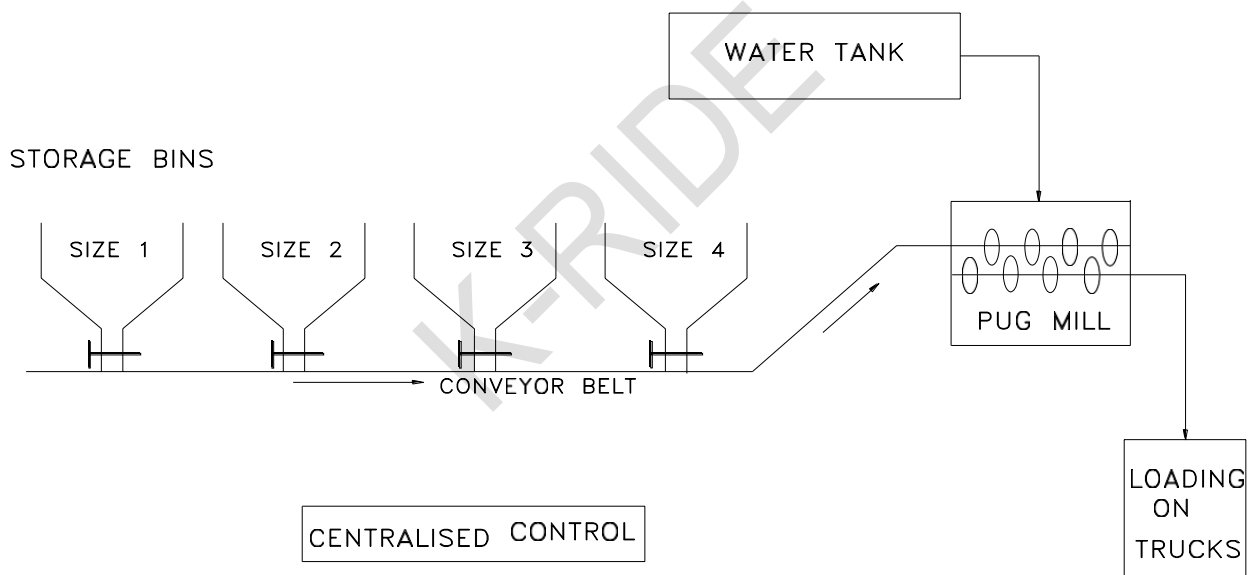


Fig-A4: Schematic Diagram of Manufacture of Blanket Material by Blending

- 2.2** The equipment for blending should enable blending of two or more materials uniformly so that the blended material satisfies the specification. The equipment chosen should be cost effective and easy to handle with and efficient.
- 3.0 Specifications of Mechanically Produced Blanket Material:** Blanket material produced in a plant should generally conform to specifications as mentioned in Table 3.3 to table 3.6, Chapter 3 of this Comprehensive Guideline and specification.

4.0 Quality Control on Blanket Material at production site:

It is desirable to have a check on quality of material at source/manufacturing point so that major deviation in quality of the material being sent to site does not exist. It would be in the interest of the supplier to have such tests conducted on his own to avoid any complication at a later stage.

4.1 Method of Test: Blanket material should be tested in pursuance to specifications for blanket material as laid down in Table 3.3 to 3.6 of this Comprehensive Guideline and specification.

4.2 Frequency of Tests at Site: As per Table 7.2 of this Comprehensive Guideline and specification.



Fig-A5: Computer Controlled Bins for Mixing



Fig-A6: Blanket Material Being Loaded into Truck

APPENDIX-B
Illustrative Examples for providing minimum thickness of Formation Layers

1.0 Construction of Formation in Embankment & Cutting:

1.1 For Embankment (where height is less than required total uniform thickness)

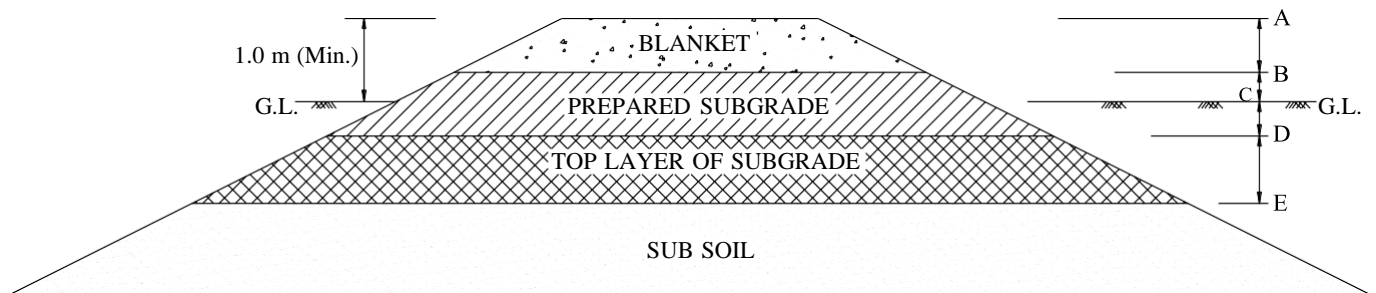


Fig-B 1: Formation Layers in Embankment

- a) If sub-soil material CD is of better quality than the specifications of prepared subgrade and DE part is of better quality than the specifications of top layer of subgrade, then remaining part of prepared subgrade (BC) and blanket layer (AB) of specified thickness only is required to be provided above ground level forebankment construction. No excavation below ground level is required.
- b) If minimum required depth of sub-soil CE is of better quality than the specifications of top layer of subgrade and inferior to that of prepared subgrade, then upper layer upto CD will be required to be replaced with specified quality of soil equivalent to prepared subgrade. Above ground level remaining part of prepared subgrade (BC) and blanket layer (AB) of specified thickness are required to be provided.
- c) If layer CE upto minimum required depth do not meet the specifications of top layer of subgrade, then upper layers of sub-soil upto "E" level should be removed and compacted with specified quality of soil i.e. in CD, soil with specified quality for prepared subgrade and in DE, soil with specified quality better than that for subgrade/top layer. Above ground level, remaining part of prepared subgrade (BC) and blanket layer (AB) of specified thickness are required to be provided.

Few representative sketches showing thickness of formation layers in embankment depending on site conditions:

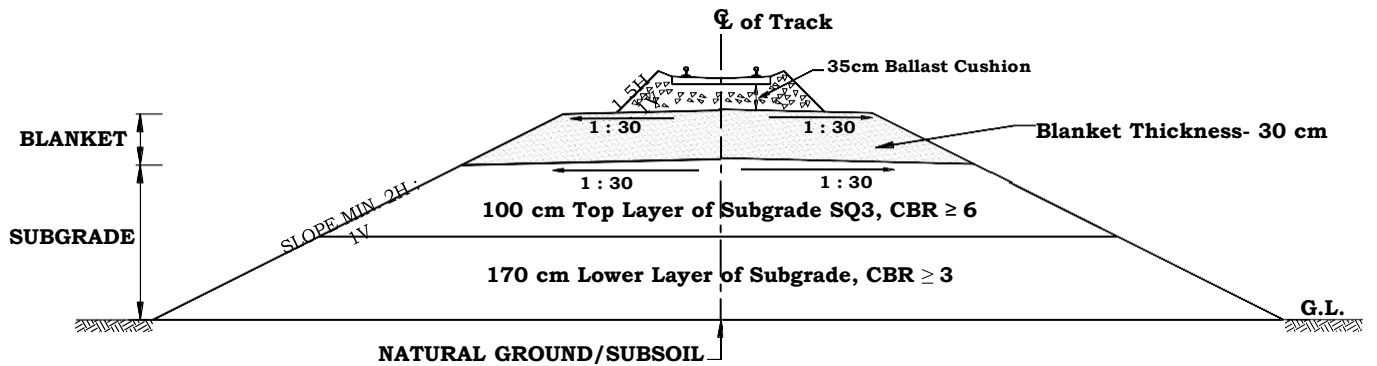


Fig-B2: Height of Bank=3.0m, **Single layer system** (25T Axle load), with SQ3 subgrade (CBR≥6)

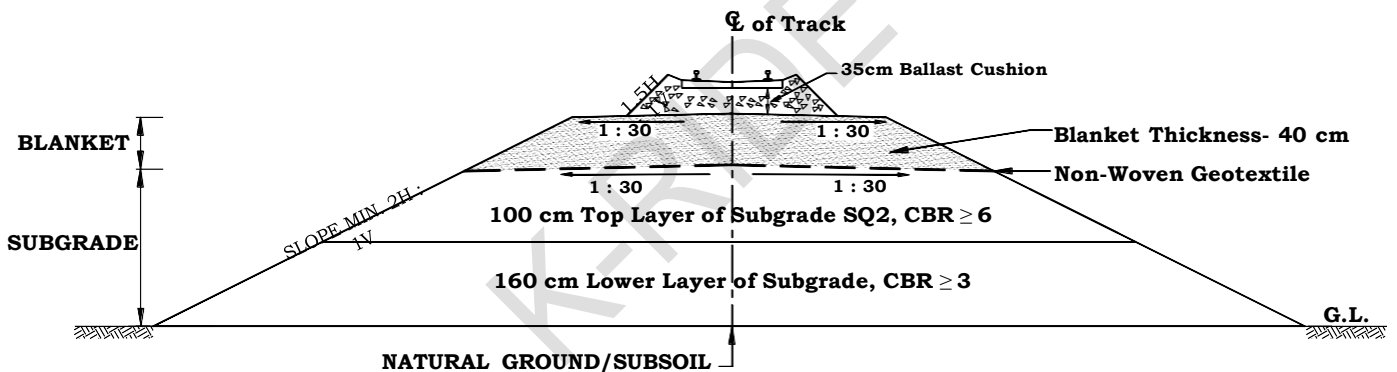


Fig-B3: Height of Bank=3.0m, **Single layer system** (25T Axle load), with SQ2 subgrade (CBR≥6)

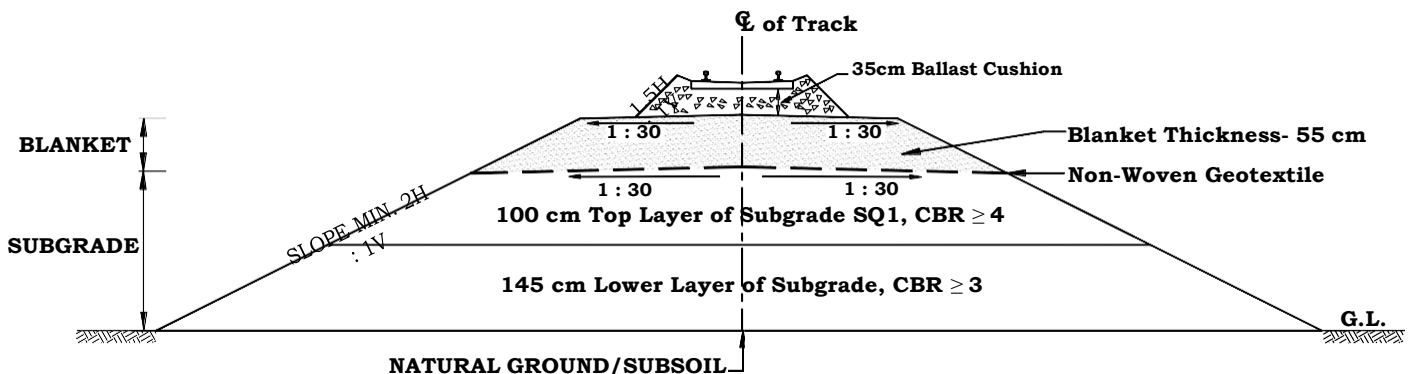


Fig-B4: Height of Bank= 3.0m, **Single layer system** (25t Axle load), with SQ1 Subgrade (CBR≥4)

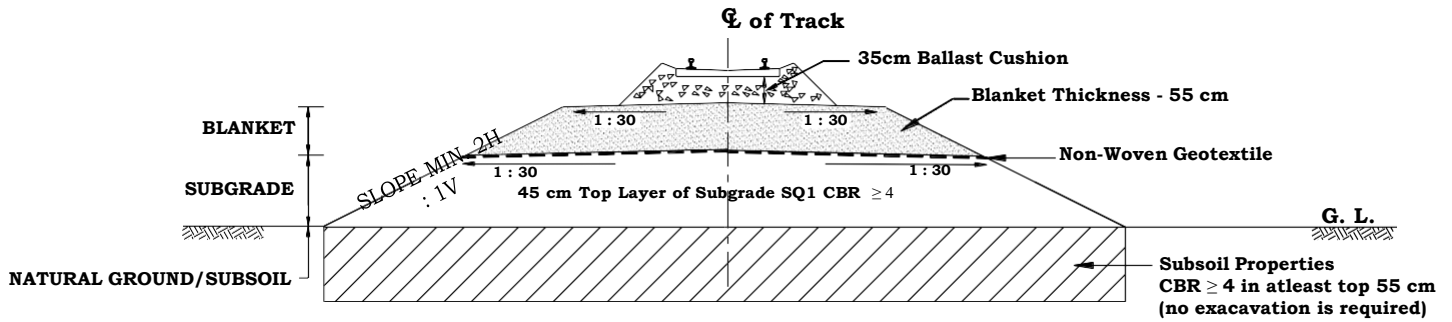


Fig-B5: Height of Bank 1.0m, **Single layer system** (25T Axle load), with SQ1 subgrade & Subsoil with CBR \geq 4 (No excavation below GL)

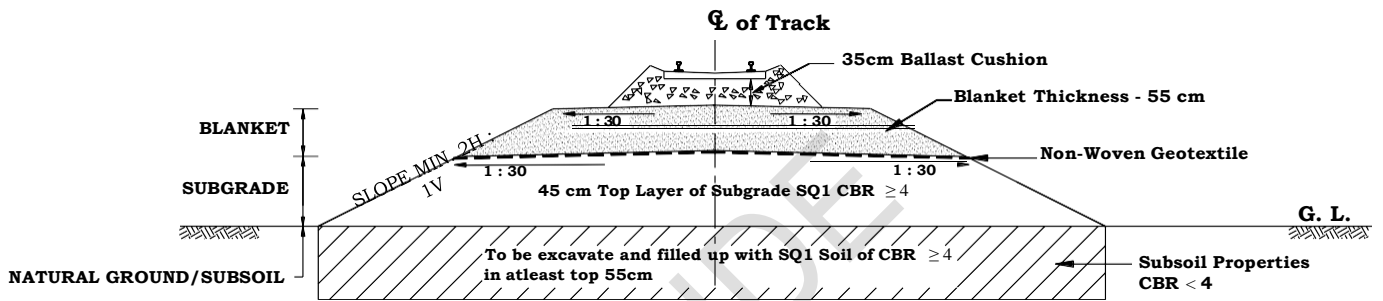


Fig-B6: Height of Bank 1.0m, **Single layer system** (25T Axle load), with SQ1 subgrade & Subsoil with CBR<4 (Excavation & replacement of min 55cm with CBR \geq 4 soil below GL)

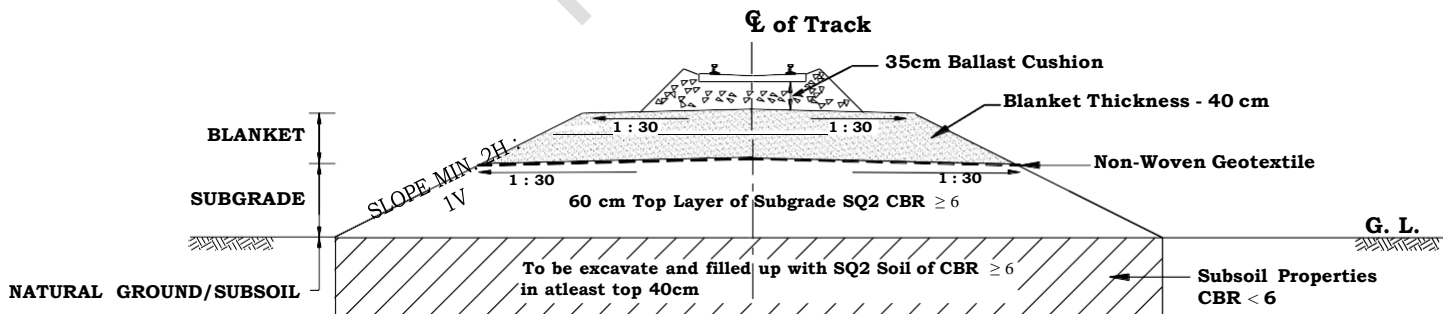


Fig-B7: Height of Bank 1.0m, **Single layer system** (25T Axle load), with SQ2 subgrade & Subsoil with CBR<6 (Excavation & replacement of min 40cm with CBR \geq 6 soil below GL)

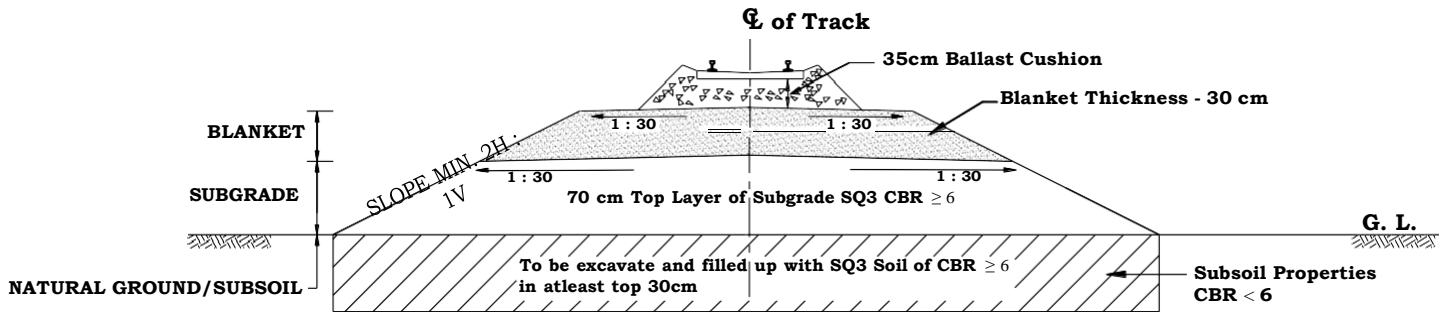


Fig-B8: Height of Bank 1.0m, **Single layer system** (25T Axle load), with SQ3 subgrade & Subsoil with CBR <6 (Excavation & replacement of min 30cm with CBR ≥ 6 soil below GL)

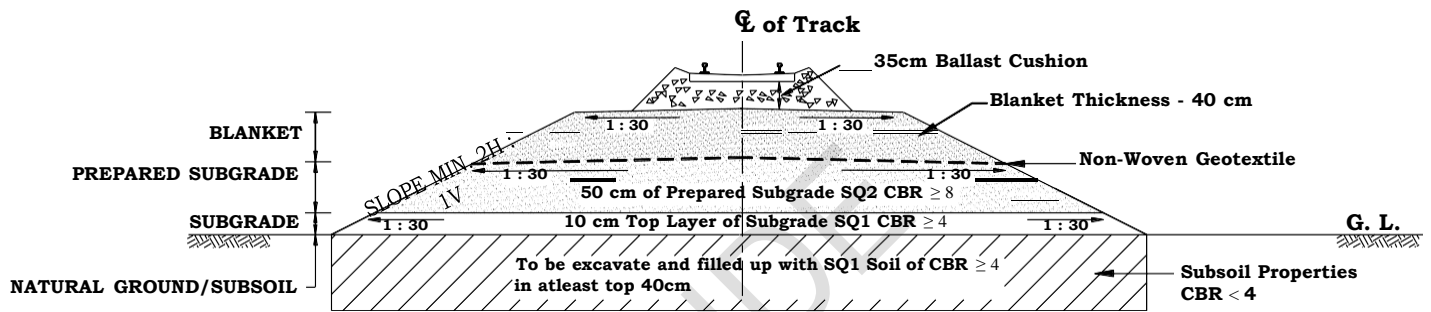


Fig-B9: Height of Bank 1.0m, **Two layer system** (25T Axle load), with SQ2 Prepared Subgrade, SQ1 Subgrade & Subsoil with CBR <4 (Excavation & replacement of min 40cm with CBR ≥ 4 soil below GL)

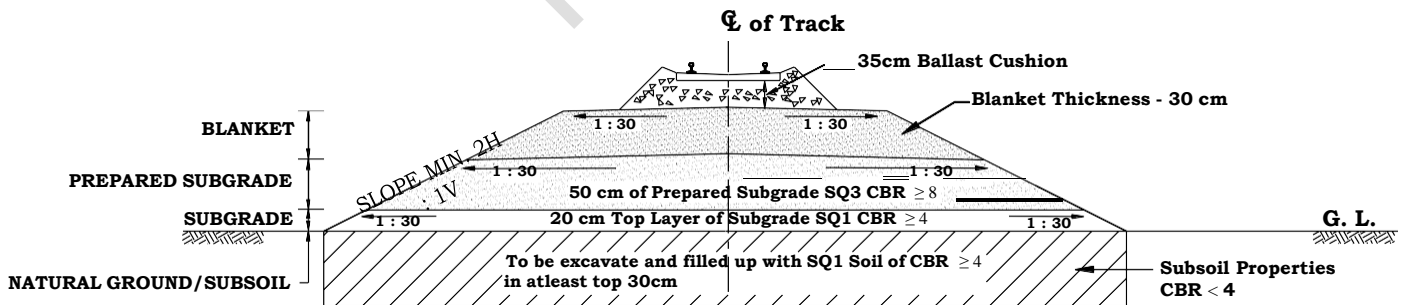


Fig-B10: Height of Bank 1.0m, **Two layer system** (25T Axle load), with SQ3 Prepared Subgrade, SQ1 Subgrade & Subsoil with CBR <4 (Excavation & replacement of min 30cm with CBR ≥ 4 soil below GL)

Fig-B 12 : Height of Bank 3.0m (Two layer system), 25T axle load, with SQ3 Prepared Subgrade & SQ2 Subgrade

1.2 For Cutting

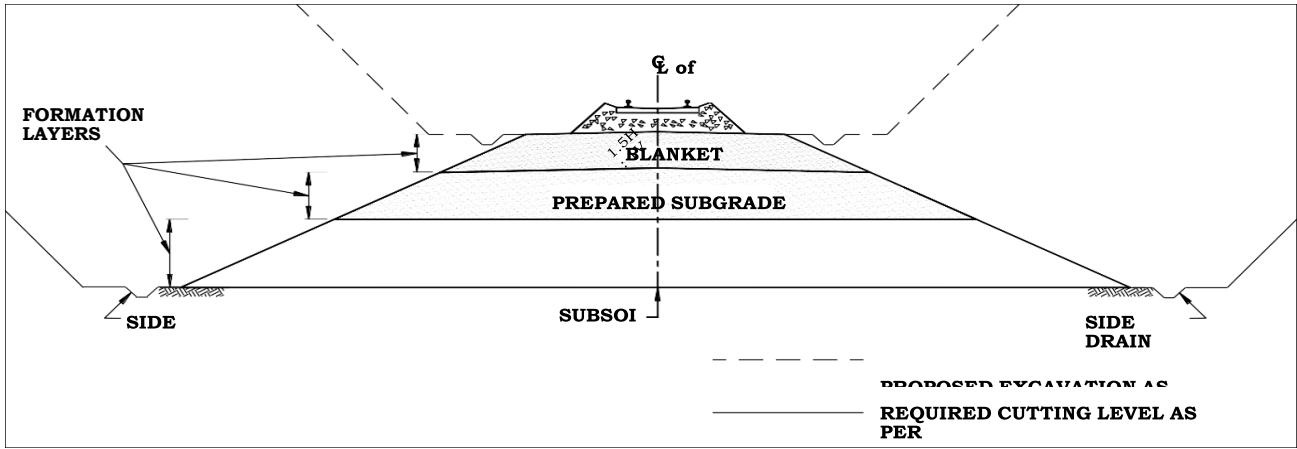


Fig-B 13: Formation Layers in Cutting

- a) As per bore log details from soil exploration & survey, at least 1.5m depth below the required cutting level, should be checked for conformity with specifications of construction material (quality of formation layers-blanket/prepared sub-grade/sub- grade top layer) as mentioned in **Para 3.10**.
 If soil encountered in this depth is of poorer quality than as specified in **Para 3.10** then the excavation for cutting will have to be planned accordingly taking into consideration the additional provisions for conformity with quality of soil as specified for formation layers (blanket/prepared sub-grade/sub-grade top layer) in the required depth, which will then cater to the requirement of heavy axle load. Same has been illustrated in **Fig-B 2** given above.
- b) For example, if in the depth of 1.5m below the proposed cutting level (as per required grade/level), soil encountered meets the specification of subgrade-top layer, then additional depth of excavation for cutting should take into account the depth of prepared subgrade & blanket only.
- c) Suitable drainage system shall be ensured in cuttings as described in Chapter 6 for Execution of Earthwork.

Representative sketches showing thickness of formation layers in Cutting depending on site conditions is given below:

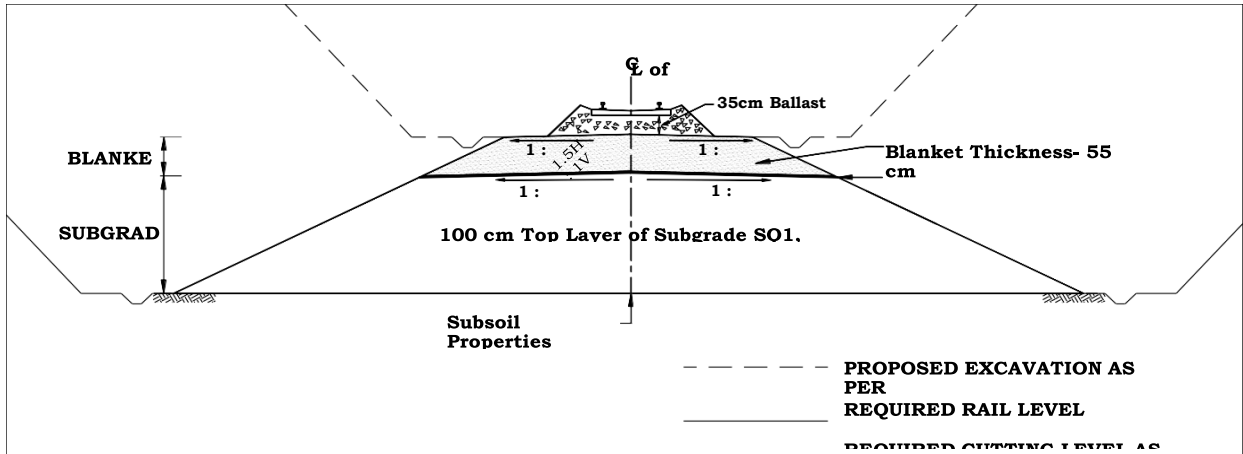


Fig-B14: Cuttings, 25T Axle Load (Single Layer System)

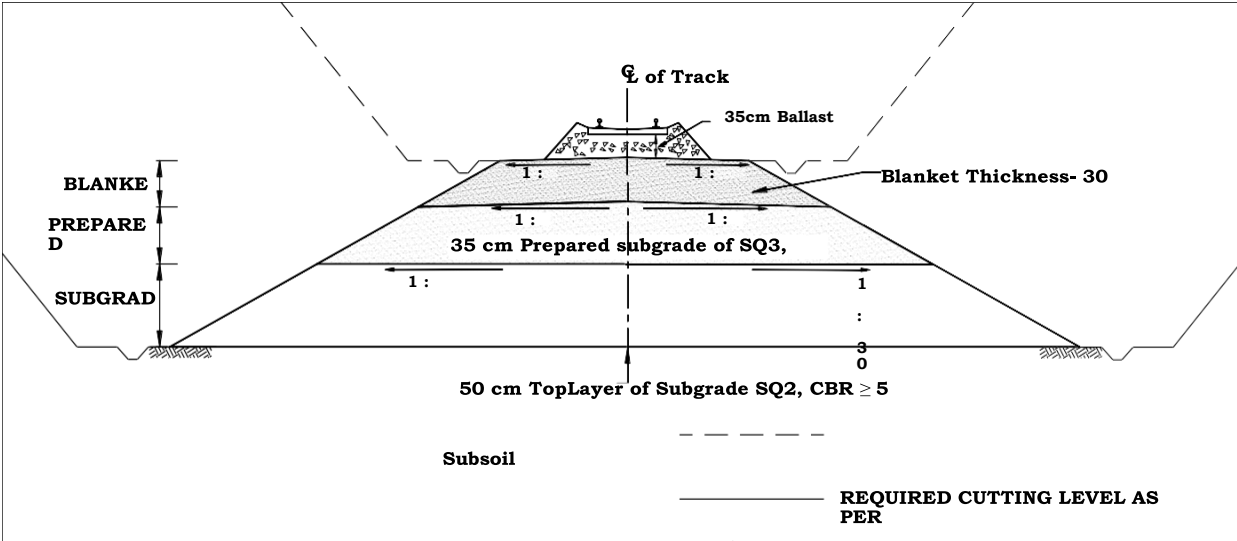


Fig-B15: Cuttings, 25T Axle Load (Two Layer System)

- Note: 1. Any Ground improvement measures (if required) shall be taken prior to the construction of embankment/cuttings (for details Refer Chapter 2).
- 2. All the above figures are just for guidance purpose. All the construction work shall conform to various relevant provisions described in this Guideline.

APPENDIX-C

Specifications of Geosynthetic Products

1.0 Specification of Non-woven Geotextile to be used as separator/filtration in Railway Formation Specification No. RDSO/2018/GE: IRS-0004-Part-I (March 2019)

A) Properties of Nonwoven Geotextile :

The Non-woven geotextile to be used as separator/filtration layer (Primary role as separator and secondary role as filtration), shall have following properties, when tested as per the latest edition of the test method indicated therein, for Railway application:

Sl. No.	Property	Test Method	Value
I	Polymer and Type		
1	Material/Polymer	-	Polypropylene/ Polyethylene/ Polyamide, Polyester or any combination thereof
2	Type/Structure	-	Non-woven Needle Punched and Mechanically or Thermally bonded type or equivalent
II	Mechanical Properties		
1	Elongation at Failure (*)		>50% in both direction
2	Grab Strength (*) : On top of subgrade or prepared subgrade before laying blanket or anywhere within the embankment Below the ballast and above the Blanket Layer	ASTM D4632 - 2015	700 N 1750 N
III	Hydraulic Properties		
1	Apparent Opening size	ASTM D4751- 2016	<=85 micron
2	Water Flow Rate normal to the Plane	ASTM D4491- 2017	20 lit/m ² /Sec
IV	Survivability Properties		

1	Trapezoidal Tear Strength (*): On top of subgrade or prepared subgrade before laying blanket or anywhere within the embankment Below the ballast and above the Blanket Layer	ASTM D4533-2018	250 N
			800 N
2	Puncture Strength–CBR (*): On top of subgrade or prepared subgrade before laying blanket or anywhere within the embankment. Below the ballast and above the Blanket Layer	ASTM D6241-2014	1800 N
			5800 N
V	Durability Properties		
1	Abrasion Strength (% strength retained in breaking load) (*)	ASTM D4886 - 2018	80%
2	Resistance to U.V. Light Weathering (% strength retained in breaking strength) after 500 hrs. of exposure	ASTM D4355-2018	Not less than 70% (After unwrapping, the geotextile should be installed and covered within a maximum of 14 days)
3	Minimum retained Ultimate Tensile Strength (*)	EN:12447-2001 and EN ISO: 13438-2004	50% (tested as per Clause B.4 of EN: 13250-2016, for 100 year service life)

* is Minimum Average Roll Value (MARV), which is derived statistically as average value minus two standard deviations.

Note:

1. The adherence to above listed specification should be checked by testing the samples at IIT, NIT, Government labs or any other NABL accredited lab.
2. Manufacturing of non-woven geotextile shall be in accordance with the manufacturer's QAP for quality control.
3. The product being supplied by the manufacturer should have been successfully used for similar application (separator /filtration-Primary role as separator and secondary role as filtration) at minimum 3 locations, with minimum 3 years' experience at one of the locations, with supporting documents as an evidence for satisfactory performance.
4. To ensure proper quality assurance and reproducibility of the product, following stipulations are as under:

- i) The manufacturer of non-woven geotextile should have ISO: 9001/CE Certification for the product being supplied. The manufacturer of Geo-synthetics should have a well- documented Quality Assurance Procedure (QAP)/Factory Production Control (FPC) Manual, covering every specific product produced on specific production site, which shall be referred/stipulated in the ISO: 9001/CE Certification. The QAP/FPC Manual shall consist of a permanent internal production control system to ensure that product being manufactured conforms to the requisite properties and it addresses following items:
 - a) Produce design requirement and criteria.
 - b) Acceptance criteria of raw/incoming material and procedures to ensure that these are met.
 - c) Relevant features of the plant and production process; giving frequency of inspections, checks & tests, together with values/criteria required on equipment and action(s) to be taken when control values or criteria are not obtained.
 - d) Tests on finished products – Size of the samples and frequency of sampling with results obtained.
 - e) Details of alternative tests and procedures, if any, and their correlation with reference tests.
 - f) Calibration of equipment having influence on test results.
 - g) Records to be maintained for various inspections, checks and tests carried out during factory production.
 - h) Assessment of results of various inspections, checks and tests carried out during factory production; where possible and applicable.
 - i) System of traceability and control of designs, incoming materials and use of materials.
 - j) Corrective action for non-conforming materials and finished products.
 - k) Training, job description and responsibility of the personnel involved in the manufacturing process.
- ii) Any subsequent changes in raw materials, manufacturing procedures or the control scheme that affects the properties of a product shall be recorded/revised in the QAP/FPC Manual and certified by the ISO: 9001/CE Certification.
- iii) Surveillance of QAP/FPC Manual shall be undertaken at least once per year. The surveillance shall include a review of the test plan(s) and production processes for each product to determine if any changes have been made since the last assessment or surveillance. The significance of changes shall be assessed.
- iv) Records of all in-house test results, as per QAP/FPC Manual, shall be shown to the purchaser; whenever requested by the purchaser

(B) Packing, Handling, Storage and Laying of Geotextiles

- i) A tag or other method of identification shall be attached to each roll of non –woven geotextile indicating following :
 - a) Manufacturer or Supplier Name
 - b) Product or Style Name

- c) Roll Number
- d) Lot or Batch Number
- ii) Rolls of non –woven geotextiles should not be dragged on the ground and they must be lifted off the ground before moving them.
- iii) Non –woven Geotextiles slowly degrade in the presence of Ultra Violet (UV) rays which are present in sunlight. Hence, they should be wrapped with a material that will protect them from damage due to shipment, sunlight (UV exposure) and contaminants. The protective wrapping, in which the non –woven geotextiles comewrapped from factory, should be kept on till their storage and installation. After unwrapping, the geotextile should be installed and covered within a maximum of 14 days.
- iv) If stored outside, they should be elevated from the ground surface and adequately covered to protect them from site construction damage, precipitation, UV radiation including sun light, chemicals that are strong acids/bases, flames including weldingsparks, temperatures in excess of 710C etc.
- v) If the protective wrapping of the non –woven geotextile roll is damaged, the rolls must be elevated off the ground surface and covered with a tarpaulin or opaque plastic sheet. If the outer layer of the geotextile itself is damaged, the outermost wraps of the geotextile must be removed and discarded. This is also required when the roll is exposed to sunlight for a period beyond that permitted by the project specifications.
- vi) If the non –woven geotextiles is exposed to moisture or water, prior to installation, it absorbs water up to three times their weight. This can lead to serious handling problems due to extra weight and installation problem because it is nearly impossible to unroll wet rolls. In addition, the strength of wet non –woven geotextile may also diminish to the point that it may not support the required load during installation/construction.
- vii) If the non –woven geotextile becomes wet, it is permissible to remove the waterproof cover to allow for a few days of exposure to wind in order to dry the fabric.
- viii) In trenches, after placing the backfill material, the non –woven geotextile shall be folded over the top of the filter material to produce a minimum overlap of 300mm for trenches greater than 300mm wide. In trenches, less than 300mm wide, the overlap shall be equal to the width of the trench. The non –woven geotextile shall then be covered with the subsequent course.
- ix) Damages to non –woven geotextile, if any during installation, shall be repaired by placing a non –woven geotextile patch over the damaged area and extending it 1m beyond the perimeter of the tear or damage.
- x) For laying of Non-woven geotextile:
 - a) Major protrusions on the surface on which non –woven geotextile is to be laid, such as rocks & bush stamps, shall be removed and local depressions etc. shall be filled with approved soil

before laying the geotextile. The geotextile shall be rolled out smoothly. The non –woven geotextile should not be dragged across the subgrade. The entire roll should be placed and rolled out as smoothly as possible. Wrinkles and folds in the fabric shall be removed by stretching as required.

- b) Adjacent rolls of non –woven geotextiles shall be overlapped, sewn or joined as required. Overlaps can be used to provide continuity between adjacent non –woven geotextile rolls through frictional resistance between the overlaps. The amount of overlap depends primarily on the soil conditions as given in the Table below:

Soil CBR	Minimum Overlap
Greater than 3	300- 450 mm
1 – 3	600 – 1000 mm
Less than 1	Sewn

- c) For curves, the non –woven geotextile shall be folded or cut and overlapped in the direction of construction. Folds in the non –woven geotextile shall be stapled or pinned approximately 0.6m centre-to-centre. Before covering, the condition of the non –woven geotextile shall be checked for damage (i.e. holes, nips, tears etc.)
- xi) Before laying the first lift of granular subgrade on the non –woven geotextile, a trial stretch of 100m shall be laid to establish a proper construction methodology of placing and compacting the sub-grade in a manner that no damages are caused to the separation layer of non-woven geotextile.

(C) Measurement for Payment of Geotextiles

The geotextiles for separation / filter layer shall be measured in square metres, with no allowance for overlapping at transverse & longitudinal joints. The contract lumpsum price of geotextile shall be in full compensation for furnishing, preparing, hauling and placing geotextiles including all labour, freight, tools, equipment and incidentals to complete the work as per specifications.

2.0 Specifications for Geogrid to be used as reinforcement/stabilisation for Railway Formation (Specification No. RDSO/2018/GE: IRS-0004- Part-III) February 2020.

A) Properties of Geogrid

The geogrid used as reinforcement/stabilisation layer shall have following properties, when tested as per the latest edition of the test method indicated therein, for Railway application:

Sl. No.	Property	Test Method	Value
I	Material/Polymer		
1	Material/Polymer	-	Polypropylene
II	Mechanical Properties		
	Tensile Strength at 2%		
	Strain (**)		
1.	(i) For use below ballast in existing line (ii) For use below blanket in new line	ISO 10319-2015	10KN/m x 10 KN/m* 9 KN/mx9KN/m
2.	Strain at Ultimate Tensile Strength (**)	ISO 10319-2015	6-15 %
3.	Aperture Stability/Torsional Rigidity Modulus (**) (i) For use below ballast in existing line (ii) For use below blanket in new line	ASTM-D7864-2015	Average Torsional Stiffness >= 0.33N-m/deg >= 0.40N-m/deg
4.	Junction Efficiency (**)	ASTM-D7737-2015	90%
III	Durability Characteristics		
1.	Resistance to Installation damage (% tensile strength at 2% strain) (**)	ASTM-D5818-2018	90%
2.	Resistance to Chemical Degradation (% Average Ultimate rib Tensile Strength) (**)	ASTM D6213-2017	100%
3.	Resistance to U.V. Light Weathering (% strength retained in Breaking strength) after 500hrs of exposer	ASTM-D4355-2018	95%
4.	Minimum retained Tensile Ultimate Strength (**)	EN ISO-13438-2004	50% (Tested as per clause B.4.2 of EN :13250-2016, for 100 year service life)

* MD: Machine Direction (Longitudinal to the roll) X CD (90o of Machine Direction): Transverse Direction (Across the roll width)

** Values marked are Minimum Average Roll Value (MARV), which is derived statistically as average value minus two standard deviations.

NOTE :

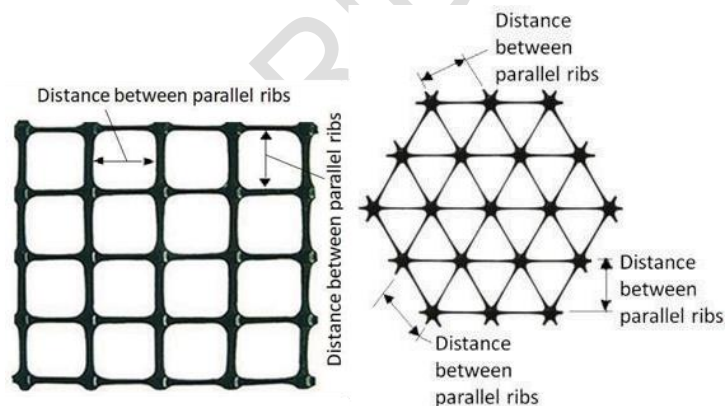
1. The adherence to above listed specification should be checked by testing the samples at IIT, NIT, Government labs or any other NABL accredited lab.
2. Aperture Opening of Geogrid:

a) For use below ballast in existing line, the distance between parallel ribs of the geogrid should be $60\text{mm} \pm 5\text{mm}$.

a) For use below blanket in new line, the distance between parallel ribs of the geogrid should be $30\text{mm} \pm 5\text{mm}$.

Aperture size/opening specified above is the clear distance between inner faces of ribs.

Reference diagrams are as given below for illustrations .



(Ref. ISO 10319-2015)

3. The particle grading for the installation damage test result determined in accordance with ASTM D5818 shall use Ballast grading as defined in IRS-GE-1 June 2016, for use below bottom of ballast in existing line and Blanket grading as defined in table 3.7 of chapter 3, for use below in blanket layer in new line.
4. The product being supplied by the manufacturer should have been successfully used as per functional requirement for similar Railway application (reinforcement / stabilization) at minimum 3 locations, with minimum 3 years India/International experience at one of the locations, and certificate duly certified by client/executive which is a government agency/PSU, should be submitted as an evidence for satisfactory performance.

5. Manufacturing of geogrid shall be performed in accordance with the manufacturer's QAP for quality control.
6. To ensure proper quality assurance and reproducibility of the product, following stipulations are as under:
 - a) The manufacturer of the Geogrid should have ISO: 9001 and CE Certification of the product being supplied. The manufacturer of Geo-synthetics should have a well- documented Quality Assurance Procedure (QAP)/Factory Production Control (FPC) Manual, covering every specific product produced on specific production site, which shall be referred/stipulated in the ISO: 9001 and CE Certification. The QAP/FPC Manual shall consist of a permanent internal production control system to ensure that product being manufactured conforms to the requisite properties and it addresses following items:
 - i) Produce design requirement and criteria.
 - ii) Acceptance criteria of raw/incoming material and procedures to ensure that these are met.
 - iii) Relevant features of the plant and production process; giving frequency of inspections, checks & tests, together with values/criteria required on equipment and action(s) to be taken when control values or criteria are not obtained.
 - (iv) Tests on finished products – Size of the samples and frequency of sampling with results obtained.
 - (v) Details of alternative tests and procedures, if any, and their correlation with reference tests.
 - (vi) Calibration of equipment having influence on test results
 - (vii) Records to be maintained for various inspections, checks and tests carried out during factory production.
 - (viii) Assessment of results of various inspections, checks and tests carried out during factory production; where possible and applicable.
 - (ix) System of traceability and control of designs, incoming materials and use of materials.
 - (x) Corrective action for non-conforming materials and finished products.
 - (xi) Training, job description and responsibility of the personnel involved in the manufacturing process.
 - b) Any subsequent changes in raw materials, manufacturing procedures or the control scheme that effects the properties of a product shall be recorded/ revised in the QAP/FPC Manual and certified by the ISO: 9001 and CE Certification.
 - c) Surveillance of QAP/FPC Manual shall be undertaken at least once per year. The surveillance shall include a review of the test plan(s) and production processes for each product to determine if any changes have been made since the last assessment or surveillance. The significance of changes shall be assessed.
 - d) Records of all in-house test results, as per QAP/FPC Manual, shall be shown to the purchaser; whenever requested by the purchaser.

B) Packing, Handling, Storage and Laying of Geogrid

- i) A tag or other method of identification shall be attached to each roll indicating the following:
 - a) Manufacturer or Supplier Name
 - b) Product name and Style
 - c) Roll Number
 - d) Lot or Batch Number
- ii) Geogrids shall be stored in a manner that prevents excessive mud, wet concrete, epoxy or other deleterious materials from coming in contact with and affixing to the geogrid.
- iii) If the geogrid comes in the protective wrapping, it should be kept in wrapped condition till their storage and installation. After unwrapping, the geogrid should be installed and covered within a maximum period of 1 month.

If the Geogrid is supplied in unwrapped condition, it should be installed and covered within a maximum period of 1 month from the date of manufacturing. In case Geogrid is supplied after more than a month's period to the site it should be ensured that it conforms to Resistance to UV light weathering criteria before laying.

- iv) Prior to laying of geogrid as reinforcement layer, the surface shall be properly prepared, ruts should be made good and dressed to the specified lines and levels.
- v) Geogrid reinforcement shall be placed flat, pulled tight and held in position by pins or suitable means until the subsequent layer is placed. Geogrid should be rolled out on the compacted surface parallel to the centre line of track.
- vi) The minimum overlap shall be of

CBR (%)	Overlap
Greater than 3	300 mm
1-3	600 mm

Overlaps must be maintained during the filling operation. This is generally achieved by placing small heaps of fill locally over the overlaps ahead of main filling operation.

- vii) No vehicle shall be allowed on geogrid unless it is covered by at least 150mm thick overlying material.

C) Measurement for Payment of Geogrid

The geogrid shall be measured in square metres, with no allowance for overlapping at transverse & longitudinal joints. The contract Lumpsum price quoted in price schedule for geogrid shall be in full

compensation for furnishing, preparing, hauling and placing geogrid including all labour, freight, tools, equipment and incidentals to complete the work as per specifications.

D) Acceptance Criteria

Conformance testing on the geogrid delivered to the site shall be undertaken by the Contractor in accordance with the requirements of Clause.

i) General

The Chief Engineer (open line/Construction) or equivalent in PSU's shall be the accepting authority and shall accept test certificates, verifying compliance with Clause (A), for tests carried out, in accordance with this Technical Specification, on the materials to be used for the specific project. In addition, Contractor's quality system shall demonstrate that the specified minimum frequency of testing has been maintained and ensuring traceability of the material.

Presently Tests Aperture Stability/Torsional Rigidity Modulus are not carried out in India, therefore upto one year, Manufacturer certificate is required for the procurement of Geogrid. All manufacturers should develop Testing facilities in one year time and this should be carried out as routine testing of Geogrid. The test certificates shall not be older than 12 months on the date of the supply to the site.

ii) Site sampling

a) Frequency for test other than durability tests

Where the total required batch size for the Contract is less than 5000 m², sampling and testing need not be undertaken. If the material supplied is higher than 5000 m² on-site sampling shall be carried out in accordance with ASTM D4354 at the frequency stated in Table D.2.

Table D.2 – On Site sampling frequency

Batch or order size defined as the lot size	Number of rolls to be sampled representing the lot
The initial 10,000 m ² or part thereof	1
Each subsequent 20,000 m ² or part thereof	1

The representative sample shall be no less than four linear metres along the roll for the full production width but not within two metres of the start or end of the roll.

Identification information including the geogrid supplier, type, batch identification, and details of the order represented by sample, sample date and roll directional markings shall be shown on or attached to the test reports.

b) Frequency for Durability Tests

Random checks on material supplied to project sites once every 5,00,000 sqm. or once in a 3 year whichever is earlier for each manufacturer.

iii) **Acceptance**

A lot shall be deemed to achieve conformance, if all samples tested comply with the Technical Specification. If a lot fails to achieve conformance, the lot may be re-sampled in accordance with Clause D.2 to verify whether the lot conforms or not. If it still does not conform to the technical specifications, the lot should be rejected.

The geogrid shall not be placed prior to the acceptance as per para D (i) above.

iv) **Audit testing** During audit testing, samples may be selected from the site and accordingly arrangement for audit testing has to be done, regardless of the quantity of geogrid supplied.

3.0 Specification of Geocomposite Drain to be used behind Bridge Abutment/ Retaining Wall for Railway Bridge- For height up to 10 m. (Specification No. RDSO/2018/GE: IRS-0006 -March 2019)

A) **Properties of Geocomposite Drain (Vertical)**

The Geocomposite Drain (or Drainage Composite) consisting of a geonet core sandwiched between non-woven geotextile filters on both sides, to be used behind Bridge Abutment/Retaining Wall of Height up to 10m, shall have following properties, when tested as per the latest edition of the test method indicated therein:

Sl. No.	Property	Test Method	Proposed value
I	Composite Drain (Non-woven geotextile on both sides)		
1	Tensile Strength	ASTM D4595-2017	20 KN/m in both MD & CD ($\pm 10\%$)
2	In-plane Water Flow (For $i=1$, Rigid/Soft Contacts) At 100 kPa (To be tested inlab)	ASTM D4716-2014	1.5 lit/m.sec.
3	Static Puncture Resistance CBR(*)	ASTM D 6241-2014	3000 N

4	Resistance to U.V. Light Weathering (% strength retained in braking strength) after 500hrs of exposer.	ASTM D4355-2018	Not less than 70% (After unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)
5	Minimum retained Ultimate Tensile Strength(*)	EN:12447-2001 and EN ISO: 13438-2004	50% (tested as per Clause B.4 of EN: 13250-2016, for 100 year service life)
II	Core		
1	Material	-	HDPE/Polypropylene/ Polyethylene or combination thereof
III	Filter (Non-woven Geotextile)		
1	Material	-	Polypropylene/Polyamide/Polyethylene, Polyester or combination thereof
2	Type/Structure	-	Non-woven Needle Punched & Mechanically or Thermally bonded type or equivalent
3	Permeability (Perpendicular to Plane)	ASTM D4491-2016	70 lit./m ² .s (Min.)
4	Apparent Opening Size	ASTM D4751-2016	150 Micron (Max.)
5	Puncture Strength – CBR (*)	ASTM D6241-2014	1400 N
6	Resistance to U.V. Light Weathering (%strength retained in breaking strength) after 500 hrs of exposure	ASTM D4355-2018	Not less than 70% (After unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)

- MD: Machine Direction (Longitudinal to the roll)
- CD: Transverse Direction i.e., 90° to MD, (Across the roll width)
- * Is Minimum Average Roll Value (MARV), which is derived statistically as average value minus two standard deviations.

Note:

1. The adherence to above listed specification should be checked by testing the samples at IIT, NIT, Government labs or any other NABL accredited lab.

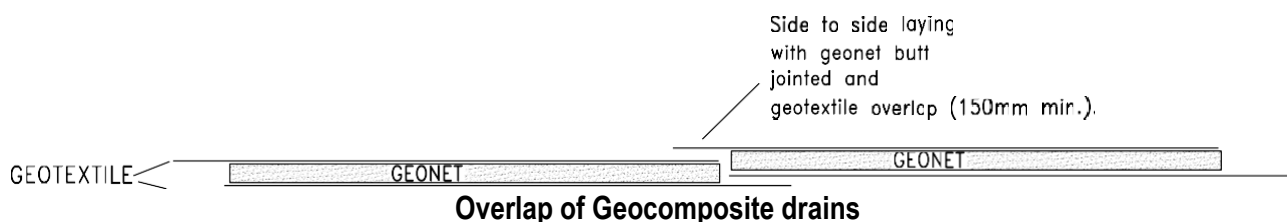
2. Manufacturing of Geosynthetics shall be in accordance with the manufacturer's QAP for quality control.
3. The product being supplied by the manufacturer should have been successfully used for similar application (i.e. for drainage behind bridge abutment/retaining wall) at minimum 3 locations, with minimum 3 years' experience at one of the locations, with supporting documents as an evidence for satisfactory performance.
4. To ensure proper quality assurance and reproducibility of the product, following stipulations are as under:
 - a) The manufacturer of Geocomposite drain should have ISO: 9001/CE Certification for the product being supplied. The manufacturer of Geo-synthetics should have a well- documented Quality Assurance Procedure (QAP)/Factory Production Control (FPC) Manual, covering every specific product produced on specific production site, which shall be referred/stipulated in the ISO: 9001/CE Certification. The QAP/FPC Manual shall consist of a permanent internal production control system to ensure that product being manufactured conforms to the requisite properties and it addresses following items:
 - i) Produce design requirement and criteria.
 - ii) Acceptance criteria of raw/incoming material and procedures to ensure that these are met.
 - iii) Relevant features of the plant and production process; giving frequency of inspections, checks & tests, together with values/criteria required on equipment and action(s) to be taken when control values or criteria are not obtained.
 - iv) Tests on finished products – Size of the samples and frequency of sampling with results obtained.
 - v) Details of alternative tests and procedures, if any, and their correlation with reference tests.
 - vi) Calibration of equipment having influence on test results.
 - vii) Records to be maintained for various inspections, checks and tests carried out during factory production.
 - viii) Assessment of results of various inspections, checks and tests carried out during factory production; where possible and applicable.
 - ix) System of traceability and control of designs, incoming materials and use of materials.
 - x) Corrective action for non-conforming materials and finished products.
 - xi) Training, job description and responsibility of the personnel involved in the manufacturing process.
 - b) Any subsequent changes in raw materials, manufacturing procedures or the control scheme that affects the properties of a product shall be recorded/revised in the QAP/FPC Manual and certified by the ISO: 9001/CE Certification.
 - c) Surveillance of QAP/FPC Manual shall be undertaken at least once per year. The surveillance shall include a review of the test plan(s) and production processes for each product to determine if any changes have been made since the last assessment or surveillance. The significance of changes shall be assessed.
 - d) Records of all in-house test results, as per QAP/FPC Manual, shall be shown to the purchaser; whenever requested by the purchaser.

- e) Geo-composite Drain shall be manufactured by thermal bonding of filter and core. Melt temperature of the bonding materials must be compatible so that the properties of each material are retained. Adhesion of filter & core using glue/adhesive tape shall not be permitted particularly for this application.
- f) In-plane water flow as per item I (2) of Specification is 1.5 lit/m.sec which is to be tested in lab. For calculating the value of short term flow creep factor is taken as 1.3. Manufactures have to give the test certificate indicating the value of creep factor for their product tested accordingly to ASTM D7931-2018. The value of creep factor of the product should be less than or equal to 1.3 for 100 years design life under 100 kPa pressure. In case the creep factor of a product is greater than 1.3 then in-plane water flow to be tested in lab i.e., 1.5 lit/m.sec as mentioned in specification at I(2) should be increased proportionally.
- g) Geocomposite drain consisting of cuspated core shall not be used.

B) Packing, Handling and Installation of Geo-composite Drains (Vertical)

- i) The Geocomposite drain shall be provided in wraps with a protective covering. A tag or other method of identification shall be attached to each wrapped package indicating the following:
 - a) Manufacturer or Supplier Name
 - b) Product Name and Style
 - c) Roll Identification Number
 - d) Lot or Batch Number
- ii) Rolls of Geocomposite drain should not be dragged on the ground and they must be lifted off the ground before moving them.
- iii) Geocomposite drain should be adequately protected from Ultraviolet (UV) exposure during storage at site. The protective wrapping, in which the Geo-composite drain come wrapped from factory, should be kept on till their installation. After unwrapping, the Geo-composite drain should be installed and covered within a maximum of 14 days.
- iv) If stored outside, they should be elevated from the ground surface and adequately covered to protect them from site construction damage, precipitation, UV radiation, chemicals that are strong acids/bases, flames including welding sparks, temperatures in excess of 710C etc.
- v) When Geo-composite drains are assembled on site, the assembly area shall be clean and dry.
- vi) Geocomposite drains shall be capable of being connected longitudinally or laterally into pipe systems or chambers for outflow purpose. Joint parallel to the direction of flow and any exposed edge shall be protected from the ingress of soil by wrapping with a minimum overlap of 150mm or other measures.

Geocomposite jointing and overlap

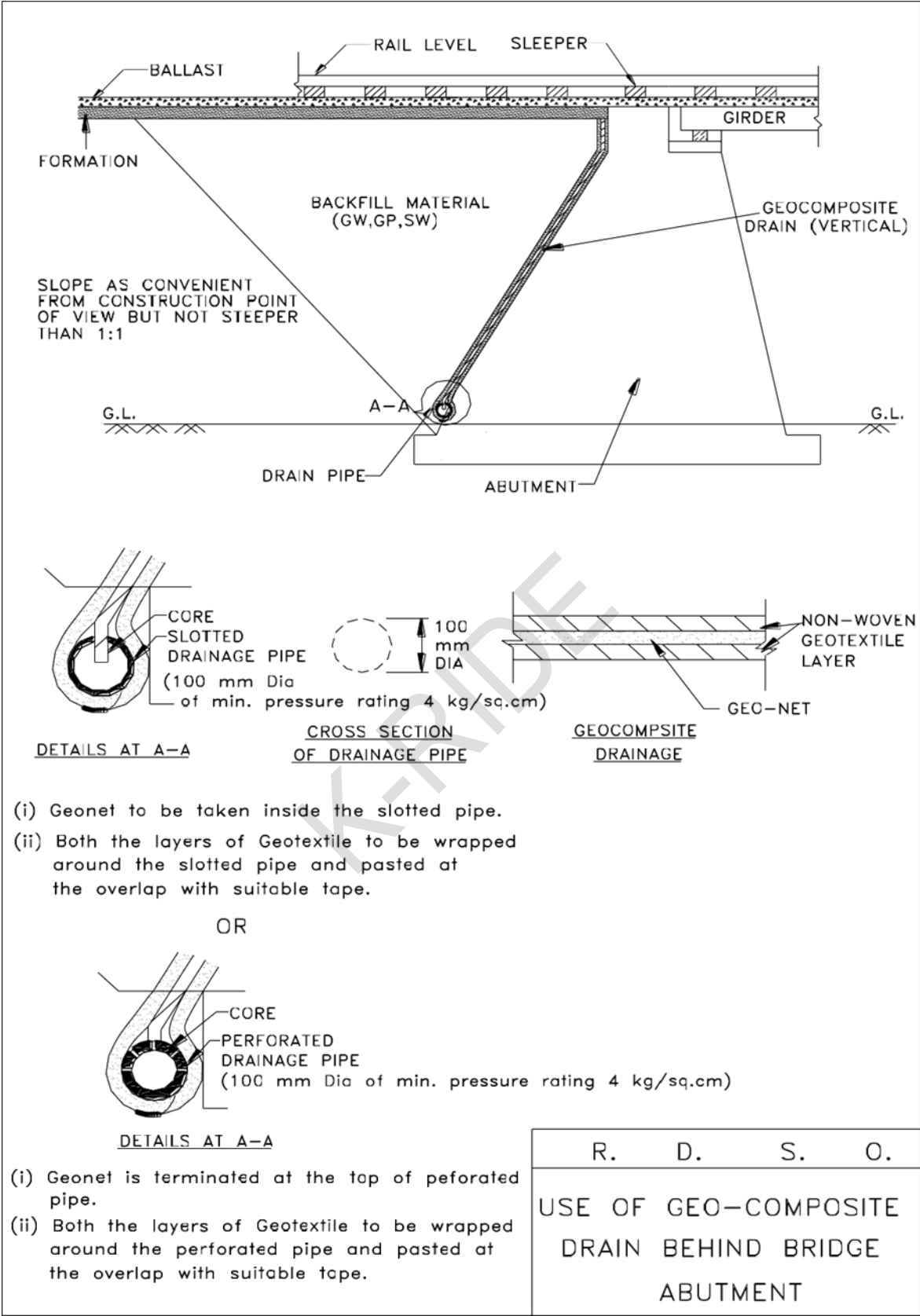


- (vii) Care must be taken to ensure that large stones are not allowed in the soil & large projections abutment surface to damage the surface of the geotextile filter.
- (viii) In case of use behind Bridge Abutment or Retaining Wall, slotted pipe can be provided for horizontal drainage at bottom, by placing Geonet inside slot and both layers of geotextile to be wrapped around the slotted pipe & pasted at the overlap with suitable tape. Or perforated pipe can be provided for horizontal drainage at bottom, by placing Geonet is terminated at the top of perforated pipe and both layers of geotextile to be wrapped around the perforated pipe & pasted at the overlap with suitable tape.
- (ix) A diagram showing GeoComposite Drain behind bridge abutment is shown below.

C) Measurement for Payment of Geo-composite Drain (Vertical)

The Geocomposite drain shall be measured in square metres, with no allowance for overlapping at transverse & longitudinal joints. The lumpsum price quoted in price schedule for Geo-composite drain shall be in full compensation for furnishing, preparing, hauling and placing Geo-composite drain including all labour, freight, tools, equipment and incidentals to complete the work as per specifications.

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Use of Geo composite drains behind bridge abutment

4.0 Specification for Geo-composite drain to be used at the base of the Embankment"- for height of embankment upto 8m, for Railway Formation(Specification No. RDSO/2018/GE: IRS-0004 Part-II)

A) Properties of Geocomposite Drain (Horizontal)

In case of embankments over weak/fine grained sub-soils (which are mostly soft clays) and having water table at higher level, it is a good practice to provide a "separator- cum-drainage layer" of sand at the ground level to provide adequate drainage path for the water coming from sub-soil (reducing excess pore water pressure in embankment and thereby increasing its' stability) and to prevent fouling of subgrade by the fine grained subsoil.

For reducing the thickness of "drainage-cum-separator layer of sand" at the base of embankment, Geo-composite Drain (or Drainage Composite) consisting of a geonetcore sandwiched between non-woven geotextile filters on both sides can be laid with cross slope of 1 in 30. Such geo-composite drain is sandwiched between two sand layers of thickness 75mm each.

The specification of geo-composite Drain shall be as listed below when tested as per the latest edition of the test method indicated therein. These specifications are for embankments of height up to 8m when laid over weak/fine grained sub-soils.

Sl. No.	Property	Test Method	Value
I	Composite Drain (Non-woven geotextile on both sides)		
1	Tensile Strength	ASTM D4595-2017	20 KN/m in both MD & CD (\pm 10%)
2	In-plane Water Flow (Min.) (For $i=1.0$, Soft/Soft Contacts) At 200 kPa (To be tested in lab)	ASTM D4716 - 2014	0.45 lit/m.sec.
3	Static Puncture Resistance CBR(*)	ASTM D6241-2014	3000 N
4	Resistance to U.V. Light Weathering (% strength retained in breaking strength) after 500 hrs of exposure	ASTM D4355-2018	Not less than 70% (After unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)
5	Minimum retained Ultimate Tensile Strength(*)	EN:12447-2001 and EN ISO: 13438-2004	50% (tested as per Clause B.4 of EN: 13250-2016, for 100 year service life)

6	Resistance to Installation damage {% retained of In-plane Water Flow (Min.) (For i=1.0, soft/soft contacts) At 200 kPa (To be tested in lab)}	ASTM- D5818-2018	90%
II Core			
1	Material	-	HDPE/Polypropylene/ Polyethylene or combination thereof
III Filter (Non-woven Geotextile)			
1	Material	-	Polypropylene/Polyamide/ Polyethylene, Polyester or combination thereof
2	Type/Structure	-	Non-woven Needle Punched & Mechanically or Thermally bonded type or equivalent
3	Permeability (Perpendicular to Plane)	ASTM D4491-2016	70 lit./m ² .s (Min.)
4	Apparent Opening Size	ASTM D4751-2016	150 Micron (Max.)
5	Puncture Strength - CBR (*)	ASTM D6241 - 2014	1400 N
6	Resistance to U.V. Light Weathering (% strength retained in breaking strength) after 500 hrs of exposure	ASTM D4355-2018	Not less than 70% (After unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)

- MD: Machine Direction (Longitudinal to the roll)
- CD: Transverse Direction i.e., 90° to MD, (Across the roll width) Is Minimum Average Roll Value (MARV), which is derived statistically as average value minus two standard deviations

Note:

1. The adherence to above listed specification should be checked by testing the samples at IIT, NIT, Government labs or any other NABL accredited lab.

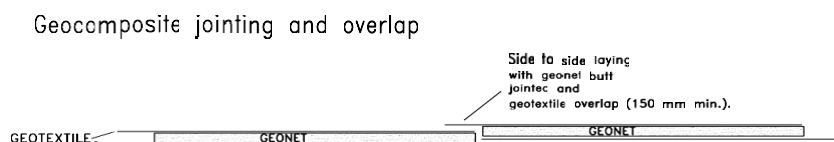
2. Manufacturing of Geosynthetics shall be in accordance with the manufacturer's QAP for quality control.
3. The product being supplied by the manufacturer should have been successfully used for similar application (i.e., Geo-composite Drain at base of the Embankment) at minimum 3 locations, with minimum 3 years' experience at one of the locations, with supporting documents as an evidence for satisfactory performance.
4. To ensure proper quality assurance and reproducibility of the product, following stipulations are as under:
 - i) The manufacturer of the Geo-composite Drain should have ISO: 9001/CE Certification for the product being supplied. The manufacturer of Geo-synthetics should have a well-documented Quality Assurance Procedure (QAP)/Factory Production Control (FPC) Manual, covering every specific product produced on specific production site, which shall be referred/ stipulated in the ISO: 9001/CE Certification. The QAP/FPC Manual shall consist of a permanent internal production control system to ensure that product being manufactured conforms to the requisite properties and it addresses following items:
 - a) Produce design requirement and criteria.
 - b) Acceptance criteria of raw/incoming material and procedures to ensure that these are met.
 - c) Relevant features of the plant and production process; giving frequency of inspections, checks & tests, together with values/criteria required on equipment and action(s) to be taken when control values or criteria are not obtained.
 - d) Tests on finished products – Size of the samples and frequency of sampling with results obtained.
 - e) Details of alternative tests and procedures, if any, and their correlation with reference tests.
 - f) Calibration of equipment having influence on test results.
 - g) Records to be maintained for various inspections, checks and tests carried out during factory production.
 - h) Assessment of results of various inspections, checks and tests carried out during factory production; where possible and applicable.
 - i) System of traceability and control of designs, incoming materials and use of materials.
 - j) Corrective action for non-conforming materials and finished products.
 - k) Training, job description and responsibility of the personnel involved in the manufacturing process.
 - ii) Any subsequent changes in raw materials, manufacturing procedures or the control scheme that affects the properties of a product shall be recorded/revised in the QAP/FPC Manual and certified by the ISO: 9001/CE Certification.
 - iii) Surveillance of QAP/FPC Manual shall be undertaken at least once per year. The surveillance shall include a review of the test plan(s) and production processes for each product to determine if any changes have been made since the last assessment or surveillance. The significance of changes shall be assessed.
 - iv) Records of all in-house test results, as per QAP/FPC Manual, shall be shown to the purchaser; whenever requested by the purchaser.
 - v) Geo-composite Drain shall be manufactured by thermal bonding of filter and core. Melt temperature

of the bonding materials must be compatible so that the properties of each material are retained. Adhesion of filter & core using glue/adhesive tape shall not be permitted particularly for this application.

- vi) In-plane water flow as per **item I (2)** of Specification is 0.45 lit/m.sec which is to be tested in lab. For calculating the value of short term flow creep factor is taken as 1.3. Manufactures have to give the test certificate indicating the value of creep factor for their product tested accordingly to ASTM D7931-2018. The value of creep factor of the product should be less than or equal to 1.3 for 100 years design life under 200 kPa pressure. In case the creep factor of a product is greater than 1.3 then in-plane water flow to be tested in lab i.e., 0.45 lit/m.sec as mentioned in specification at I(2) should be increased proportionally.
- vii) Geocomposite drain consisting of cusped core shall not be used.

B) Packing, Handling and Installation of Geo-composite Drains (Horizontal)

- i) The Geo-composite drain shall be provided in wraps with a protective covering. A tag or other method of identification shall be attached to each wrapped package indicating the following:
 - a) Manufacturer or Supplier Name
 - b) Product Name and Style
 - c) Roll Identification Number
 - d) Lot or Batch Number
- ii) Rolls of Geo-composite drain should not be dragged on the ground and they must be lifted off the ground before moving them.
- iii) Geo-composite drain should be adequately protected from Ultraviolet (UV) exposure during storage at site. The protective wrapping, in which the Geo-composite drain come wrapped from factory, should be kept on till their installation. After unwrapping, the Geo-composite drain should be installed and covered within a maximum of 14 days.
- iv) If stored outside, they should be elevated from the ground surface and adequately covered to protect them from site construction damage, precipitation, UV radiation, chemicals that are strong acids/bases, flames including welding sparks, temperatures in excess of 710C etc.
- v) When Geo-composite drains are assembled on site, the assembly area shall be clean and dry.
- vi) Geo-composite drains shall be capable of being connected longitudinally or laterally into pipe systems or chambers for outflow purpose. Joint parallel to the direction of flow and any exposed edge shall be protected from the ingress of soil by wrapping with a minimum overlap of 150mm or other measures.

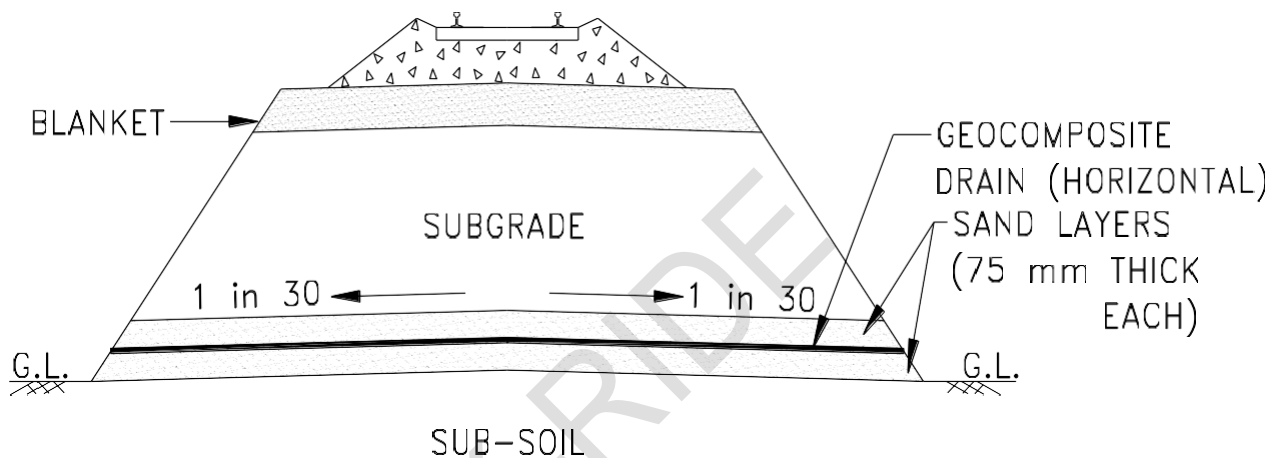


Showing overlap of Geo-Composite Drain

- vii) Care must be taken to ensure that large stones are not allowed in sub soil & subgrade soil to damage the surface of the geotextile filter.
- viii) The water coming from the Geo-Composite Drain can be disposed of by providing side drain along the embankment.
- ix) A diagram showing Use of Geo-Composite Drain in bank over soft subsoil is shown below.

C) Measurement for Payment of Geo-composite Drain (Horizontal)

The Geo-composite drain shall be measured in square metres, with no allowance for overlapping at transverse & longitudinal joints. The lumpsum price quoted in price schedule for Geo-composite drain shall be in full compensation for furnishing, preparing, hauling and placing Geo-composite drain including all labour, freight, tools, equipment and incidentals to complete the work as per specifications.



Use of Geo-Composite Drain in bank over soft subsoil

APPENDIX-D

FIELD COMPACTION TRIAL OBSERVATIONS & COMPUTATION SHEETS
EQUIPMENT DATA

TABLE -D-1

Project.....

Location.....

Date.....

Item		Roller - 1	Roller - 2	Roller - 3
Type of Roller				
Gross weight (tonnes)				
Drum Dimension (Roller Type)	Width (mm)			
	Diameter (mm)			
Foot (Sheep foot Type)	Type			
	Number			
	Length (mm)			
	Area (mm ²)			
Contact Area (cm ²) (Sheep foot/Pneumatic Tyred/Vibratory Plate Type)				
Tyre Inflation Pressure(Kg/cm ²)				
Nominal Amplitude(mm)				
Frequency(Hz)				
Dynamic Force(Kg)				
Operational Speed(Kmph)				
Static Linear Loads(Kg/cm)				
Contact Pressure(Kg/cm ²)				
LIST OF EQUIPMENT FOR FIELD TRIALS/MONITORING				
S.No.	Equipment	No. Reqd.	No. available	
1.	Field density apparatus complete: a) Sand replacement b) Core cutter with dolly and hammer	4 Sets 4 Sets		
2.	Balance: a) Electronic balance – 20 kg capacity (with 2.0 gm Least Count) b) Electronic balance – 500 gm capacity (with 0.1 gm Least Count)	1 Set 1 Set		
3.	Straight edge 300mm long	4 Nos.		
4.	Frying Pan	1 No.		
5.	Containers plastic (about 500g capacity)	8 Nos.		
6.	Enamel plates: 6 inch dia.8 inch dia. 10 inch dia.	10 Nos. 3 Nos. 3 Nos.		
7.	Uniform clean sand (Ottawa Sand) (bags of 50 Kg)	10 Bags		

8.	Measuring tape (3M/5M)	1 No.	
9.	Measuring tape (15 M/30M)	1 No.	
10.	Kerosene oil stove	1 No.	
Signature of Monitoring Official _____ Name _____ Designation _____ Date _____		Signature of Project Official _____ Name _____ Designation _____ Date _____	

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FIELD COMPACTION TRIAL OBSERVATION
TABLE- D-2

Project _____

Date _____

Location _____

Strip No.	Location on the ramp	Moisture content before watering				Moisture content after adding the water			
		ContainerNo.	Weight of wet soil.(gms)	Weight of dry soil.(gms)	Moisture content(%)	Container No.	Weight of wet soil.(gms)	Weight of dry soil.(gms)	Moisture content(%)
1	2	3	4	5	6	7	8	9	10
J	1								
	2								
	3								
	4								
K	1								
	2								
	3								
	4								
L	1								
	2								
	3								
	4								
M	1								
	2								
	3								
	4								

Signature of Monitoring official _____	Signature of Project Official _____
Name _____	Name _____
Designation _____	Designation _____ Date _
Date _____	

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FIELD COMPACTION TRIAL OBSERVATION TABLE-
D-3

Project _____ Location: _____ Date _____
 STRIP No. _____ OMC _____ % MDD _____ gms/cc Volume of core cutters: _____ C.C.

No. of roller passes	Location of the Ramp	In-situ bulk density					Moisture content					Dry density of soil	Percent of MDD	Remark
		Core cutter No.	Wt. Of empty core cutter (gm)	Wt. of wet soil with core cutter (gm)	Wt. of wet soil (gm)	Bulk density of soil (gm/cc)	Container No.	Wt. of wet soil (gms)	Wt. of dry soil (gms)	Moisture content (%)				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
4	1													
	2													
	3													
	4													
6	1													
	2													
	3													
	4													
8	1													
	2													
	3													
	4													
10	1													
	2													
	3													
	4													
12	1													

	2												
	3												
	4												
14	1												
	2												
	3												
	4												

Signature of monitoring official _____
Name _____
Designation _____
Date _____

Signature of project official _____
Name _____
Designation _____
Date _____

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FIELD COMPACTION TRIAL-COMPUTATION SHEET
TABLE- D-4

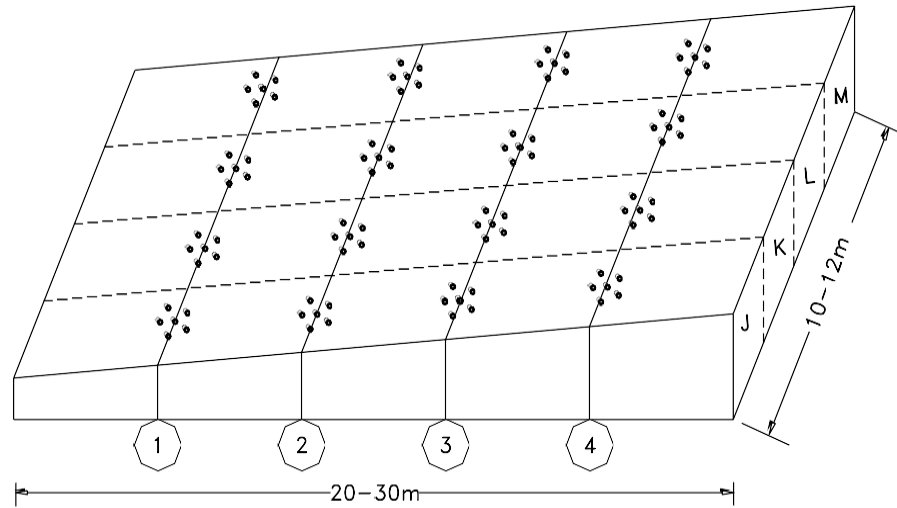
Project _____

Location _____

S. No	Lift thickness (mm)	Moisture content %	Dry density of soil(gm/cc)						Remarks
			Nos. of the roller passes						
			4	6	8	10	12	14	
1.	225								
2.	300								
3.	375								
4.	450								

<p>Computed by _____</p> <p>Name _____</p> <p>Designation _____</p> <p>Date _____</p>	<p>Checked by _____</p> <p>Name _____</p> <p>Designation _____</p> <p>Date _____</p>
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Fig -D-1

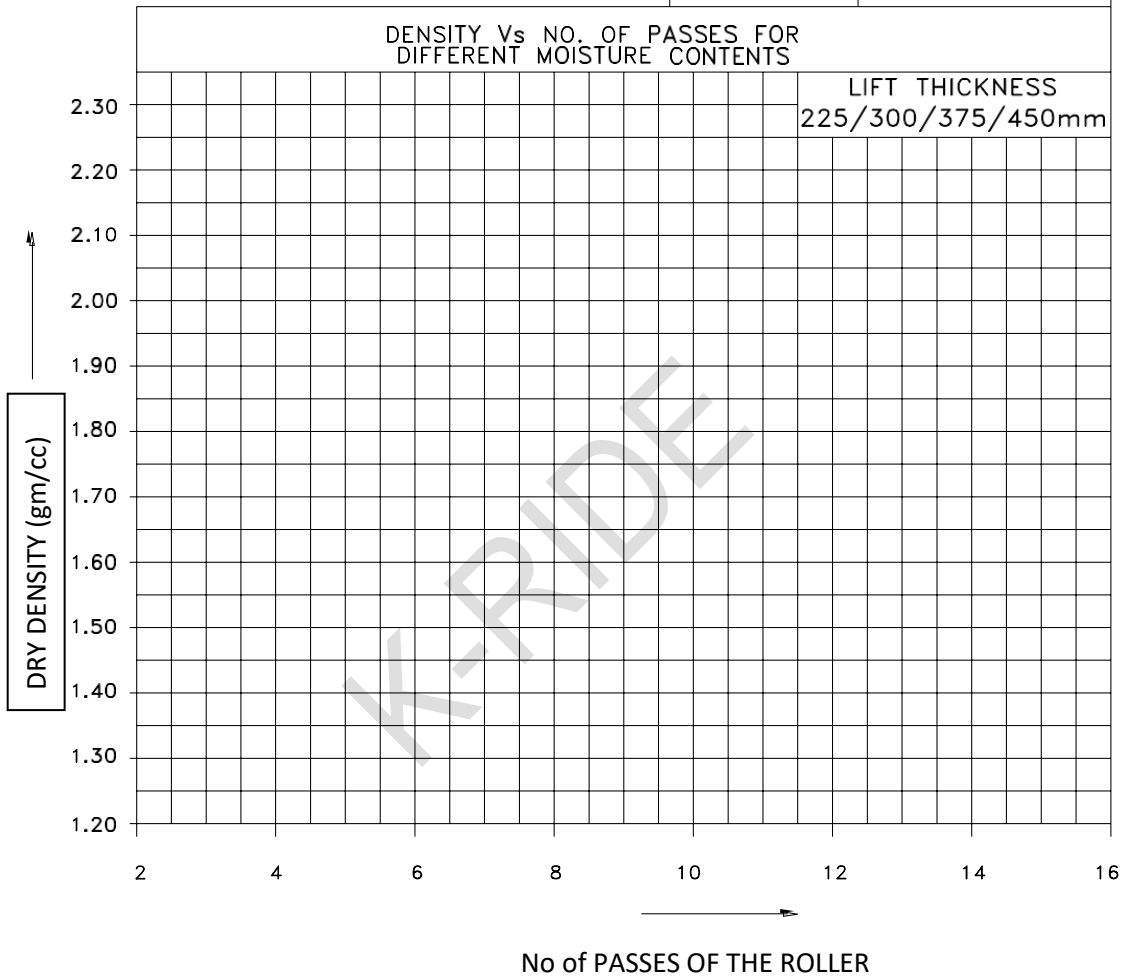


RAMP OF EARTH FOR COMPACTION TRIALS IN THE FIELD

• SAMPLING	-	J	K	L	M
• MOISTURE CONTENT (%) (WITH VARIATIONS OF $\pm 2\%$)	-	OMC-4	OMC	OMC+4	PL-2
• SAMPLING POINTS	-	J ₁ , J ₂ , J ₃ , J ₄ ; K ₁ , K ₂ , K ₃ , K ₄ ; L ₁ , L ₂ , L ₃ , L ₄ ; M ₁ , M ₂ , M ₃ , M ₄ .			
• THICKNESS IN MM.	-	225, 300, 375 & 450			
• NO. OF TIMES FOR OBSERVATIONS	-	6(SIX), (AFTER INTERVAL OF 4,6,8,10,12 & 14 PASSES OF ROLLER)			
• TOTAL NO. OF OBSERVATIONS	-	4x4x6 = 96			

Fig - D-2

NAME OF PROJECT _____	OMC-4	○ ————— ○
LOCATION _____	OMC	● ————— ●
	OMC+4	△ ————— △
	PL-2	▲ ————— ▲



OFFICIALS – IN - CHARGE	QUALITY CONTROL OFFICIALS
SIGNATURE _____	SIGNATURE _____
NAME OF OFFICER _____	NAME OF OFFICER _____
DESIGNATION _____	DESIGNATION _____
DATE _____	DATE _____

Fig- D-3		
NAME OF PROJECT _____	LIFT	NOTATION
LOCATION _____	225mm	○ — ○
	300mm	● — ●
	375mm	△ — △
	450mm	▲ — ▲
MOISTURE CONTENT Vs MAX.DRY DENSITY FOR VARIOUS LIFT THICKNESS		
OFFICIALS – IN – CHARGE		QUALITY CONTROL OFFICIALS
SIGNATURE _____	SIGNATURE _____	SIGNATURE _____
NAME OF OFFICER _____	NAME OF OFFICER _____	NAME OF OFFICER _____
DESIGNATION _____	DESIGNATION _____	DESIGNATION _____
DATE _____	DATE _____	DATE _____
SIGNATURE _____	SIGNATURE _____	SIGNATURE _____
NAME OF OFFICER _____	NAME OF OFFICER _____	NAME OF OFFICER _____
DESIGNATION _____	DESIGNATION _____	DESIGNATION _____
DATE _____	DATE _____	DATE _____

APPENDIX-E

Modern Equipment's for Earth Work

The details given below are based on the information available in the public domain and the list is not exhaustive. There may be many manufactures / suppliers of these equipment's and many such similar equipment's.

1.0 Compactors/Rollers

1.1 Slope Compactors

(a) Slope Compactor Vibratory Roller (Double Drum) Rope Start

Slope compactor vibratory roller (Double drum) with Hydraulic drive can work on slope of 1:2 to 1:1.5, a pair of compactors works on Counter Balance Principle have to be linked via wire rope pulley (i.e. two compactors (One at the top and other at bottom of the slope), supported on loaded truck at the top. The two compactors with individual operator have to operate Single lever simultaneously in downward and upward direction from two ends of slope. One of the Slope Compactor Vibratory Roller (Double Drum) Rope Start in operation is given below for illustration.



Fig-E1: Slope Compactor Working with counter balance Method

(b) Slope Vibratory Roller

Slope Vibratory Compactor is a unique attachment which can be attached to any Excavators/Backhoes/Long Reach. This attachment is specially designed for various applications like Railway track extension /Canal / Dam Slope Compaction and sloping surface where compaction is required. This attachment is capable of reaching surfaces where normal compactors cannot reach and can-do deep compaction than an ordinary compactor.

On Steep Slopes, slushy and most difficult terrains, where the normal Roller would easily swamp down, Slope Vibratory Compactors can easily work. These rollers work on the double vibratory principle that provides superior compaction.



Fig-E2: Slope Vibratory Roller



Fig-E3: Working of Slope Vibratory Roller

(c) Slope Vibratory Compactor

Slope Vibratory Compactor is an attachment to normal excavators. The major advantage of this compactor is that it can compact 360 degrees for a height of 2m to 17m depending on size of excavator and attachment length.



Fig-E4: Slope Vibratory Compactor

1.2 Vibrating Plate Compactors:

The vibratory plate compactor is power-engines, walk-behind equipment that imparts powerful vibratory compaction effort to loose materials, by transmitting vibration through the vibrating plate which generates power from the single rotor in vibration case. A plate compactor works by vibrating or driving a flat metal plate against the ground over and over. This flat plate helps to compress and smoothen out the rough and uneven dirt. Plate compactors work best on granular soil, such as sand and gravel. These vary in weight from

100 kg to 2 tonne with plate areas between 0.16 sqm and 1.6 sq cm. Smaller versions are manually guided and therefore suitable for compacting small or awkwardly shaped areas.

They usually travel at about 0.7 km/h. They are classified in terms of mass divided by the area of the base in contact with the ground.



Fig-E5: Vibrating Plate Compactor

1.3 Small Width Vibratory Roller for Compaction of Earthwork in Gauge Conversion Work and Narrow Width Portion

Proper compaction in the widened portion of embankment is difficult to achieve with conventional means of compaction like ramming & hand rollers. The small width vibratory roller is to achieve the desired compaction in widening of embankment in narrow width portion, from MG to BG in Gauge Conversion Works.



Fig-E6: Small Width Vibratory Roller (Drum width 90 cm)

1.4 Walk behind Vibratory Roller

Walk behind Double Drum Vibratory Roller is modern compact design for use in a wide range of compaction application. Hydraulic with integrated travel control eases the operating effort required for movement. Walk behind Roller has the vibratory source located in the drum which provides maximum compaction and traction performance.



Fig-E7: Walk behind Roller

1.5 Vibratory Rollers with Latest Techniques:

Even some latest techniques have been developed in World Railways, where vibratory roller includes the machine to directly determine the vibration modulus as parameter for the dynamic stiffness of the soil. There is continuous optimization of amplitude and compaction energy which reduces loosening in upper layers on uniform and granular material types.

1.6 Double Drum Vibratory Roller:

Double Drum Vibratory rollers are used primarily to compact paving materials & their surface layer. It can also be used for the compaction of small and medium- sized foundations, sub-foundations and filling materials. These machines have two steel drums that vibrate via an internal, eccentric mechanism, which often can be adjusted to vary the frequency and amplitude of the vibratory action.



Fig-E8: Double Drum Vibratory Roller

Few Models Of The Double Drum Vibratory Rollers Manufactured In India	
<p>Fig-E8.1 Delivers excellent mat density, good visibility and comfort, fuel efficiency with Eco-mode & good water spray system</p>	<p>Fig-E8.2 (Solid drum type & excels on a variety of asphalt mix designs as well as other granular materials)</p>

1.0 Single Drum Vibratory Roller:

Single Drum Vibratory Roller which is widely used in the construction to compact the granular layer. It ensure smooth surface after the application and therefore, used for the bridges, patching, footpath and landscaping applications. These machines have one steel drum that vibrates via an internal, eccentric mechanism, which often can be adjusted to vary the frequency and amplitude of the vibratory action.



Fig-E9: Single Drum Vibratory Roller

Few Models Of The Single Drum Vibratory Rollers Manufactured In India



Fig-E9.1: (Drum Type & used for better gradeability)



Fig-E9.2: (Available in Standard, Drum& Pads + Drum type & used for better gradeability & breaking clods)



Fig-E 9.3: Vibratory Rollers(Drum Type & used for better gradeability)

2.0 Heavy Machinery for Railway Embankment Construction

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(BYPL-BAW/AT GRADE & ELEVATED)

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Rail Road construction equipment's are found in a wide variety ranging from the very heavy equipment to portable and lighter equipment. This modern and heavy construction equipment makes the construction job easier and quicker. Also the work done by heavy machinery is of good quality. The heavy machines make possible a lot of tasks to be completed safely reliably and time saving that cannot be carried out manually properly.

2.1 Backhoe:

Backhoe comprises a bucket on the end of an articulated boom, set on a pneumatic tyred or crawler tractor unit. The boom, bucket arm and bucket are usually controlled by hydraulic rams. Back-acters operate by digging towards the machine in an arc from a small distance above the surface on which the machine stands to a position vertically below the outer edge of the machine. The maximum depth of excavation is related to the length of the boom and machines with depth capacities between 2.6 and 6 m are in common use. Long reach machines with nominal reach and depth capacities up to 18 to 14m respectively are also available. Buckets are available for back-acters in different sizes up to 3 cum, depending on the power of the machine and the use. Loading is generally carried out by lifting the bucket and swinging the boom away from the working face to the awaiting haulage vehicle. Alternatively, material can be dumped adjacent to the machine.

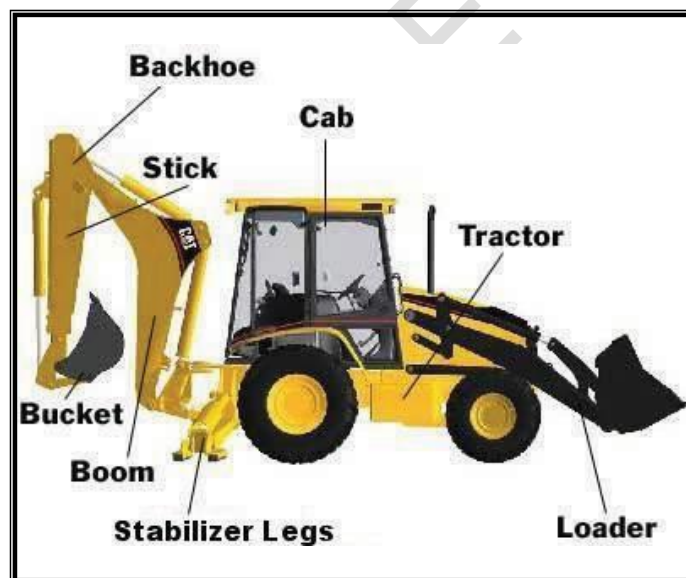


Fig-E 10: Backhoe

2.2 Face, Front or Loading Shovel:

Face, front or loading shovel is constructed in a similar manner to a back-acter except the boom; bucket arm and bucket operate in the opposite direction, i.e. up and away from the machine. Generally used for excavating faces upto about 8m high and stockpiles. Buckets are available in different sizes upto 4cum (heaped) depending on the power of the machine. Loading is carried out in a similar mannerto the back-acter, although some machines have bottom dump buckets to increasethe speed of loading. It is useful in excavating soils, weak rocks and blasted rocksfrom faces in cutting etc. some larger excavators can be converted from back- acters to face shovels.



2.3 Forward Loader:

Forward loader consists of a pneumatic tyred or crawler tractor at the front of which is mounted a wide bucket that can be moved in a vertical plane. Excavation is carried out by driving the machine towards and the bucket into the material; the bucket is then turned and lifted upwards, thus catching and excavating the material. The hauling vehicle is loaded by driving the loader to and emptying the bucket into the body of a vehicle. Loaders are generally used to excavate the materials at and for a distance above ground level and can be used to push or haul material in the bucket over a short distance. Modern loaders have hydrostatically powered buckets and the smaller units may be equipped with back-acters (i.e. backhoe loader)



Fig-E 13: Forward Loader

2.4 Excavator:

Excavators are heavy construction equipment consisting of a boom, dipper, bucket and cab on a rotating platform known as the "house". The house sits atop an undercarriage with tracks or wheels. They are a natural progression from the steam shovels and often mistakenly called power shovels. These machineries are used for various earthwork purposes such as excavation of earth and loading etc.



Fig-E14: Excavator

2.5 Graders:

Graders are used for levelling the surface during earthwork in embankments and providing blanket surface before spreading ballast and laying track.

Graders are used to spread fill and finely trim the subgrade. They consist of a blade which can rotate in a circular arc about a sub horizontal axis and which is supported beneath a longitudinal frame joining the front steering wheels and the rear drive wheels. The front wheels are generally articulated whilst the rear wheels are set in tandem beneath the motor and control units. The blade is used to trim and redistribute soil and therefore graders usually operate in the forward direction.



Fig-E15: Grader

2.6 Dumpers:

Dump trucks or dumpers generally vary in size from 1 to about 80 tonne capacity. Large capacity machines are also available but are generally used in mines, quarries or open cast sites. In recent years articulated dump trucks with capacities up to 35 tonne have become popular as they are versatile and are especially suitable for hauling on softer sub grades. The speed of tipping is increased over a road lorry by the absence of a tailgate. Small dumper units are available for work on small sites and mounted dump trucks are also available with load capacities up to about 20 tonne.



Fig-E 16: Dumper

2.7 Dozers:

Bulldozer also called Dozer, powerful machine for pushing earth or rocks, used in road building, farming, construction, and wrecking, is a tractor equipped with affront pusher blade, which can be raised and lowered by hydraulic rams.

An angle dozer has a blade that is capable of being set an angle to push material sideways whilst the tractor moves forward. The tractor unit is usually mounted on crawler tracks thus allowing it to travel over and push off a wide variety of ground conditions although wheel mounted units is available. Blades are manufactured in a variety of styles but are all of heavy duty construction with a hardened steel basal leading edge driven into the ground to cut and push the material to be excavated. Dozers have a wide variety of roles including excavating soils and weak rocks, ripping moving excavated material over short distances spreading materials, trimming earthworks and acting as a pusher to boost the effective power of scrapers and other plants. Wide ranges of crawler units are available ranging from 45 to 575 kW.



Fig-E 17: Dozer

2.8 Scraper:

A scraper is a machine used for moving or removing dirt, gravel and any other unnecessary material from the surface. Scraper can excavate load and deposit material in one cycle and may

be towed or self-propelled. It consists of a centrally mounted bowl, the bottom, leading edge of which can be controlled. Both towed and self-propelled scrapers are effectively articulated between the front motorized or towing unit and the bowl and larger self-propelled scraper may second engine mounted on the rear.



Fig-E 18: Scraper

APPENDIX – F

Typical Compaction Characteristics for natural soils & rocks (Ref: BS: 6031(latest version))

Material (1)	Major divisions (2)	Sub groups (3)	Suitable type of compaction plant (4)	Maximum number of passes for satisfactory compaction (5)	Maximum thickness of compacted layer (mm) (6)	Remarks (7)
Rock- like materials	Natural rocks	All rock fill (except chalk)	Heavy vibratory roller not less than 180 kg per 100 mm of roll Grid roller not less 180 kg per 100 mm of roll Self-propelled tamping rollers	4 to 12	500 to 1500 depending on plant used	If well graded or easily broken down then this can be classified as a coarse-grained soil for the purpose of compaction. The maximum diameter of the rock fragment should not exceed two third of the layer thickness.
Coarse-grained soils	Gravel sand, gravelly soils	Well graded gravel and gravel/sand mixture: little or no fines Well graded gravel/ sand mixtures with excellent clay binder Uniform gravel: little or no fines Poorly graded gravel and gravel/sand mixtures: little or no fines	Grid roller over 540 kg per 100mm of roll Pneumatic tired over 2000 kg per wheel Vibratory plate compactor over 1100 kg/sq.m. of base plate Smooth wheel roller Vibratory roller	3 to 12 depending on type of plant	75 to 275 depending on type of plant	

		Gravel with excess fines, silty gravel, clayey gravel, poorly graded gravel/ sand/clay mixtures	Vibro-rammer Self-propelled tamping roller			
	Sand and sandy soils	Well graded sands and gravelly sands; little or no fines Well graded sands with excellent clay binder				
1	2	3	4	5	6	7
	Uniform sands and gravels	Uniform gravels; little or no fines Uniform sands; little or no fines Poorly graded sands; little or no fines Sands with fines, silty sands, clayey sands, poorly graded sand/clay mixtures	Smooth wheeled roller below 500kg per 100mm of roll Grid roller below 540kg per 100mm of rolling Pneumatic tired roller below 1500kg per wheel Vibratory roller Vibrating plate compactor Vibro-tamper	3 to 16 depending on type of plant	75 to 300 depending on type of plant	

Fine Soils	having low plasticity	Silts (inorganic) and very fine sands, rock flour, silty or clayey fine sands with slight plasticity Clayey silts (inorganic) Organic silts of low plasticity	Sheep foot roller Smooth wheeled roller Pneumatic tired roller Vibratory roller over 70 kg per 100 mm of roll Vibratory plate compactor over 1400 kg/sq.m of base plate Vibro-tamper Power rammer	4 to 8 depending on type of plant	100 to 450 depending on type of plant	If water content is low, it may be preferable to use vibratory roller. Sheep foot rollers are best suited to soils at water contents below their plastic limit.
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Note: The information in this table should be taken only as a general guide. Field trials for compaction should be conducted for working out optimum layer thickness and number of roller passes for the type of compaction equipment being used. Compaction of mixed soils should be based on that subgrade requiring most compactive effort.

APPENDIX- G
QUALITY CHECKS PROFORMA

Proforma No. G-1

Details of Borrow soil/ Formation subgrade/Prepared Subgrade

Sl. No.	Date of taking sample	Location layer Ch./Km	Soil type				Soil classification	LL	PL	PI
			Gravel %	Sand %	Silt %	Clay %				
1	2	3	4	5	6	7	8	9	10	

CBR value	Whether of dispersive nature	Suitable/ Non suitable	Signature and name of Engineer's representative	Signature and name of contractor representative	Remarks
11	12	13	14	15	16

Proforma No. G-2

QUALITY OF BLANKET MATERIAL

1. Type of material: Manufactured/Naturally available
2. Source location:

Sl.No.	Date of taking sample	Location of laying	Soil type			C _u	C _c	Abrasion Value
			Gravel %	Sand %	Fines passing 75 micron sieve %			
1	2	3	4	5	6	8	9	10

CBR value	Signature and name of Rly official	Signature and name of contractor	Remarks
11	12	13	14

Proforma No. G-3

PROFORMA FOR FIELD COMPACTION RECORD

Chainage / km from

to.....

Soil Classification:

Height of embankment:

OMC:

Type of roller being used:

Lab. MDD/ Field Trial MDD:

CORE CUTTER METHOD

Date of Laying	Layer no.	location coordinate for check	Placeme nt moisture content (%)	No. of passes	Wt. of core cutter+ wet soil (W _s) (g)	Wt. of core cutter (W _c) (g)	Wt of wet soil (W _s - W _c) (g)	Vol. of core cutter (V _c) (cc)	Bulk density, $y_b = \frac{(W_s - W_c)}{V_c}$ (g/cc)
1	2	3	4	5	6	7	8	9	10

Moisture content of compacted layer (w) (%)	Dry Density(y _d) = $y_b / 1+w * 100$ (g/cc)	Degree of compaction (%)	Sig. and name of Rly officer	Sig. and name of contractor	Remarks
11	12	13	14	15	16

Note: 1. In case of compaction of blanket material, percentage of fines should also be mentioned in a column.

2. Determination of Dry Density, (y_d) of soil in above table is done as per IS: 2720 Pt 29 – 1975 (latest version) titled as Determination of Dry Density of Soils In-Place By The Core-Cutter Method

Proforma No. G-4

PROFORMA FOR FIELD COMPACTION RECORD

Chainage /km from to.....

Soil Classification:

Height of embankment:

SAND REPLACEMENT METHOD

Location	Bulk density of sand, (γ_s) g/cum	Wt of wet soil from hole, W_w (g)	Wt of Cylinder + Sand, before pouring W_1 (g)	Wt of sand + Cylinder after pouring W_2 (g)	Mean weight of sand in cone W_3 (g)	Wt of sand in hole $W_b = W_1 - W_2 - W_3$	Bulk Density of Soil $\gamma_b = (W_w / W_b) * \gamma_s$
1	2	3	4	5	6	7	8

Moisture content of soil (w), %	Dry Density of soil $\gamma_d = \gamma_b / (1+w)$	Relative Density I_D	Sign. and name of Rly Official	Sign and name of contractor	Remarks
9	10	11	12	13	14

Ref: IS: 2720 (Pt 28)1974 (latest version)
(Determination of dry density (γ_d) of soils in-place, by the sand Replacement method)

- Note:** 1. Density Index (Relative Density) shall be find out as per IS 2720 (Part 14) -1963 – (latest version).
2. The density index, I_D (relative density) expressed as a percentage should becalculated as follows:

$$\text{Relative density (ID)} = \frac{\gamma_{\text{max}} (\gamma_d - \gamma_{\text{min}}) / \gamma_d (\gamma_{\text{max}} - \gamma_{\text{min}}) \times 100$$

γ_{max} (from lab as per IS 2720 (Part 14)

γ_{min} (from lab as per IS 2720 (Part 14)

γ_d determined in field as shown in above table by the sand Replacement method.

APPENDIX-H

QUALITY ASSURANCE TESTS (STANDARD TEST PROCEDURES)

1.0 California Bearing Ratio (Laboratory Method)

(Ref: IS: 2720 (part 16)–Laboratory Determination of CBR (latest version)

1.1 California Bearing Ratio

California Bearing Ratio (CBR) test is a penetration test developed by the California State Highway Department of USA for the evaluation of subgrade strengths for roads and pavements.

California Bearing Ratio (CBR) is defined as the Ratio of Force per unit Area required to penetrate a soil mass with a circular plunger of 50 mm diameter at the rate of 1.25 mm/minute to that required for corresponding penetration of a standard material. The test results may not be directly related to fundamental properties governing the strength of soils such as cohesion, angle of internal friction etc. Schematic of CBR Test shown below:

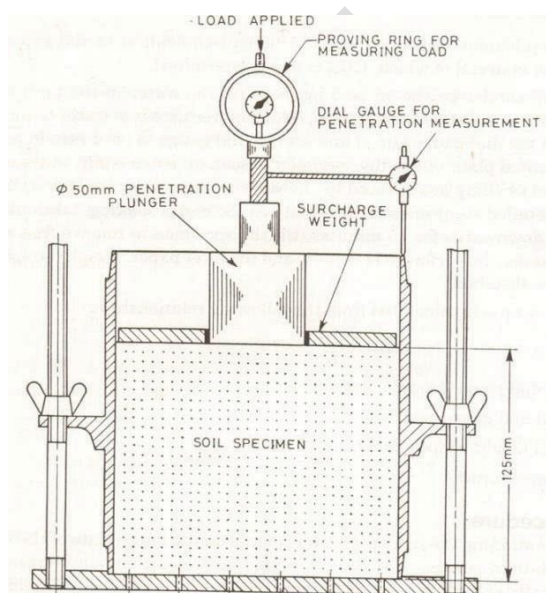


Fig-H 1

1.2 Apparatus:

- i) CBR mould 150 mm diameter and 175 mm high with detachable perforated base plate. (Net capacity is 2250 ml).
- ii) Collar 50 mm high.
- iii) Penetration plunger - 50 mm diameter.
- iv) One annular and a few slotted surcharge masses 2.5 kg each.
- v) Rammer 2.6 kg with 310 mm drop and 4.89 kg with 450 mm drop.
- vi) Steel rod 15-20 mm in dia and 400 mm long.
- vii) Cutting edge.

- viii) Loading machine of approximately 5000 kg capacity, fitted with a calibrated proving ring giving a constant rate of penetration of about 1.25 mm/minute.
- ix) Penetration measuring 2 dial gauges accurate to 0.01 mm.
- x) Soaking tank of pan, drying oven, dishes and calibrated measuring jar.
- xi) Swelling gauge consisting of a perforated plate with an adjustable extension stem.
- xii) I.S. Sieves 4.75 mm and 19 mm.
- xiii) Straight edge, mixing basin.
- xiv) Filter paper
- xv) Weights

1.3 Preparation of test specimen:

The test may be conducted on undisturbed as well as disturbed (remoulded) soil specimen which may be compacted statically or dynamically.

i) Undisturbed soil specimen

Undisturbed soil specimen shall be obtained from the field in natural condition. For this, use 127.3 mm high mould and attach the steel cutting edge to its one end. Push the mould gently into the ground. When the mould is full of soil, it shall be taken out carefully. The top and bottom surfaces are then trimmed flat so as to achieve the correct length of specimen for testing. The specimen is then sealed with paraffin wax on both sides of the mould so as to preserve it with the natural moisture content.

ii) Remoulded specimen (From disturbed sample) : (As per para 4.3 of IS 2720- Part-16)

The dry density for a remoulding shall be either the field density or the value of the maximum dry density estimated by the compaction test (IS: 2720 part.7 & part.8) or any other density at which bearing ratio is desired. The water content used for compaction should be at optimum moisture content or the field moisture as the case may be.

Remoulded specimens are prepared in the laboratory by compaction. The material used in the remoulded specimen shall pass 19 mm I.S. sieve. Allowance for large material shall be made by replacing it by an equal amount of material which passes a 19mm I.S. Sieve but is retained on 4.75 mm sieve.

1.4 Test Procedure:

i) Soaking of remoulded specimen:

Weight the mould with base plate and the specimen. Keep the filter paper on the specimen and place the perforated top plate with adjustable stem over the specimen. Keep the mould in a tank in which water is filled for soaking. Apply weights to produce a surcharge equal to the weight of base material and pavement to the nearest 2.5 kg on the compacted soil specimen. The whole mould and weights shall be immersed in a tank of water allowing free access of water to top and bottom of the specimen.

The tripod for the expansion measuring device shall be mounted on the edge of the mould and the initial dial gauge reading recorded. This set up shall be kept as such undisturbed for 96 hours and noting down the readings every day against the time of reading. A constant water level shall be maintained in the tank throughout the period.

At the end of the soaking period, the final reading of the dial gauge shall be noted, the tripod removed and the mould is taken out of the water tank.

The free water collected in the mould shall be removed and the specimen allowed to draining downward for 15 minutes. After draining out water, the weights, the perforated plate and the top filter paper shall be removed and the mould with the soaked soil sample shall be weighed and the mass recorded.

ii) Penetration Test

The mould containing the test specimen is placed on the lower plate of the testing machine with the base plate in position and the top surface exposed. Surcharge mass is placed on the specimen. If the specimen has been soaked previously, the surcharge shall be equal to that use during the soaking period. To prevent upheaval of soil into the hole of the surcharge weights, 2.5 kg annular weight shall be placed on the soil surface. The plunger shall be seated under a load of 4 kg so that full contact is established between the surface of the specimen and the plunger. Load shall be applied to the penetration plunger so that the penetration is approximately 1.25 mm per minute. Reading of the load shall be taken at penetrations of 0.0, 0.5, 1.0, 2.0, 2.5, 4.0, 5.0, 7.5, 10.0 and 12.5 mm.

After the completion of the test, the plunger is raised and the mould is detached from the loading equipment. About 20 to 50 g of soil shall be collected from the top 30 mm layer of specimen for water content determination.

iii) Load Penetration Curve

The load penetration curve is drawn as shown in Fig-H 2. The curve is generally convex upwards, although the initial portion of the curve may be concave upwards due to surface irregularities. A correction shall then be applied by drawing a tangent to the upper curve at the point of contra flexure. The corrected curve shall then be taken to be this tangent plus the convex portion of the original curve with the origin of strains shifted to the point where the tangencuts the horizontal strain axis as illustrated in Fig-H 2 below:

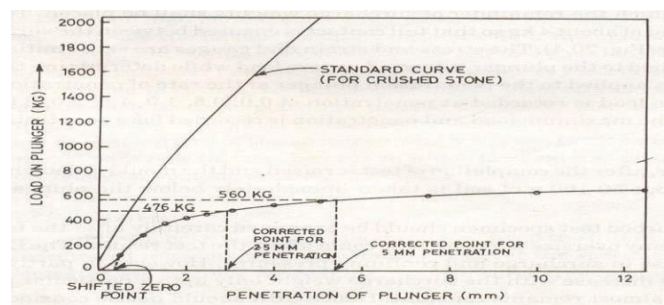


Fig-H 2: Load Penetration Curve for a CBR Test

iv) Determination of CBR

Corrected load value shall then be taken from the load penetration curve corresponding to the penetration value at which CBR is desired. The CBR is then determined as follows

$$\text{CBR} = P_T/P_s \times 100$$

Where, P_T = Corrected load corresponding to the chosen penetration from the load penetration curve,

P_s = Standard load for the same depth of penetration as for P_s

The CBR values are usually calculated for penetration of 2.5mm and 5mm. Generally, the CBR value at 2.5 mm penetration will be greater than that at 5mm penetration and in such a case; the former shall be taken as the CBR value for design purpose. If the CBR value corresponding to a penetration of 5mm exceeds that for 2.5mm, the test shall be repeated. If identical results follow, the bearing ratio corresponding to 5mm penetration shall be taken for design.

Table-H-1 Standard Loads for CBR test

Penetration Depth(mm)	Unit Standard Load (kg/cm ²)	Total Standard Load(kg)
2.5	70	1370
5.0	105	2055
7.5	134	2630
10.0	162	3180
12.5	183	3600

Test Observations are recorded in the table as given in the code.

1.5 Report:

The CBR value shall then be reported correct to the first decimal place. The details shall be reported in prescribed proforma:-

CBR of specimen at 2.5 mm penetration -

CBR of specimen at 5 mm penetration - CBR of specimen atPenetration - Results of repeat test, if conducted:

2.0 Field determination of E_{v2}

(Ref.: DIN 18134 – April 2012)

2.1 Introduction:

Deformation Modulus (E_{v2}) is a parameter which gives the deformation characteristics of a finished layer of soil and it is determined from the second cycle of loading in the Plate Load Test. It is to be determined on top of compacted Blanket layer, prepared sub-grade layer and Subgrade layer.

2.2 Test Procedure

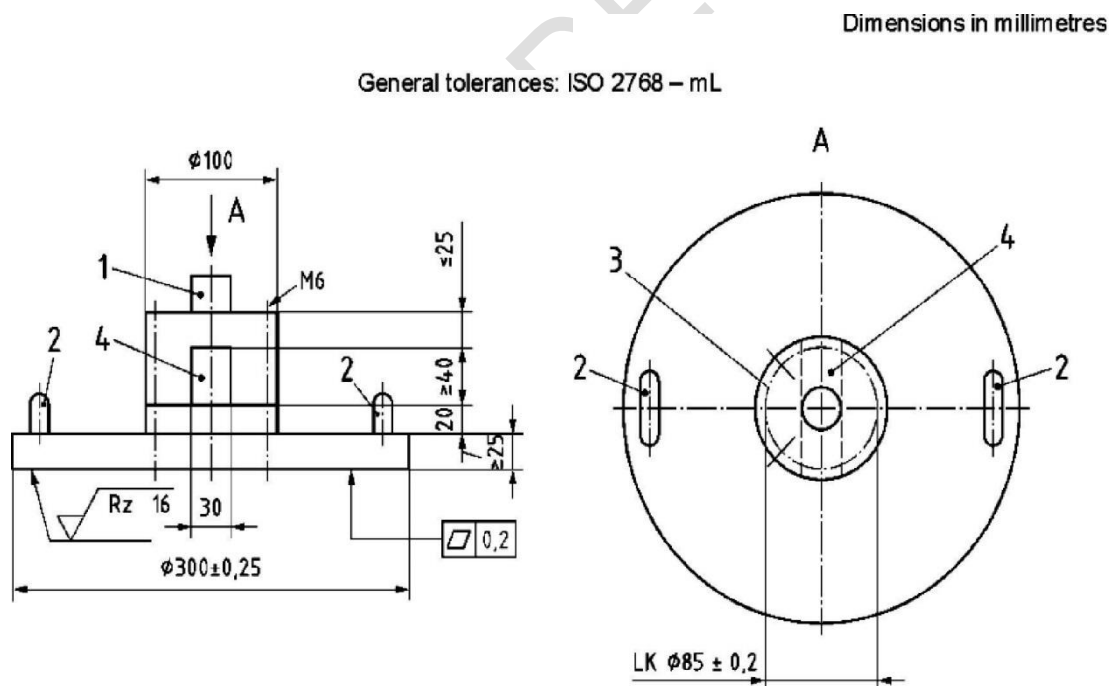
a) Apparatus

i) Reaction Loading System

The reaction loading system shall produce a reaction load which is at least 10 kN greater than the maximum test load required. It may be a loaded truck or roller or any other object of sufficient mass.

Loading plate

The 300mm dia loading plate shall have two handles (Fig-H 3) and minimum thickness of 25 mm.



Key

- 1 Centring pin to hold the force transducer with articulated top
- 2 Handle
- 3 Hole circle (e.g. 85 mm with three M6 bolts (distributed equally on hole circle))
- 4 Measuring tunnel

Fig-H 3: 300mm Dia Loading Plate

ii) Loading system

The loading system consists of a hydraulic jack, capable of applying and releasing the load in stages. The hydraulic jack shall be hinged on both sides and secured against tilting. The pressure piston shall act through at least 150mm.

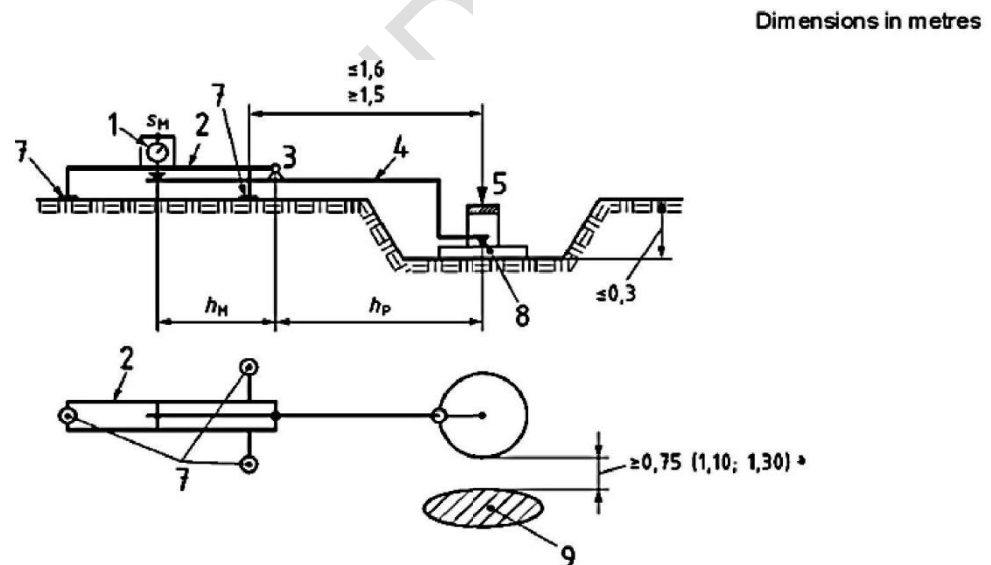
The height of the plate loading apparatus during operation should not exceed 600 mm. In order to compensate for differences in the heights of the vehicles used as reaction loads, elements shall be provided that allow the initial length of the hydraulic jack to be increased to at least 1000 mm. Suitable means shall be provided to prevent buckling of these elements.

iii) Force-measuring apparatus

A mechanical or electrical force transducer shall be fitted between the loading plate and the hydraulic jack. It shall measure the load on the plate with a maximum permissible error of 1 % of the maximum test load. The stress shall be indicated at a resolution of at least 0.001 MN/m².

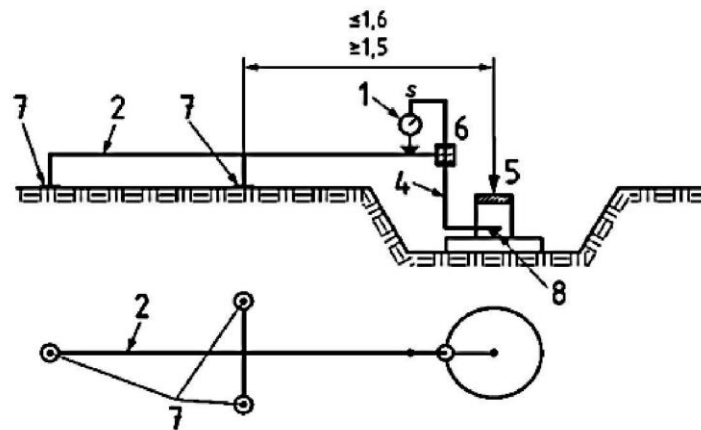
iv) Settlement-measuring device

The settlement-measuring device can be with a rotatable contact arm (Fig-H 4) or with a contact arm capable of being moved horizontally in axial direction (i.e. with a slide bearing, see Fig-H 4).



a) Rotatable contact arm according to the "weighbeam principle"; measurement of settlement taking into account the lever ratio $h_P : h_M$

Dimensions in metres



b) Contact arm with slide bearing; measurement of settlement in the lever ratio 1:1

Key

1 Dial gauge or displacement transducer	6 Slide bearing
2 Supporting frame	7 Support
3 Fulcrum	8 Stylus
4 Contact arm	9 Area taken up by reaction load system
5 Load	
$s_{M, s}$ Settlement reading on dial gauge or displacement transducer	

Fig-H 4: Settlement Measuring Device

The settlement-measuring device consists of

- (i) A frame supported at three points (see "2" in Fig-H4),
- (ii) A vertically adjustable, torsion-proof, rigid contact arm (see "4" in Fig-H4),
- (iii) A displacement transducer or dial gauge (see "1" in Fig-H 4).

The distance from the center of the loading plate to the Centre line of the support shall be at least 1.5 m and shall not be greater than 1.6 m (see Fig-H 4).

The $h_p:h_M$ ratio (Fig-H 4 a) shall not exceed 2.0. The setting of the assembly shall be capable of being locked so that the h_p/h_M ratio does not change during measurement.

The settlement-measuring device shall be capable of measuring the settlement of the loading plate with a maximum permissible error of 0.04 mm in the measuring range up to 10mm. The indication shall have a resolution of at least 0.01 mm.

Measurement of settlement with alternative measuring devices is permitted if these have at least the same resolution and measure to the same accuracy and are recognized as remaining unaffected by soil deformation occurring as a result of testing.

2.3 Test conditions

In the case of soil which has formed a surface crust, has been softened or has been otherwise disturbed in its upper zone, this disturbed soil shall be removed before the plate load test is carried out. The density of the soil under test shall remain as unchanged as possible.

For fine-grained soil (e.g. silt, clay), the plate load test can only be carried out and evaluated satisfactorily if the soil is stiff to firm in consistency. In case of doubt, the consistency of the soil under test shall be determined at various depths up to a depth "d" below ground level (d= diameter of loading plate).

2.4 Procedure for Plate Load Test

2.4.1 Test area preparation

An area sufficiently large to receive the loading plate shall be leveled using suitable tools (e.g. steel straightedge or trowel) or by turning or working the loading plate back and forth. Any loose material shall be removed.

2.4.2 Setting up the plate loading apparatus

The loading plate shall lie on, and be in full contact with, the test surface. If necessary, a thin bed (i.e. only a few millimeters in thickness) of dry medium-grained sand or gypsum plaster paste shall be prepared to obtain a level surface. The plate shall be bedded on this surface by turning and slightly tapping on its upper face. When using gypsum plaster as bedding material, the plate shall be greased on its underside. Any excess plaster shall be removed with the spatula before it sets. Testing shall not begin until the plaster has set.

The hydraulic jack shall be placed onto the middle of, and at right angles to, the loading plate beneath the reaction loading system and secured against tilting. The minimum clearance between loading plate and contact area of the reaction load shall be 0.75 m. The reaction load shall be secured against displacement at right angles to the direction of loading.

2.4.3 Arrangement of settlement-measuring device

In order to measure settlement, the stylus shall be placed in the center of the loading plate. The distance between the support for the supporting frame and the area taken up by the reaction load shall be at least 1.25 m. The dial gauge or transducer shall be set up so as to be vertical.

When placing the loading plate, care shall be taken to ensure that the stylus of the contact arm can be passed without hindrance into the measuring tunnel in the plinth of the loading plate and positioned centrally on the plate.

The settlement-measuring device shall be protected from sunlight and wind. Care shall be taken to ensure that the device and the reaction loading system are not subjected to vibration during the test.

2.4.4 Preloading

Prior to starting the test, the force transducer and dial gauge or displacement transducer shall be set to zero, after which a load shall be applied corresponding to a stress of 0.01 MN/m². The reading of the gauge or transducer shall not be reset to zero until at least 30 s after the preload has been applied.

2.4.5 Loading and unloading

To determine the strain modulus, E_v , the load shall be applied in not less than six stages, in approximately equal increments, until the required maximum stress is reached. Each change in load (from stage to stage) shall be completed within one minute. The load shall be released in 3 stages, to 50%, 25% and approximately 2 % of the maximum load. Following unloading, a further (2nd) loading cycle shall be carried out, in which; however, the load is to be increased only to the penultimate stage of the first cycle (so that the full load is not reached).

When increasing and decreasing the load, 60 s after the previous loading stage has been reached shall elapse before beginning the next stage. The load shall be held constant during this period. The reading shall be recorded at the termination of each loading stage (see Table H-2 & H-3).

To determine the strain modulus, a 300 mm loading plate shall be used and load is increased until a settlement of 5 mm or a normal average stress below the plate of 0.5 MN/m² is reached. If the required settlement is reached first, the normal average stress measured at this stage shall be taken as maximum stress.

Table H-2: Measured values for first loading and unloading cycle

Loading stage no.	Load F (kN)	Normal Stress σ_0 (MN/m ²)	Dial gauge reading S_m (mm)	Settlement of loading plate S (mm)
0	0.71	0.01	0	0
1	5.65	0.080	0.86	1.15
2	11.31	0.160	1.57	2.09
3	17.67	0.250	2.15	2.87
4	23.33	0.330	2.44	3.25
5	29.69	0.420	2.85	3.80
6	35.34	0.500	3.16	4.21
7	17.67	0.250	2.97	3.96
8	8.84	0.125	2.78	3.71
9	0.71	0.01	1.94	2.59

Table H-3: Measured values for second loading test

Loading stage no.	Load F (kN)	Normal Stress σ_0 (MN/m ²)	Dial gauge reading S_m (mm)	Settlement of loading plate S (mm)
9	0.71	0.01	1.94	2.59
10	5.65	0.080	2.42	3.23
11	11.31	0.160	2.65	3.53
12	17.67	0.250	2.84	3.79
13	23.33	0.330	2.99	3.99
14	29.69	0.420	3.10	4.13

If any local inhomogeneity is encountered (e.g. stones, or soil of varying consistency), this shall be recorded.

If, during the loading cycle, a higher load than intended is inadvertently applied, this load shall be maintained and a note made in the test report.

2.5 Evaluation and representation of results

2.5.1 Load-settlement curve

For each load increment, the average normal stress (σ_0) and the associated settlement reading (M) shall be recorded on the dial gauge or displacement transducer. For the assembly shown in Fig. 2b, M shall be taken as the settlement (s) of the plate. For the assembly shown in Fig-H 4, s is to be obtained by multiplying the settlement reading (S_M) by the lever ratio $h_P : h_M$, in accordance with Equation (1):

$$s = S_M \cdot \frac{h_P}{h_M} \quad (1)$$

A load (mean stress below the plate)-settlement fitting curve shall be drawn for the first loading cycle and second loading cycle as shown in Fig-H 5.

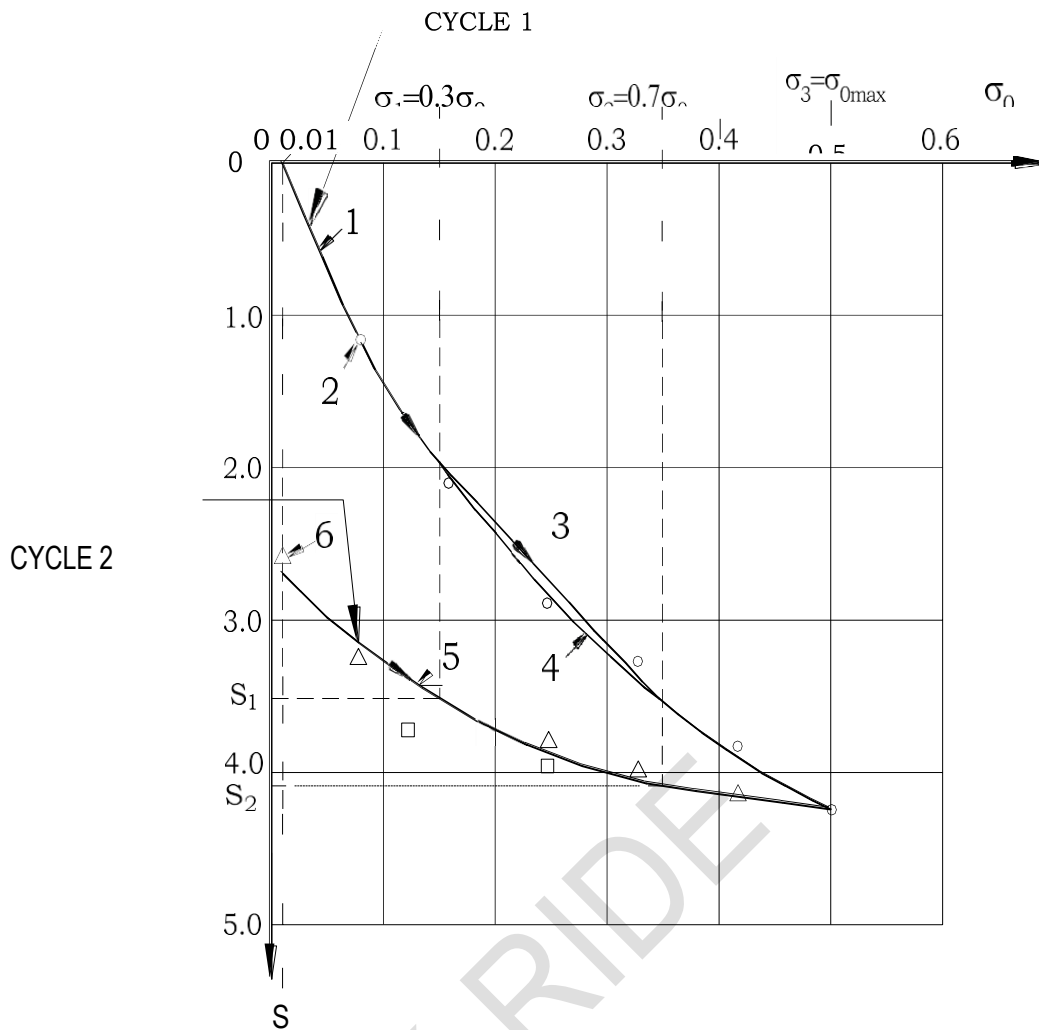


Fig-H 5: Load (Stress)-Settlement curve

Key

- Measurement points from the first loading cycle
- Measurement points from the unloading cycle
- △ Measurement points from the second loading cycle
- 1. Line connecting point (0.01MN/m²; 0 mm) and the first point from the first loading cycle
- 2. First point from the first loading cycle.
- 3. Secant between $0.3\sigma_{0max}$ and $0.7\sigma_{0max}$.
- 4. Quadratic parabola between the first and the last point from the first loading cycle.
- 5. Quadratic parabola between the first and the last point from the second loading cycle
- 6. First point from the second loading cycle.s

Settlement in mm

σ_0 Normal stress in MN/m²

2.5.2 Calculation of strain modulus, E_v

Calculation of the strain modulus (E_v) from the first and of the second loading cycle shall be based on load-settlement curves, by using following equation:

$$E_v = 1.5 * r * \frac{(\Delta\sigma)}{(\Delta s)}$$

Where: E_v is the strain modulus, in MN/m^2 ; r is the radius of loading plate, in mm;

$\Delta\sigma$ is the change in stress between $0.7\sigma_{\text{max}}$ and $0.3\sigma_{\text{max}}$; and

Δs is the change in settlement corresponding to stress values of $0.7\sigma_{\text{max}}$ and $0.3\sigma_{\text{max}}$, from the load settlement curve, in mm.

The subscript 1 shall be used after E_v to denote the first loading cycle, and the subscript 2 to denote the second loading cycle. $\sigma_{0\text{max}}$ from the first loading cycle shall also be used to determine the parameters of the second loading cycle also.

2.6 Examples for determination of E_v

A typical load (stress) – settlement curve is plotted in Fig-H 5 and using this curve, values of E_v are calculated as under:

- (i) For First loading cycle:

$$\begin{aligned} E_{v1} &= 1.5 * 150 * (0.7\sigma_{0\text{max}} - 0.3\sigma_{0\text{max}}) / (S \text{ at } 0.7\sigma_{0\text{max}} - S \text{ at } 0.3\sigma_{0\text{max}}) \\ &= 1.5 * 150 * (0.4 * 0.500) / (3.5 - 1.95) \\ &= 29.03 \text{ MN/m}^2 \end{aligned}$$

- (ii) For Second loading cycle:

$$\begin{aligned} E_{v2} &= 1.5 * 150 * (0.7\sigma_{0\text{max}} - 0.3\sigma_{0\text{max}}) / (S \text{ at } 0.7\sigma_{0\text{max}} - S \text{ at } 0.3\sigma_{0\text{max}}) \\ &= 1.5 * 150 * (0.4 * 0.500) / (4.08 - 3.50) \\ &= 77.58 \text{ MN/m}^2 \end{aligned}$$



Fig-H 6: Ev₂ Measuring Equipment

3.0 Measuring in-situ Density and Water Content by Nuclear Moisture Density Gauge

1.0 Apparatus

1.1 Nuclear Density/Moisture Gauge

While exact details of construction of the apparatus may vary, the system shall consist of



Fig.H-7 : Nuclear Gauge

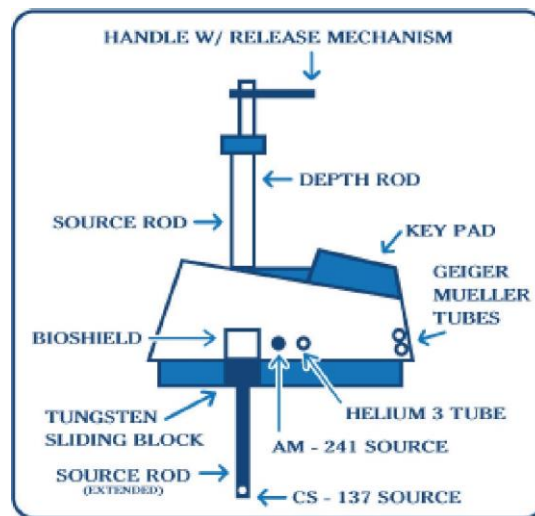


Fig.H-8 : Parts of a Nuclear Gauge

- (a) Gamma Source: A sealed source of high-energy gamma radiation, such as cesium or radium.
 - (b) Gamma Detector: Any type of gamma detector such as a Geiger-Mueller tube(s).
 - (c) Fast Neutron Source: A sealed mixture of a radioactive material such as americium, radium and a target material such as beryllium, or a neutronemitter such as californium-252.
 - (d) Slow Neutron Detector: Any type of slow neutron detector such as boron trifluoride or helium-3proportional counters.
- 1.2 Reference Standard: A block of material used for checking instrument operation, correction of source decay, and to establish conditions for a reproducible reference count rate.
- 1.3 Site Preparation Device: A plate or straight edge or other suitable leveling tool used for levelling the test site to the required smoothness, and in the Direct Transmission Method, guiding the drive pin to prepare a perpendicular hole.
- 1.4 Drive Pin: A pin of slightly larger diameter than the probe, used to prepare a hole in the test site for inserting the probe



- (a) Drive Pin Guide: A fixture that keeps the drive pin perpendicular to the test site. Generally part of the site preparation device.
 - (b) Drive Pin Extractor: A tool that is used to remove the drive pin in a vertical direction so that the pin will not distort the hole in the extraction process.
- 1.5 Hammer: Heavy enough to drive the pin to the required depth without undue distortion of the hole.
- 2.0 General
- 2.1 This procedure covers determination of in-situ density and water content of soil by means of a Nuclear Gauge designed to operate on the ground surface. Most of the gauges normally have combined facilities for determination of density and moisture content both.
- 2.2 The quality of the result produced is dependent on the competence of the personnel using the gauge and the suitability of the equipment and facilities used.
- 2.3 Two alternative modes are provided in the gauges:
- a) Direct Transmission Mode in which the gamma source rod extends through the base of the gauge

in to a pre-formed hole to a desired depth. This is preferred mode for Density Measurement and should be used where possible because of its deeper zone of influence.

- b) Backscatter Mode in which the gamma and neutron source and the detectors are kept at the surface. Moisture Density can be determined only by using the backscatter mode.

- 2.4 The presence of moisture inside the gauge cavity will cause malfunctioning of the gauge. Hence, they should be stored in a warm and dry place and not used in the rain.
- 2.5 Gravel particles or large voids in the source-detector path may cause higher or lower density measurements. Where lack of uniformity in the soil due to layering, aggregate or voids is suspected, the test site should be excavated and visually examined to determine whether the test material is representative of the in-situ material in general and whether an oversize correction is required, in accordance with practice ASTM D4718.

3.0 Calibration of the Gauge

- 3.1 Calibration of the gauge should be done by an Accredited Agency or by the Manufacturer of the gauge, in accordance with procedure given in Annex A1 and Annex A2 of ASTM:D-6938.
- 3.2 Gauges shall be calibrated initially and after any repairs that can affect the gauge geometry or the existing calibration. To be within specified tolerances, calibration curves, tables, or equivalent coefficients shall be verified, at periods not to exceed 12 months. If the tolerances cannot be met at any time, the gauge shall be calibrated to establish new calibration curves, tables, or equivalent coefficients. If the owner does not establish a verification procedure, the gauge shall be calibrated at a period not to exceed 12 months.
- 3.3 Record of calibration shall be maintained, in conformity with procedure given in Annexure- A1 and Annexure- A2 of ASTM:D-6938 and before use of any gauge it should be ensured that the gauge is having valid calibration certificate issued in conformity with stipulated standard.

4.0 Standardization of the Gauge

- 4.1 Nuclear moisture density gauges are subject to long-term aging of the radioactive sources, which may change the relationship between count rates and the material density and water content. To correct for this aging effect, Standardization of the gauge shall be performed at the start of each day's work and a record of this data should be retained. This procedure shall also be repeated after 8 Hours of continuous use.
- 4.2 Standardization should be done with the gauge located at least 9 m away from other nuclear moisture density gauges and clear of large masses of water or other items which can affect the reference count rates.

4.3 Standardization Process

- (a) Turn on the gauge and allow for stabilization according to the manufacturer's recommendations.
- (b) Using the reference standard block, whose serial number matches with the serial number on the

gauge, take a reading that is at least four times the duration of a normal measurement period (typically one minute). Use the procedure recommended by the gauge manufacturer to establish the compliance of the standard measurement to the accepted range. Without specific recommendations from the gauge manufacturer, use the procedure given in Para (c) below.

- (c) If the values of the current standardization counts are outside the limits set by Eq.1 and Eq.2, repeat the standardization check. If the second standardization check satisfies Eq. 1 and Eq.2, the gauge is considered in satisfactory operating condition.

$$0.99(N_{dc})e^{\frac{-(\ln(2))t}{T_d(1/2)}} \leq N_{d0} \leq 1.01(N_{dc})e^{\frac{-(\ln(2))t}{T_d(1/2)}} \quad (1)$$

and

$$0.98(N_{mc})e^{\frac{-(\ln(2))t}{T_m(1/2)}} \leq N_{m0} \leq 1.02(N_{mc})e^{\frac{-(\ln(2))t}{T_m(1/2)}} \quad (2)$$

Where:

$T_d(1/2)$ = the half-life of the isotope that is used for the density determination in the gauge.

$T_m(1/2)$ = the half-life of the isotope that is used for the water content determination in the gauge.

N_{dc} = the density system standardization count acquired at the time of the last calibration or verification.

N_{mc} = the moisture system standardization count acquired at the time of the last calibration or verification,

N_{d0} = the current density system standardization count, N_{m0} = the current moisture system standardization count,

t = the time that has elapsed between the current standardization test and the date of the last calibration or verification.

$\ln(2)$ = the natural logarithm of 2, which has a value of approximately 0.69315,

e = the inverse of the natural logarithm function, which has a value of approximately 2.71828.

- 4.4 If for any reason, the measured density or moisture becomes suspect during the day's Use, another standardization check should be performed.

5.0 Procedure for measurement

- 5.1 Select a test location where the gauge will be placed at least 600 mm away from any object sitting on or projecting above the surface of the test location. If measurement is to be made at a specific location and the aforementioned clearance cannot be achieved, such as in a trench, follow the gauge manufacturer's correction procedure(s). Keep all other radioactive sources at least 9 m away from the gauge to avoid any effect on the measurement.

- 5.2 Prepare the test site in the following manner:

- (a) Remove all loose and disturbed material and additional material as necessary to expose the true surface of the material to be tested.
- (b) Prepare an area to accommodate the gauge by grading or scraping the area to a smooth condition so as to obtain maximum contact between the gauge and material being tested.
- (c) The depth of the maximum void beneath the gauge shall not exceed 3 mm. Use native fines or fine sand to fill the voids and smooth the surface with a rigid straight edge or other suitable tool. The depth of the filler should not exceed approximately 3 mm.
- (d) The placement of the gauge on the surface of the material to be tested is critical to accurate density measurements. The optimum condition is total contact between the bottom surface of the gauge and the surface of the material being tested. The total area filled should not exceed approximately 10% of the bottom area of the gauge.

5.3 Turn on and allow the gauge to stabilize (warmup) according to the manufacturer's recommendations.

5.4 Direct Transmission Mode

- a) Make a hole perpendicular to the prepared surface using the rod guide and drive pin. The hole should be a minimum of 50mm deeper than the desired measurement depth and of an alignment that insertion of the probe will not cause the gauge to tilt from the plane of the prepared area. Care must be taken in the preparation of the access hole in uniform cohesion less granular soils. Measurements can be affected by damage to the density of surrounding materials when forming the hole.
- b) Remove the hole-forming device carefully to prevent the distortion of the hole, damage to the surface or loose material to fall in to the hole.
- c) Place the gauge on the material to be tested. Lower the probe in to the hole to desired test depth. As safety measure, it is recommended that the probe not be extended out of its shielded position prior to placing it in to the test site.
- d) Secure and record one or more sets(s) of one-minute bulk density and water content readings. Read the in-situ bulk density and water content directly.
- e) Retract the probe into the housing and check that the radioactive source is safely housed.

5.5 Backscatter Mode:

- a) Seat the gauge firmly. Set the gauge in to the Backscatter position.
- b) Secure and record one or more set(s) of one-minute density and water content readings.
- c) Read the in-situ bulk density and water content.

5.6 Water Content Correction and Oversize Particle Correction:

- a) For getting accurate values of water content and bulk density, both of these corrections need to be

made when applicable.

- b) Prior to using the gauge-derived water content on any new material, the value should be verified. As part of a user developed procedure, occasional samples should be taken from beneath the gauge and comparison testing done to confirm gauge-derived water content values. All gauge manufacturers have a procedure for correcting the gauge-derived water content values.
- c) When oversize particles are present, the gauge can be rotated about the axis of the probe to obtain additional readings as a check. When there is any uncertainty as to the presence of these particles it is advisable to sample the material beneath the gauge to verify the presence and the relative proportion of the oversize particles.
- d) When sampling for water content correction or oversize particle correction, the sample should be taken from a zone directly under the gauge. The size of the zone is approximately 200 mm in diameter and a depth equal to the depth setting of the probe when using the direct transmission mode; or approximately 75 mm in depth when using the backscatter mode.

6.0 Calculation and expression of Results

In most of the gauges, the Bulk Density, Water Content and Dry Density are calculated and displayed directly. Otherwise, calculate the Dry Density (ρ_d) as under:

$$\rho_d = (100 \times \rho) / (100 + w)$$

Where ,

ρ = Bulk Density of the soil determined by Nuclear Gauge

w = Moisture Content of the soil (in %)

If the Nuclear Gauge determines the Water Content of the soil per unit volume of the soil, then the Dry Density is calculated as under

$$\rho_d =$$

$\rho - W$ Where,

ρ = wet density

W = Moisture Density i.e. water mass per unit volume of soil

The Moisture Content (in %) "W" can be calculated as: $w = (W \times 100) / (\rho - W)$

7.0 Reporting of Results

The Field Data Records shall include, as a minimum, the following

- (i) Make, model and serial number of the Nuclear Gauge.
- (ii) Validity date of Gauge calibration.
- (iii) Data for Standardization of the gauge.
- (iv) Data/details about daily Verification of gauge Results (see Para 8.0)
- (v) Location of test (e.g. Chainage and Lift/Layer No.).
- (vi) Visual description of material tested.
- (vii) Name of the operator(s).
- (viii) Test mode (i.e. Direct transmission or Backscatter) and depth of test.

- (ix) Any corrections made in the reported values and reasons for these corrections (i.e. over-sized particles, water content).
- (x) Maximum Laboratory Density value.
- (xi) Bulk Density measured.
- (xii) Water Content in percent.
- (xiii) Dry Density Calculated/measured.
- (xiv) Degree of Compaction/Percent Compaction.

8.0 Daily Verification of Gauge Results

- 8.1 At the start of each day's work, the Degree of Compaction (% compaction) should be measured at minimum 3 locations by the Nuclear Gauge and compared with the results given by the conventional methods like Sand Replacement Method or Core Cutter Method at the same locations.
- 8.2 If the difference in Degree of Compaction (%) at any of the location is more than 6%, the reason for the difference should be examined in detail.
- 8.3 If the difference in average Degree of compaction (%) of all the locations, ignoring its' Sign, is more than 4%, the standardization of the gauge shall be repeated.
- 8.4 After standardization, the procedure given in Para 8.1 to 8.3 shall be repeated again. If the difference in average Degree of compaction (%) of all the locations, ignoring its' sign, is still more than 4%, the nuclear gauge shall be re-calibrated, to bring the difference in average Degree of compaction (%) of all the locations within 4%.

9.0 Safety Precautions

- 9.1 These gauges utilize radioactive materials that may be hazardous to the health of the users unless proper precautions are taken. Users of these gauges must become familiar with applicable safety procedures and government regulations.
- 9.2 Effective user instructions, together with routine safety procedures and knowledge of and compliance with Regulatory Requirements, are a mandatory part of the operation and storage of these gauges.
- 9.3 This procedure does not purport to address all of the safety concerns, if any, associated with its use. The user of this standard should establish appropriate safety and health practices and ensure compliance to all regulatory limitations.

4.0 COMPACTION TEST (Laboratory Method)

[As per IS: 2720 (Part 8)-1983]

Compaction is the process of densification of soil by reducing air voids. The degree of compaction of a given soil is measured in terms of its dry density. The dry density is maximum at the optimum water content. A curve is drawn between the water content and dry density to obtain the maximum dry density and optimum water content. Dry density = $M / V (1+w)$

Where ,

M = Total mass of soil

V = Volume of soil

w = Water content

1. Cylindrical metal compaction mould

Capacity: 1000 cc with dia 100 mm + 0.1,

2250 cc with dia 150 mm + 0.1

Internal diameter: 100 mm + 0.1, 150 mm + 0.1 Internal effective height of mould: 127.3 + 0.1 mm

Collar: 60 mm high

Detachable base plate

2. Rammer Mass: For Heavy compaction = 4.9 kg, Dia: 50 mm

3. IS sieve: 19 mm & 4.75 mm

4. Oven: Thermostatically controlled to maintain a temperature of 105^o to 110^o C

5. Weighing Balance: sensitivity - 1 g for capacity 10 kg,
0.01g for capacity 200 g

6. Steel straight edge of about 300 mm in length with one edge levelled.

7. Gradation jar

8. Large mixing pan

9. Spatula

Preparation of Sample

1. Break the clods of soil sample as received from the field and remove the organic matter like tree roots, pieces of bark etc. from the sample.
2. Dry the sample in the air. In wet weather, use drying oven but the temperature of the sample should not exceed 60^oC.
3. Take a representative portion of air-dried soil material and large enough to provide about 6 kg of material passing a 19-mm IS sieve (for soils not susceptible to crushing during compaction, or about 15 kg of material passing a 19-mm IS sieve (for soils susceptible to crushing during compaction)
4. Sieve above material through 19 mm & 4.75 mm IS sieve.
5. Sieve above material through 19-mm IS sieve and if soil retained on this sieve is more than 5%, use mould of 2250 cm³ and reject soil retained on 19-mm sieve after its proportion of the total sample has been recorded.
6. If percentage retained on 4.75 mm IS sieve is greater than 20, then use mould of 2250 cm³ otherwise use small mould of 1000 cm³.

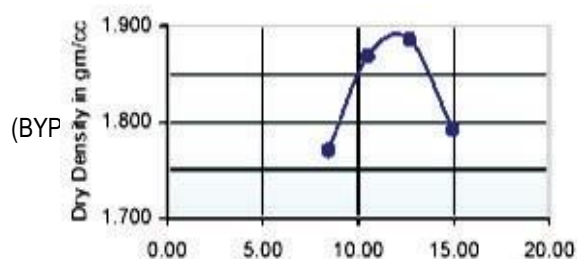
7. Determine the ratio of fraction retained and that passing 4.75 mm IS sieve to access the density of the soil.
8. Mix the soil sample retained on 4.75 mm sieve and that passing 4.75 mm sieve for further testing.
9. The amount of water to be mixed with air-dried soil at the commencement of the test will vary with the type of soil under test.
 - (a) Sandy and gravely soil: a moisture content of 3 to 5 % would be suitable.
 - (b) Cohesive soil: Moisture content about 12 to 16% below the plastic limit of the soil should be suitable.
10. With clay of high plasticity or where hand mixing is employed, it may be difficult to distribute the water uniformly through the air dried soil by mixing alone, and it may be necessary to store the mixed sample in a sealed container for a minimum period of about 16 hours before continuing with the test.

PROCEDURE

1. Clean and dry the mould and base plate and apply a thin layer of grease on the inside the mould.
2. Weigh the mould to the nearest 1 gram. Attach the collar to the mould and place on a solid base.
3. Compact the moist soil in to the mould in five layers of approximately equal mass, each layer being given 25 blows from 4.9 kg rammer dropped from a height of 450 mm above the soil. The blows should be distributed uniformly over the surface of each layer.
4. Remove the collar and trim off the excess soil projecting above the mould by using straight edge. Take the weight of mould with compacted soil in it.
5. Remove 100 g of compacted soil specimen for the water content determination.
6. Add water in increment of 1 to 2 % for sandy and gravely soils and 2 to 4 % for cohesive soils
7. Above procedure will be repeated for each increment of water added. The total number of determinations shall be at least four and moisture content should be such that the OMC at which MDD occurs, is within that range.

PRECAUTIONS

1. Ramming should be done continuously taking care of height of 450 mm free fall accurately.
2. The amount of soil taken for compaction should be in such a way that after compacting the last layer, the soil surface is not more than 5 mm above the top rim of the mould.
3. Weighing should be done accurately.



Moisture Content (%)

Fig-H 10: Curve for Dry Density v/s Moisture Content

5.0 LOS ANGELES ABRASION TEST FOR BLANKET MATERIAL**(Based on IS: 2386-Part-4)****Purpose:** To determine the Los Angeles abrasion value of Blanket Material.**Apparatus:** Los-Angeles Machine, Drying Oven, IS sieves of size 10 mm, 6.3 mm, 4.75mm, 2.36 mm and 1.70 mm.**Preparation of Test sample**

- i) The test sample shall consist of clean material which has been dried in oven at 105-110°C to a constant weight.
- ii) The sample shall be sieved through 4.75 mm IS sieve and grading of test sample shall be decided based on percentage passing through it.

Sample passing 4.75 mm IS sieve	Grading to be adopted for preparation of testsample
Less than 50%	C
Equal to or more than 50%	D

- iii) The sample shall be prepared for the grading 'C' or 'D' [as decided in (ii) above]

Grading	IS Sieve Size		Weight of Sample taken for testing (g)	
	Passing	Retained on		
C	10 mm	6.3 mm	2500	Weight 'A'
	6.3 mm	4.75 mm	2500	
D	4.75 mm	2.36 mm	5000	Weight 'A'

- iv) The abrasive charge shall consist of cast iron or steel spheres approx. 48mm diameter and each weighing between 390 and 445g.

The abrasive charge, depending upon the grading of the test sample as follows

Grading	Number of Spheres	Weight of Abrasive Charges (g)
C	8	3330±20
D	6	2500±15

Testing Procedure

1. The test sample and the abrasive charge shall be placed in the Los Angles Abrasion Machine and the machine rotated at a speed of 20 to 33 revolution / minute. For grading C & D, the machine shall be rotated for 500 revolutions.
2. At the completion of test, the material shall be discharged and sieved through 1.70 mm IS Sieve.
3. The material coarser than 1.70 mm IS Sieve shall be washed dried in oven at 105- 110°C to a constant weight and weighed (Weight 'B').

Calculation

1. The proportion of loss between Weight 'A' and 'B' of the test sample shall be expressed as a percentage of the original weight of the test sample.
2. This value shall be reported as:
Aggregate Abrasion Value (%) = $(A-B) \times 100 / A$ = Original weight of the Sample
B= Final weight of the Sample

Precautions

1. Avoid loss of any part of sample.
2. Ensure revolutions according to grading.
3. Separate material on completion of test, on appropriate sieve coarser than 1.70mm.

K-RIDE

APPENDIX-I

Fitment of Existing Railway Formation

1.0 Introduction

The methodology to assess the fitment of existing formation & requirement for 22.9T/25T axle load operation at 100 kmph & passenger train operations at 160 kmph, is covered in this Appendix.

2.0 Methodology:

The adopted methodology involves determination of induced stress at top of subgrade due to design axle load including dynamic augment for different speeds and makes an arrangement by providing a suitable thickness of blanket layer so that the induced stress at top of subgrade should not exceed the threshold stress of the subgrade soil.

2.1 Assumptions:

- i) The induced stress on top of subgrade is calculated by Empirical formula on the basis of various assumptions. References have been taken from IIT/Kanpur Research report no. 1/93, April-1993, "Modern Railway Track" book by C. Esveld. However, the actual stresses may vary, which are measured by instrumentation in the field.
- ii) Dynamic Augment (for live load) to be considered for different speed has been calculated assuming an average condition of Track i.e. 'Good' condition.
- iii) The permissible stress on the formation has also been calculated using empirical formula. References have been taken from "Modern Railway Track" book by C. Esveld, ORE Report No. D-117, RP-28 and ORE Report No. D-71, RP-12.
- iv) E_{v2} value wherever used for calculations, corresponds to the lower limits of different soil quality class and approximate correlation to the different CBR values from ORE report D 117 RP 28 has been used.
- v) The CBR of the subgrade soil which is considered in calculation is assumed as minimum CBR value for soil available in top 1.5 - 2.0 m depth of the formation, below the bottom of the ballast.
- vi) The thickness of ballast (ballast cushion) used in calculations is total clean ballast cushion of 350 mm.
- vii) As per IPWE technical diary 2019-20, passenger locomotive WAP5 has maximum speed of 160 kmph and its axle load is 19.5 T. This is considered for calculation for assessment of requirement for Passenger train operations at 160Kmph.
- viii) It is assumed that 30% reduction in blanket thickness requirement can be achieved with application of two layers of geo-grid.
- ix) In fitment calculations, it is presumed that there are no persisting problems in sub- soil/subgrade like ground settlement, slope failure etc. in existing formation.

- x) In case of stretches where weak/unstable formation exists - Formation rehabilitation measures should be adopted first in pursuance to Para 291 to 295 of IRPWM, before implementation of the recommendations mentioned in Para 4.0.
- xi) Other considerations like cess width, slope of embankment etc. for railway formation as per extant policies shall also have to be ensured.

2.2 Calculation of blanket layer thickness:

On the basis of methodology described above & various assumptions, requirement of blanket layer thickness for 22.9T/25 T (Heavy Axle Load) operation upto 100 Kmph and Passenger Train operations upto 160 Kmph has been calculated for different speed and CBR values of soil & are presented below:

2.2.1 22.9 T Axle load:

Table- I: 1

Speed (kmph) ↓	Thickness of Blanket Layer (mm) Assuming Ballast cushion - 350 mm			
	40	60	75	100
2	550	550	550	600
3	450	450	450	500
4	300	300	300	350
5	150	150	150	200
6	50	50	100	100
7	0	0	0	50

2.2.2 25 T Axle Load:

Table-I: 2

Speed (kmph) ↓	Thickness of Blanket Layer (mm) Assuming Ballast cushion - 350 mm			
	40	60	75	100
2	600	600	650	650
3	500	500	550	550
4	350	350	400	400
5	200	200	250	250
6	150	150	150	200
7	50	50	100	100

2.2.3 Passenger Trains (for 17T Axle Load/Train 18):**Table-I: 3**

Speed → (kmph) CBR ↓	Thickness of Blanket Layer (mm) Assuming Ballast cushion - 350 mm			
	100	130	140	160
2	300	300	300	350
3	200	250	250	250
4	50	100	100	100

2.2.4 Passenger Trains (for 19.5 T Axle Load/WAP-5 loco.):**Table-I: 4**

Speed → (kmph) CBR ↓	Thickness of Blanket Layer (mm) Assuming Ballast cushion - 350 mm					
	60	75	100	130	140	160
2	400	400	450	450	450	500
3	300	300	350	350	350	400
4	150	150	200	200	200	250
5	0	0	50	50	100	100

3.0 Determination of CBR of Subgrade Soil (Sampling & Testing):

- i) The soil samples should be collected @ of 4 to 5 locations in a block section. The testing shall be done on a few samples based on the visual examination.
- ii) Take out the three soil samples from a location at the depth of 50-100 cm (50 cm depth where embankment height is 1-2 m, assuming ballast penetration if any is less than 30cm) according to sketch-I.(i).
 - a) One sample below ballast in the line of rail seat between two sleepers.
 - b) One sample on each side of the Cess near the toe of ballast.
 - c) Soil samples should not contain pulverised ballast, grass roots etc.
- iii) Determine CBR value of soil samples in the Geo-tech lab/soil testing laboratory.
- iv) Take the average value of all three CBR values of a location.

- v) Based on the determined average value of the CBR of subgrade soil, provision of blanket layer (if required) shall be made, as per the recommendations given in Para 4.0.

4.0 Recommendations for Fitment of Existing Formation:

For operations of 22.9T / 25T axle load at 100 Km/h and Passenger Train (for 19.5T axle load) at 160 Km/h, in existing Railway Formation, the recommendations are as given below (assuming 350 mm ballast cushion and 60 kg Rail Section): -

4.1 Recommendations for 22.9T/25T axle load operation at 100 Km/h:

CBR of Subgrade soil	Recommendation	Remarks
<2	<p>A minimum 1000 mm thick blanket layer should be provided.</p> <p>Alternatively, thickness of blanket layer can be reduced to 700 mm by provisions of two layers of geogrid one at bottom and another in middle of blanket layer (sketch-I.(ii)).</p>	<p>However, as CBR is low, detailed geotechnical investigation shall also be conducted & if necessary suitable additional measures required as per site conditions/soil investigation should be taken for fitment of Existing formation.</p>
≥2 and <4	<p>A 650 mm thick blanket layer should be provided along with a 350 mm thick layer of better quality soil i.e. soil having CBR ≥ 4.</p> <p>Alternatively, thickness of blanket layer can be reduced to 450 mm by provisions of two layers of geogrid one at bottom and another in middle of blanket layer (sketch-I.(ii)).</p>	
≥4 and <5	A 400 mm thick blanket layer should be provided.	
≥5 and <8	A 300 mm thick blanket layer should be provided.	
≥8	No blanket layer is required.	

4.2 Recommendations for Passenger train operations (assuming 19.5 T Axle Load for passenger train/ WAP-5 loco) at 160 Kmph :

CBR of Subgradesoil	Recommendation	Remarks
<2	A minimum 1000 mm thick blanket layer should be provided. Alternatively, thickness of blanket layer can be reduced to 700 mm by provisions of two layers of geogrid	However, as CBR is low, detailed geotechnical investigation shall also be conducted & if necessary suitable additional measures required as per
	one at bottom and another in middle of blanket layer (sketch-I.(ii)).	Site conditions/soil investigation should be taken for fitment of existing formation.
≥ 2 and <4	A 600 mm thick blanket layer should be provided along with a 350 mm thick layer of better quality soil i.e. soil having CBR ≥ 4 . Alternatively, thickness of blanket layer can be reduced to 400 mm by provisions of two layers of geogrid one at bottom and another in middle of blanket layer (sketch-I.(ii)).	
≥ 4 to <6	A 300 mm thick blanket layer should be provided.	
≥ 6	No blanket layer is required.	

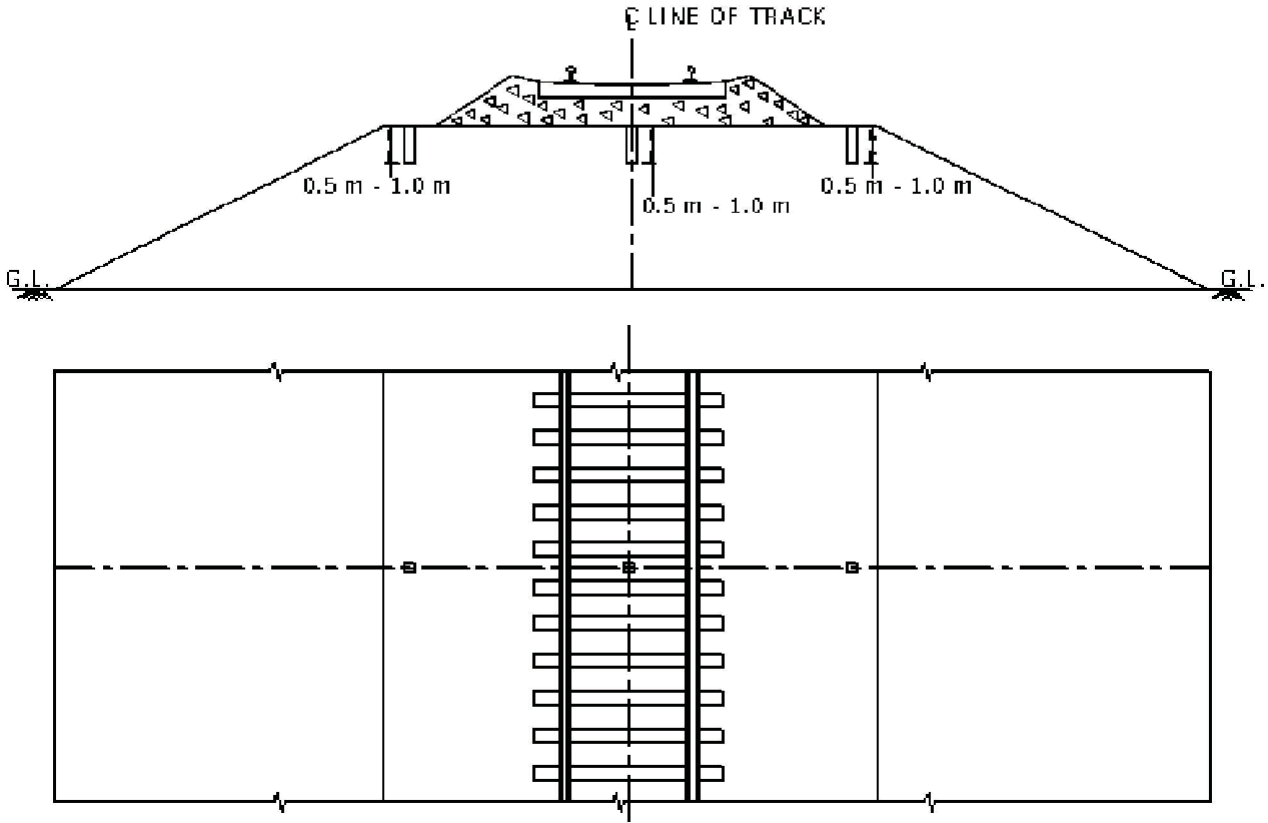
- 4.3** Wherever the blanket layer is to be provided; a suitable non-woven geo-textile layer should be provided below the blanket layer as a separator layer to prevent upward migration of fines from subgrade to blanket layer and penetration of coarse particles of blanket into subgrade.
- 4.4** The above recommendations are on the basis of 350 mm clean ballast cushion. Wherever it is less, full clean ballast cushion of 350 mm shall be ensured in the section, even where no blanket layer requirement is recommended based on CBR of subgrade.
- 4.5** Geo-grid and Geo-textile to be used as per RDSO specification no. RDSO/2018/GE: IRS- 0004 Pt.-III (Feb 2020) and RDSO/2018/GE: IRS-0004 Pt-I (March 2019) respectively mentioned in **Appendix - C**.
- 4.6** The above recommendations cover formation related aspects only.
- 4.7** The formation stretches where the above recommendations are implemented, should be monitored for a period of two year and feedback/suggestions are to be given to RDSO. Based on the feedback of Railways, the above guidelines will be reviewed and improvement suggested (if any) will be incorporated for finalization accordingly.
- 4.8** After implementation of above-mentioned recommendations, if any problem arises in the formation the same shall be referred to RDSO. Even otherwise also, subgrade soils with higher CBR values where no

blanket requirement has been stated as per para 4.1 & 4.2 above, if any problem is reported in the formation after heavy axle load operation and passenger train at 160 kmph same shall also be reported.

K-RIDE

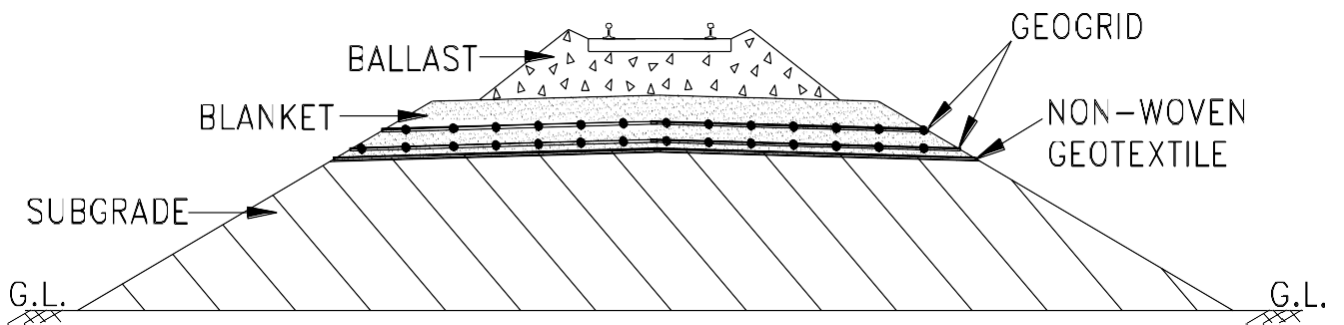
Sketch- I - (i)

LOCATION OF SOIL SAMPLE TO BE COLLECTED



Sketch- I(ii)

Illustrative diagram for Geo-grid and Geo-textile Application



APPENDIX-J

PROFORMA FOR REPORTING UNSTABLE FORMATION

1. General Details:

Affected Km. From:..... To:.....
 Station between

Section.....

Division.....

Railway.....

	Officer	Name	HQ	Telephone Nos.
1.	CE Construction or concerned CE (Open line)			
2.	CTE			
3.	Sr.DEN (CO)			
4.	Dy. CE or concerned Sr.DEN/DEN			
5.	ADEN/AXEN			
6.	PWI/IOW In-charge			

Reference: By:.....Letter No..... Dated:.....

2. Sectional Details:

Gauge	No. of lines	Max. Permissible Speed	Axle Load	GMT per year	Construction Year	Open to traffic/Year

3. Track Particulars:

Km.	Strength/Curved	Degree	Cant (in mm)	Gradient

4. Track Structure:

Km	Rail			Sleeper			Ballast Cushion mm	
	Section	Year laid	Single/SWR/LWR	Type	Density	Year laid	Clean	Caked

5. Condition of rails

Type			Percentage
Roaring	Scabbed	Wheel Burnt	

6. Condition of sleepers/fastenings (Tick any one)

Good	Fair	Bad
------	------	-----

7. Specific deficiencies of track structure:

8. Last deep screening done on:

Month	Year

9. Track Quality Index Values of Previous Three Years:

Date of TRC Run	Track Quality Index (TQI)/Composite Track Qualityindex	Date of OMS Run	Oscillation monitoring System(OMS) data

10. Formation/Cutting Details:

Km	Bank/Cutting	Max. height/depth (in m)	Condition of		Condition of Cess and adequacy of width
			Catch Water drain	Side drain	

11. Details of ballast penetration (Attach Cross section of problematic location with ballast penetration profile)

Depth of Ballast Penetration (cm)		
Under left rail	Under right rail	At Centre

12. Details of Erosion control measure, if any

13. Hydrological Characteristics

Average annual rainfall	Erosion of slope during rain (Yes/No)	Position of water table below RL	
		Highest	Lowest

14. Important incidents/problems faced with brief details:

Year of occurrence	Km	Kind of incident	Remarks

Slips/Breach/Raising/Conversion etc.

(Enclose Sketch & brief description)

15. Details of past rehabilitation measures (km-wise)

Km		Type of treatment	Year of execution	Approx. cost	Comments on performance
From	To				

(Enclose separate annexure, if necessary)

16. Details of track attentions in past years, Km-wise (With details)

Year/Km	No. of attentions/year								Remarks
	Km	Km	Km	Km	Km	Km	Km	Km	

17. Speed Restrictions imposed due to unstable formations:

Year/Km	Restriction Imposed			
	1	2	3	4

18. Any proposals for renewals/LWR/CWR: Give brief details**19. Blanket provided: Yes/No**

If blanket provided (test results of blanket material to be provided)

20. Type of ground/Formation soil (if not available, relevant tests shall be got done and test reports generated for further analysis as required):

Bank soil/ Cutting	Type of soil	CBR	Remarks
Ground soil			
Formation Soil			

21. Bore log details/report of problematic stretch for sub soil (if not available, bore log should be conducted and report generated for problem analysis, as required):

(Type of Soil & other parameters etc.)

22. Slope stability analysis carried out: Yes/No

If yes, attach the report

23. Maintenance efforts during summers & monsoons, along with brief description of the problem being faced:**24. Any settlement problem of track being faced: Yes/No**

If yes, give details

25. Geological details of site (should be made available especially for cuttings related problem & in hilly areas):**26. Details of minor/ major bridge near the problematic location****27. Any rehabilitation carried out using Geosynthetics such as Non-woven Geotextile/Geogrid in past: Yes/No**

If yes, give details

28. Any other relevant data/information: Such as consultancy reports rendered by other parties etc.

Signature of Railway Officer

Name:

Designation:

K-RIDE

APPENDIX- K

LIST OF EQUIPMENTS FOR FIELD LAB

Table-K.1

Sl. No.	Description of Equipment	Reference Of I.S. Code (latest version to be used)	UNIT
1	IS set of sieves with base & top lid 20mm,19mm,10mm, 4.75mm, 2mm 600mic, 425mic, 212mic, 75mic,.	IS-460	sets
2	Hand operated sieve shaker for above sieves.		1 no.
3	BALANCE i) Pan balance/Electronic weighing machine - 10 kg capacity (with 1.0 gm Least Count)		1 no. 1 no.
	ii) Electronic balance - 500 gm capacity (with 0.1 gm Least Count)		
4	iii) Electronic weighing machine 200gm(LC-0.01g)		2 sets 5 sets
5	Field density apparatus complete. sand replacement core cutter with dolly	2720-1974 part-XXVIII 2720-1975 part-XXIX 2720 part-8-1983	2 sets 1 set
6	Heavy Compaction Test apparatus full unit.	2720 part-16-1987	2 sets
7	Laboratory California Bearing Ratio(CBR) Test Apparatus & it's required accessories	2386 part-4	1 no.
8	Abrasion Test Apparatus	IS 2720 Part-5-1985	1 no.
9	Liquid Limit apparatus hand operated with counter & grooving tools.	IS 2720 Part-6-1972	3 no.
10	Shrinkage limit apparatus		4 no.
11	Stainless steel spatula - 25cm long		6 no.
12	Porcelain bowl for LL - 15cm dia.		
13	Aluminium dish with lid – 5cm dia. Wash bottle - 1 lit. capacity		2 no. 2 no.
14	500ml capacity		3 no.
15	Glass plate 10mm thick 50x50 cm		3 no.
16	Ground glass 5mm thick 50x50 cm		10 no.
	Enameled trays 45x30cm		10 no.
	20x20cm		10 no.
	&		
	Enameled plates 6inch dia		3 no.
	8 inch dia.		2 no.

17		10 inch dia.		3 no.
18	Frying pans			3 no.
19	Stove janta			1 no.
20	Straight edge	300mm long		2 no.
21	Sample Tube (Size Dia-150mm, Length-450mm)			5 no.

K-RIDE

LIST OF EQUIPMENT FOR FIELD LAB

Table-K.2

S. NO.	DESCRIPTION OF EQUIPMENT	REFERENCE OF I.S. CODE (latest version to be used)	UNIT
22	Grain size analyser of fines a) Hydrometer b) Thermometer 0 to 50 c c) Glass cylinder 1000cc capacity with 60mm dia. d) Nomogram chart e) Stop Watch	IS-2720 part-4-1985	2 no. 2 no. 5 no. 1no. 1no.
22	Desiccators as IS –6128		2 no.
23	Gallon of 10 litter capacity for distilled water		3 no.
24	Wooden mortar and pestle.		1 no.
25	Specific gravity test apparatus.		2 no.
26	Density bottle-50ml capacity		2 no.
27	Glass cylinder 100 cc capacity (for Free Swell index test)		1 no.
28	Oven- thermostatically controlled to maintain a temperature 105-110c		
29	Relative Density test Apparatus	IS-2720 Part-14-1983	1 no.
30	Standard Penetration Test (SPT) Appratus	IS- 2131- 1981(Reffeed- 1997)	1 no.
31	Nuclear Moisture Density Gauge (NMDG) Apparatus		
32	Note -Preparation of dry soil samples for various test	Follow IS–2720 Part-1- 1983	
33	Consumable Item		
34	Sieve brush		
35	Wire brush		
36	Sodium carbonate		
37	Sodium hexa meta phosphate.		
38	Kerosene		
39	Mercury		
40	Additional Equipment Hand auger 150mm dia with extension rod Sampling tube 100mm dia. And 450mm length		
41	All machines and equipment's should have Calibration Certificate.		

APPENDIX – L

1.0 Soil Classification

(Ref: IS: 1498 – 1970, Reaffirmed 2016)

1.1 Background and Basis of Classification

The Geotechnical Engineers/Agencies had evolved many soil classification systems, over the world. The soil classification system developed by Casagrande was subsequently modified and named as 'Unified Classification' system. In 1959, Bureau of Indian Standards adopted the Unified classification system as a standard, which was revised in 1970. According to BIS classification system, soils are primarily classified based on dominant particle sizes and its plasticity characteristics. A soil particle mainly consists of following four size fractions:

- Gravel : 80 – 4.75 mm
- Sand : 4.75mm – 0.075mm (75 micron)
- Silt : 75 – 2 micron
- Clay : less than 2 micron

Particle size distribution of a soil is determined by a combination of sieving and sedimentation analysis as per procedure detailed in IS: 2720 (Part 4) – 1985 (Reaffirmed 2015) and its plasticity characteristics are determined by Liquid Limit and Plastic Limit as per procedure detailed in IS:2720 (Part 5) –1985 (Reaffirmed 2015).

1.2 Symbols used in Soil Classification:

Symbols and other soil properties used for soil classification are given below:

Primary Letter	Secondary Letter
G: Gravel	W: well-graded
S: Sand	P: poorly graded
M: Silt	M: with non-plastic fines
C: Clay	C: with plastic fines
O: Organic soil	L: of low plasticity
P: Peat	I: of medium plasticity
	H: of high plasticity

Other soil parameters required for soil classification:

- C_U : Coefficient of Uniformity = D_{60} / D_{10}
- C_C : Coefficient of Curvature = $(D_{30})^2 / (D_{60} * D_{10})$
- D_{60} , D_{30} & D_{10} are particle sizes, below which 60,30 and 10 percent soil particles byweight are finer than these sizes.
- Plasticity Index (PI) = Liquid Limit (LL) - Plastic Limit (PL)
- Coarse-grained soils: Soils having fines (particles of size less than 75 micron) upto 50%
- Fine grained soils: Soils having fines(particles of size less than 75 micron) more than 50%

1.3 Based on above, soils encountered in India are classified as under (as per ISCode):

1.3.1 Coarse grained soils:

GW-Well graded gravels, gravel-sand mixtures; little or no fines

GP-Poorly graded gravels or gravel-sand mixtures; little or no fines

GM-Silty gravels, poorly graded gravel-sand-silt mixtures

GC-Clayey gravels, poorly graded gravel-sand-clay mixtures

SW-Well graded sands, gravelly sands; little or no fines

SP – Poorly Graded Sands or gravelly sands; little or no fines

SM-Silty sands, poorly graded sand-silt mixtures

SC-Clayey sands, poorly graded sand-clay mixtures

1.3.2 Fine grained soils:

ML-Inorganic silts and very fine sands rock flour, silty or clayey fine sands or clayey silts with none to low plasticity

CL-inorganic clays, gravelly clays, sandy clays, silty clays, lean clays of lowplasticity

OL-Organic silts and organic silty clays of low plasticity

MI-Inorganic silts, silty or clayey fine sands or clayey silts of medium plasticity

CI-Inorganic clays, gravelly clays, sandy clays, silty clays, lean clays of mediumplasticity

OI-organic silts and organic silty clays of medium plasticity

MH-Inorganic silts of high compressibility, micaceous or diatomaceous fine sandy or silty soils, elastic silts

CH-Inorganic clays of high plasticity, fat clays OH- Organic clay of medium to high plasticity

Pt-Peat and other highly organic soils with very high compressibility.

Table-L.1 Coarse grained soils

Soil Particle	Gradation		Mixed Soils(s)
	Well Graded	Poorly Graded	Silt & Clay
Sand	SW	SP	SM, SC
Gravel	GW	GP	GM, GC

Table – L.2 Fine grained soils

Soil Particle	Plasticity/compressibility		
	Low	Medium	High
Clay	CL	CI	CH
Silt	ML	MI	MH
Organic	OL	OI	OH & Peat

Soils having dual symbol: GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SP-SM, SP-SC & CL-ML

1.4 Limiting gradation curve for separating liquefiable and non-liquefiable soil is as given below for reference:

Poorly graded sand and gravel with $C_u < 2.0$, should not be used in earthwork for the banks to safeguard against liquefaction. Generally, most liquefiable soils as falling in gradation zone as indicated in the Fig-L1 & having coefficient of uniformity, $C_u < 2$ shall not be used. Potentially liquefiable soils as shown in Fig-L1 should be specifically examined and designed to prevent possibility of any liquefaction.

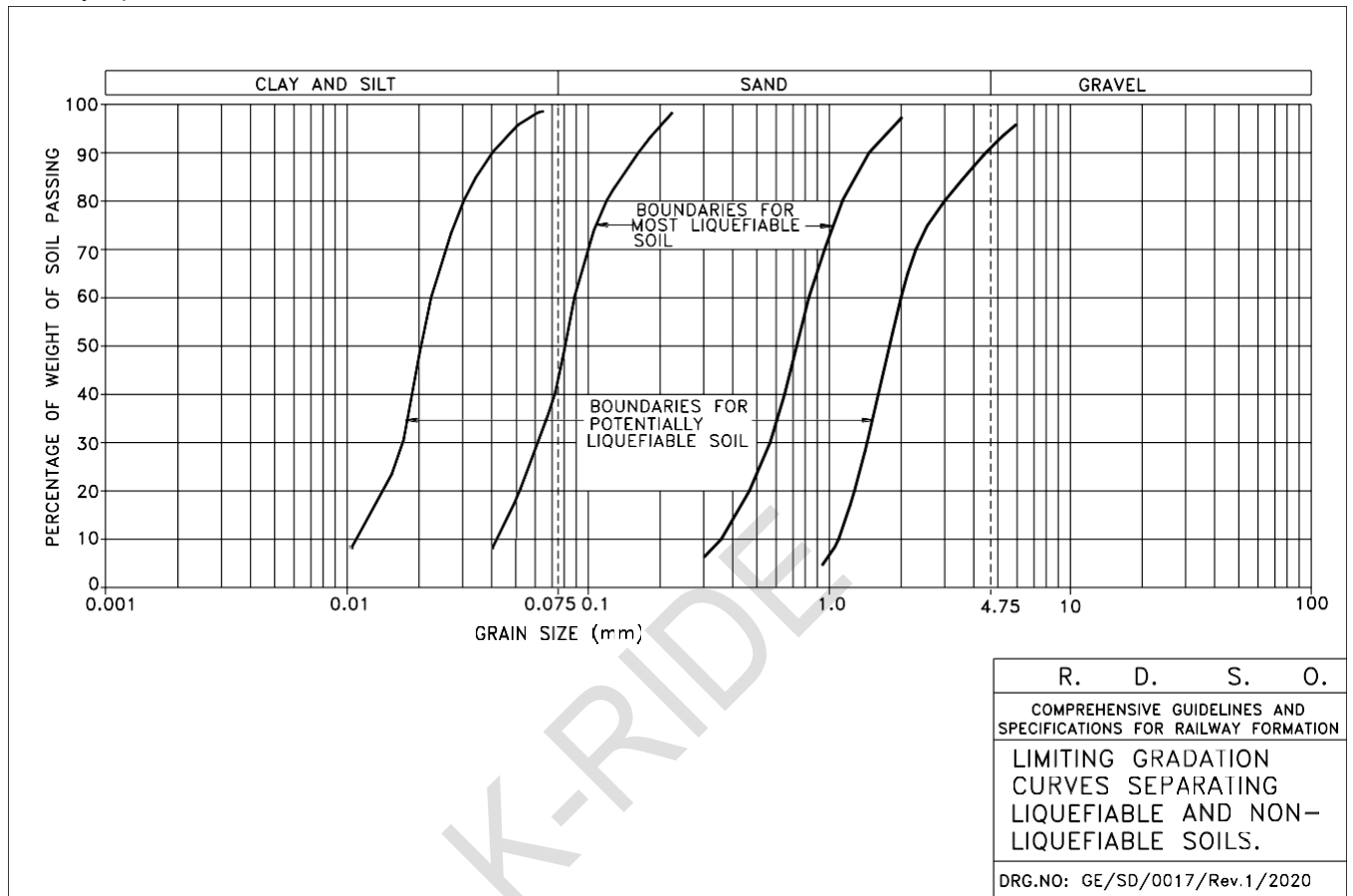


Fig-L1: Limiting Gradation Curves Separating Liquefiable and Non-Liquefiable Soils

APPENDIX- M**CHECKLIST FOR CERTIFICATION OF QUALITY OF EARTHWORK IN RAILWAY PROJECTS
(NEW LINES/ DOUBLING/ GAUGE CONVERSION PROJECTS)**

(As per Guideline & Specification for Railway Formation No. RDSO/2020/GE: IRS-0004, June 2020)

1.0 GENERAL INFORMATION:

- i) Name of the Project :
- ii) Length of the Project :
- iii) New Line/Doubling/Gauge Conversion :
- iv) Section & Length being certified :

2.0 SOIL EXPLORATION:

(As per Chapter 1 of RDSO/2020/GE: IRS-0004)

- (i) Is soil survey carried out as per para 1.2 of Chapter 1 of RDSO/2020/GE: IRS-0004. :
- (ii) Reference of record/report of soil exploration :
- (iii) Any problematic soils encountered in soil exploration such as soft soil, Organic clays & silts etc. :
- (iv) Whether results of soil exploration taken into account in project formulation and alternatives explored. :
- (v) Whether geological investigations carried out in case of hilly terrain. :
- (vi) Reference of record/report of geological investigation :
- (vii) Reference if any, to RDSO for proof checking & consultancy report submitted by private agencies. :

3. FIELD COMPACTION TRIALS

(As per para 6.2.3 (c), Chapter 6 of RDSO/2020/GE: IRS-0004)

- (i) Whether field trials conducted :
- (ii) Details of field trial (indicate) :
 - (a) Classification of soil :
 - (b) Type of roller used and its weight :

- (c) Optimum thickness of layer achieved :
- (d) Optimum number of passes of the roller used :
- (e) Field moisture content :
- (f) Maximum attainable field dry density :
- (iii) Whether field compaction trial taken into account in execution. :
- (iv) Reference of record of field trials :
- (v) Reference of record of field compaction trails (maintained as given in Annexure III, IV, V & VI) :

4. **QUALITY CHECK OF EARTH WORK**

(As per Para 6.2.8, Chapter 6 of RDSO/2020/GE: IRS-0004)

- (i) Whether GE Field Laboratory has been set up at site for quality check. :
- (ii) Whether equipment available in the GE Lab is as per Annexure –VIII (attached). :
- (iii) Dates of inspection of GE Lab by CE/Con based on which item Nos (i) & (ii) above is certified. :

4.1 **BORROW MATERIAL**

(As per para 7.3.1, Chapter 7 of RDSO/2020/GE: IRS-0004)

- (i) Type of fill material (indicate classification as per IS-1498):used in the earth work. :
- (ii) Is soil suitable for embankment (As per Para 3.7 of Chapter 3 of RDSO/2020/GE: IRS-0004) :
- (iii) Frequency of testing at site to assess the suitability of fill materials (As per Table 7.2 Chapter 7 of RDSO/2020/GE: IRS-0004) :
- (a) Total quantum of earthwork involved :
- (b) Minimum number of test required :

at least one test at every change of subgrade/ Prepared

subgrade material subjected to minimum
of one test per 5000 cum)

- (c) Number of tests actually done :
- (iv) Maximum size of materials used in the bank
in case of cobbles/boulders/rock etc. :
- (v) Is it certified that record of quality of fill material has
been maintained as given in format in Annexure VII (A), attached
record of testing is preserved in the reference :

4.2 BLANKET MATERIALS

(As per para 7.3.2, Chapter 7 of RDSO/2020/GE: IRS-0004)

- (i) Source of blanket material :
- (ii) Type of blanket material used
(Natural/Mechanically Crushed/ Blended) :
- (iii) Whether quality of blanket material selected in conforming :to
specification as given in para (As per table 3.3,
3.4, 3.5 & 3.6, Chapter 3 of RDSO/2020/GE: IRS-0004)
- (iv) Thickness of blanket layer
(a) Type of sub-grade (in top 1m) :
- (b) Thickness required (As per table 3.3, 3.4, 3.5 &
3.6, Chapter 3 of RDSO/2020/GE: IRS-0004) :
- (c) Thickness actually provided :
- (d) Deviation from prescribed thickness, if any :
- (v) Frequency of testing to assess the suitability of blanket :material
(As per Table 7.2, Chapter 7 of
RDSO/2020/GE: IRS-0004)
- (a) Total quantum of blanket material involved in cum :
- (b) Minimum number of test required
(at least one test per 5000 cum) :

(c) Number of tests actually done :

(vi) Reference of record of testing where quality of blanket material has been maintained as given in format in Annexure VII (B) attached.

4.3 QUALITY CONTROL CHECKS ON FINISHED EARTHWORK

(As per Para 7.4, Chapter 7 of RDSO/2020/GE: IRS-0004)

4.3.1. For Soil

(i) Frequency of tests for degree of compaction (As per Table 7.2, Chapter 7 of RDSO/2020/GE: IRS-0004)

(a) Total area of earth work involved (Cumulative for every layer in Sqm.)

(b) Minimum number of density test required :
(at least one per 200 sqm for top one metre of subgrade and one per 500 sqm for balance)

(c) Number of de(d) Number of test where degree of compaction is less than 98% of MDD :

(e) Action taken in case of (d) :

(ii) Reference of record where report of checking of degree of compaction has been preserved as given in format in Annexure VII (C) (enclosed) :

(iii) Soil used as subgrade (SQ1/SQ2/SQ3)
:

(iv) E_{v2} Value on top of subgrade (As per Table 7.2, Chapter 7 of RDSO/2020/GE: IRS-0004) :

(v) Compaction at top layer of subgrade(As per Table 7.2, Chapter 7 of RDSO/2020/GE: IRS-0004) :

4.3.2. For Ballast

Ballast Cushion Thickness :

4.3.3. For Blanket

- (i) Frequency of tests for degree of compaction / Relative Density done (As per Table 7.2, Chapter 7 of RDSO/2020/GE: IRS-0004) :
- a) Total area of blanket involved :
- b) Minimum number of density test required :
(at least one par 200 sqm for every blanket layers)
- c) Number of density check actually done :
- d) Number of test where degree of compaction is less than 98% of MDD or 70% of Relative Density (Relative Density should be calculated if fines in the soil are less than 5%) :
- e) Action taken in case of (d) :
- (ii) Reference of record where report of checking of degree of compaction has been maintained as given in format in Annexure VII (D) attached. :
- (iii) Compaction of blanket layer (100% of MDD(As per Table 7.2, Chapter 7 of RDSO/2020/GE: IRS-0004) :
- (iv) Blanket material specification test Report : Y/N
- (v) Blanket thickness (Single layer/ Two layer) :
- (vi) E_v Value on top of blanket layer (As per Table 7.2, Chapter 7 of RDSO/2020/GE: IRS-0004) :
- 4.3.4. Prepared Subgrade** (As per table 3.4 & 3.6 of RDSO/2020/GE: IRS-0004) (For Two Layer Formation system only)
- (i) Prepared sub grade specification and test report : Y/N
- (ii) Soil used as prepared sub grade (SQ2/SQ3) :
- (iii) Prepared sub grade thickness :
- (iv) Compaction of Prepared Sub-grade :
- (v) E_v Value on top of Prepared Sub-grade :
- 4.3.5. Formation level** (As per para 7.6, Chapter 7 of RDSO/2020/GE: IRS-0004)
- (i) Has it been ensured that finished top sub grade level is within ± 25 mm of designed level and finished top of blanket layer is within +25 mm from designed level and top of formation is level without ruts of low pocket. :
- (ii) Reference of level book maintained to ensured item (i) above :
- 4.3.6 Cross Slope** (As per para 7.7 of RDSO/2020/GE: IRS-0004) :
- 4.3.7. Side Slope** (As per para 7.8 of RDSO/2020/GE: IRS-0004) :
- 4.3.8. Formation System** (As per para 3.1 of RDSO/2020/GE: IRS-0004) Single layer/ Two layer :

4.3.9. Formation width (As per IRSOD latest version)	:	
4.3.10 Cess Width (90cm Min.) (As per Para 3.3 (a) of RDSO/2020/GE: IRS-0004)	:	
4.3.11 a) Provision of Berm (for more than 6m High embankment)	:	Y/N
b) Berm Width (2.0m Min.) (As per Para 5.1.2 of RDSO/2020/GE: IRS-0004)	:	
5.0 SLOPE STABILITY FOR EMBANKMENT/ CUTTING (As per chapter 5 of RDSO/2020/GE: IRS-0004)		
(i) Maximum height of bank (at chainage)	:	
(ii) Maximum depth of cutting (at chainage)	:	
(iii) Designed side slope in bank/cutting as per slope stability analysis (attach profile duly approved)	:	
(iv) Agency which carried out slope stability analysis	:	
(v) Actual side slope provided in bank/cutting at site (attach profile duly approved)	:	
6.0 EROSION CONTROL MEASURES (As per para 8.3, Chapter 8 of RDSO/2020/GE: IRS-0004)		
(i) Type of soil used in earth work	:	
(ii) Chainage where erosion control measures required	:	Y/N
(iii) Chainage where erosion control measures planned	:	
(iv) Type of erosion control measures provided chainage wise:		
7.0 Slope Protection Measures (Ref: RDSO Guidelines for Cuttings in Railway Formations, GE: G-2)		
(i) Slope protection measures required	:	Y/N
(ii) Slope protection planned	:	
(iii) Slope protection provided	:	
8.0 Drainage system (As per para 6.2.6, Chapter 6 of RDSO/2020/GE: IRS-0004)		
(i) Drainage system required	:	Y/N
(ii) Catch water Drain System Planned	:	
(iii) Catch water Drain System Provided	:	
(iv) Side drain planned	:	
(v) Side drain Provided	:	
9.0 CUTTINGS (Ref: Para 8.4, Chapter 8 of RDSO/2020/GE: IRS-0004 & GE: G-2) K-RIDE (BYPL-BAW/AT GRADE & ELEVATED)		

- (i) Details of cutting as per **Annexure –1** enclosed :
- (ii) Attach copy of designed & approved cutting profiles :
- (iii) Details of deviation, if any, to recommendation of Geologist investigation. :

10.0 BACKFILL BEHIND BRIDGE ABUTMENT/WING WALLS/ RETURN WALL

(As per Para 6.2.5, Chapter 6 of RDSO/2020/GE: IRS-0004)

- (i) Details of backfill behind bridge approach **Annexure –II** :enclosed.

11.0 GE LAB AT SITE (Para 6.2.8, Chapter 6 RDSO/2020/GE: IRS-0004)

- (i) Organization
 - a) In Charge :
 - b) Total Staff strength with particular :
 - c) Qualification and training of personnel :
- (ii) Period for which lab at site was in operation :
- (iii) Total number of tests carried out at site :
- (iv) Reference of record of tests :
- (v) Equipments (As per Annexure VIII attached) :

12.0 GENERAL SITE DETAILS

- (i) Pond/Ditches/ Borrow pits along the Alignment (distance :
from toe of bank) (As per para. 3.6, Chapter 3 of
RDSO/2020/GE: IRS-0004)
- Rain cuts on slope : Y/N (if Y chainage)
- (ii) Cracks on formation and slope : Y/N (if Y chainage)
- (iii) Details of benching in case of doubling :
- (iv) Minimum center to center distance between tracks :

13.0 BRIEF DETAILS OF DEVIATIONS

Sl. No.	Nature of Deviations	Approved by	Reference of approval.
1.			
2.			
3.			
4.			

It is certified that the earthwork and blanketing from chainage ----- to chainage i.e. -----km have been done strictly as per prescribed specification, stipulated in (as per RDSO Guideline & Specification No. RDSO/2020/GE: IRS-0004) under my active administrative and technical control except

minor deviations as stated in para. 13.0 above for which approval of the component authority has been obtained and necessary precautions for ensuring safety on the account of deviation have been taken.

Chief Engineer (Con)

K-RIDE

**ANNEXURE-I
DETAILS OF CUTTING**

Location Chainage/ Km	Max Depth of Cutting	Geological investigation carried out	Details of Beam provided (Not less than 4-5m)	Type of Rock/ soil strata	Side slope		Side Drain		Catch Water Drains				Other measures taken like gabions, R/walls, etc.	
					Designed (Y/S)	Actual at site	Designed	Provided	Required	Desi gned	Prov ided	Katcha /Lined		

ANNEXURE-II
BACK FILL BEHIND BRIDGE ABUTMENT

Bridge No.	Boulder Shape	Boulder Size	Packing of Boulders	Thickness of Boulder packing	IS classification of back fill in triangular zone	Weep holes	Any special treatment like toe pitching, toe wall etc.

ANNEXURE- III

FIELD COMPACTION TRIAL OBSERVATIONS & COMPUTATION SHEETS
EQUIPMENT DATA

Project..... Location..... Date.....

Item		Roller - 1	Roller - 2	Roller - 3
Type of Roller				
Gross weight (tonnes)				
Drum Dimension (Roller Type)	Width (mm)			
	Diameter (mm)			
Foot (Sheep foot Type)	Type			
	Number			
	Length (mm)			
	Area (mm ²)			
Contact Area (cm ²) (Sheep foot/Pneumatic Tyred/Vibratory Plate Type)				
Tyre Inflation Pressure(Kg/cm ²)				
Nominal Amplitude(mm)				
Frequency(Hz)				
Dynamic Force(Kg)				
Operational Speed(Kmph)				
Static Linear Loads(Kg/cm)				
Contact Pressure(Kg/cm ²)				

LIST OF EQUIPMENT FOR FIELD TRIALS/MONITORING

S. No.	Equipment	No. Reqd.	No. available
1.	Field density apparatus complete: a) Sand replacement b) Core cutter with dolly and hammer	4 Sets 4 Sets	
2.	Balance: a) Electronic balance – 20 kg capacity (with 2.0 gm Least Count) b) Electronic balance – 500 gm capacity (with 0.1 gm Least Count)	1 Set 1 Set	
3.	Straight edge 300mm long	4 Nos.	
4.	Frying Pan	1 No.	
5.	Containers plastic (about 500g capacity)	8 Nos.	
6.	Enamel plates: 6 inch dia. 8 inch dia. 10 inch dia.	10 Nos. 3 Nos. 3 Nos.	
7.	Uniform clean sand (Ottawa Sand) (bags of 50 Kg)	10 Bags	
8.	Measuring tape (3M/5M)	1 No.	
9.	Measuring tape (15 M/30M)	1 No.	
10.	Kerosene oil stove	1 No.	

Signature of Monitoring Official _____	Signature of Project Official _____
Name _____	Name _____
Designation _____	Designation _____
Date _____	Date _____

K-RIDE

ANNEXURE- IV
FIELD COMPACTION TRIAL OBSERVATION
TABLE- 1

Project _____

Date _____

Location _____

Strip No.	Location on the ramp	Moisture content before watering				Moisture content after adding the water			
		Container No.	Weight of wet soil.(gms)	Weight of dry soil.(gms)	Moisture content (%)	Container No.	Weight of wet soil.(gms)	Weight of dry soil.(gms)	Moisture content (%)
1	2	3	4	5	6	7	8	9	10
J	1								
	2								
	3								
	4								
K	1								
	2								
	3								
	4								
L	1								
	2								
	3								
	4								
M	1								
	2								
	3								
	4								

Signature of Monitoring official _____	Signature of Project Official _____
Name _____	Name _____
Designation _____	Designation _____
Date _____	Date _____

K-RIDE

ANNEXURE- V
FIELD COMPACTION TRIAL OBSERVATION
TABLE- 2

Project _____ Location: _____ Date _____
 STRIP No. _____ OMC _____ % MDD _____ gms/cc Volume of core cutters: _____ C.C.

No. of roller passes	Location of the Ramp	In-situ bulk density					Moisture content				Dry density of soil	Percent of MDD	Remark
		Core cutter No.	Wt. Of empty core cutter (gm)	Wt. of wet soil with core cutter (gm)	Wt. of wet soil (gm)	Bulk density of soil (gm/cc)	Container No.	Wt. of wet soil (gms)	Wt. of dry soil (gms)	Moisture content (%)			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
4	1												
	2												
	3												
	4												
6	1												
	2												
	3												
	4												
8	1												
	2												
	3												
	4												
10	1												
	2												

	3												
	4												
12	1												
	2												
	3												
	4												
14	1												
	2												
	3												
	4												

Signature of monitoring official _____ Name _____ Designation _____ Date _____	Signature of project official _____ Name _____ Designation _____ Date _____
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K-RIDE

ANNEXURE- VI

FIELD COMPACTION TRIAL-COMPUTATION SHEET
TABLE- 3

Project _____

Location _____

S. No	Lift thickness (mm)	Moisture content %	Dry density of soil (gm/cc)						Remarks
			Nos. of the roller passes						
			4	6	8	10	12	14	
1.	225								
2.	300								
3.	375								
4.	450								

Computed by _____
 Name _____
 Designation _____
 Date _____

Checked by _____
 Name _____
 Designation _____
 Date _____

ANNEXURE- VII

A) DETAILS OF BORROW SOIL/ FORMATION SUBGRADE/PREPARED SUBGRADE

S. no	Date of taking sample	Location layer Ch./Km	Soil type				Soil classification	LL	PL	PI
			Gravel %	Sand %	Silt %	Clay %				
1	2	3	4	5	6	7	8	9	10	

CBR value	Whether of dispersive nature	Suitable/ Non suitable	Signature and name of Engineer's representative	Signature and name of contractor representative	Remarks
11	12	13	14	15	16

B) QUALITY OF BLANKET MATERIAL

1. Type of material: Manufactured/Naturally available
2. Source location:

S.no	Date of taking sample	Location of laying	Soil type			C _u	C _c	Abrasion Value
			Gravel %	Sand %	Fines passing 75 micron sieve %			
1	2	3	4	5	6	8	9	10

CBR value	Signature and name of Rly official	Signature and name of contractor	Remarks
11	12	13	14

(c) PROFORMA FOR FIELD COMPACTION RECORD

Chainage / km from to

Soil Classification:

Height of bank: OMC:

Type of roller being used: Lab. MDD/ Field Trial MDD:

CORE CUTTER METHOD

Date of Laying	Layer no.	location coordinate for check	Placement moisture content (%)	No. of passes	Wt. of core cutter+ wet soil (W_s) (g)	Wt. of core cutter (W_c) (g)	Wt of wet soil ($W_s - W_c$) (g)	Vol. of core cutter (V_c) (cc)	Bulk density, $\gamma_b = \frac{(W_s - W_c)}{V_c}$ (g/cc)
1	2	3	4	5	6	7	8	9	10

Moisture content of compacted layer (w) (%)	Dry Density (γ_d) $= \frac{\gamma_b}{1+w} * 100$ (g/cc) ^{γ}	Degree of compaction (%)	Sig. and name of Rly officer	Sig. and name of contractor	Remarks
11	12	13	14	15	16

- Note:** 1. In case of compaction of blanket material, percentage of fines should also be mentioned in a column.
2. Determination of Dry Density, (γ_d) of soil in above table is done as per IS: 2720 Pt 29 – 1975 (latest version) titled as Determination of Dry Density of Soils In-Place By The Core-Cutter Method

(D) PROFORMA FOR FIELD COMPACTION RECORD

Chainage /km from to.....

Soil Classification: Height of embankment:

SAND REPLACEMENT METHOD

Location	Bulk density of sand, (γ_s) g/cum	Wt of wet soil from hole, W_w (g)	Wt of Cylinder + Sand, before pouring W_1 (g)	Wt of sand + Cylinder after pouring W_2 (g)	Mean weight of sand in cone W_3 (g)	Wt of sand in hole $W_b = W_1 - W_2 - W_3$	Bulk Density of soil $\gamma_b = (W_w / W_b) * \gamma_s$
1	2	3	4	5	6	7	8

Moisture content of soil (w), %	Dry Density of soil $\gamma_d = \gamma_b / (1+w)$	Relative Density I_D	Sign. and name of Rly Official	Sign and name of contractor	Remarks
9	10	11	12	13	14

Ref: IS: 2720 (Pt 28)1974 (latest version)

(Determination of dry density (γ_d) of soils in-place, by the sand Replacement method)

- Note:**
1. Density Index (Relative Density) shall be find out as per IS 2720 (Part 14) -1963 – (latest version).
 2. The density index, I_D (relative density) expressed as a percentage should be calculated as follows:

$$\text{Relative density (ID)} = \frac{\gamma_{\text{max}} (\gamma_d - \gamma_{\text{min}}) / \gamma_d (\gamma_{\text{max}} - \gamma_{\text{min}}) \times 100$$

 γ_{max} (from lab as per IS 2720 (Part 14) γ_{min} (from lab as per IS 2720 (Part 14) γ_d determined in field as shown in above table by the sand Replacement method.

ANNEXURE – VIII
LIST OF EQUIPMENTS FOR FIELD LAB

Table-1

SL. NO.	DESCRIPTION OF EQUIPMENT	REFERENCE OF I.S. CODE (LATEST VERSION TO BE USED)	UNIT
1	IS set of sieves with base & top lid 20mm,19mm,10mm, 4.75mm, 2mm 600mic, 425mic, 212mic, 75mic,.	IS-460	sets
2	Hand operated sieve shaker for above sieves.		1 no.
3	BALANCE i) Pan balance/Electronic weighing machine - 10 kg capacity (with 1.0 gm Least Count)		1 no. 1 no.
	ii) Electronic balance - 500 gm capacity (with 0.1 gm Least Count)		
4	iii) Electronic weighing machine 200gm(LC-0.01g)		2 sets 5 sets
	Field density apparatus complete.	2720-1974 part-XXVIII	2 sets
5	sand replacement core cutter with dolly	2720-1975 part-XXIX 2720 part-8-1983	1 set
6	Heavy Compaction Test apparatus full unit.	2720 part-16-1987	2 sets
7	Laboratory California Bearing Ratio(CBR) Test Apparatus & it's required accessories	2386 part-4	1 no.
8	Abrasion Test Apparatus	IS 2720 Part-5-1985	1 no.
9	Liquid Limit apparatus hand operated with counter & grooving tools.	IS 2720 Part-6-1972	3 no.
10	Shrinkage limit apparatus		4 no.
11	Stainless steel spatula - 25cm long		6 no.
12	Porcelain bowl for LL - 15cm dia.		
13	Aluminium dish with lid – 5cm dia.		2 no.
	Wash bottle - 1 lit. capacity		2 no.
14	500ml capacity		3 no.
15	Glass plate 10mm thick 50x50 cm		3 no.
16	Ground glass 5mm thick 50x50 cm		10 no.
	Enameled trays 45x30cm		10 no.
	20x20cm		10 no.
	&		
	Enameled plates 6inch dia		3 no.
	8 inch dia.		2 no.
17	10 inch dia.		3 no.
18	Frying pans		3 no.
19	Stove janta		1 no.

20	Straight edge	300mm long		2 no.
21	Sample Tube (Size Dia-150mm, Length-450mm)			5 no.

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LIST OF EQUIPMENT FOR FIELD LAB

Table-2

SL. NO.	DESCRIPTION OF EQUIPMENT	REFERENCE OF I.S. CODE (latest version to be used)	UNIT
22	Grain size analyser of fines a) Hydrometer b) Thermometer 0 to 50 c c) Glass cylinder 1000cc capacity with 60mm dia. d) Nomogram chart e) Stop Watch	IS-2720 part-4-1985	2 no. 2 no. 5 no. 1no. 1no.
22	Desiccators as IS –6128		2 no.
23	Gallon of 10 litter capacity for distilled water		3 no.
24	Wooden mortar and pestle.		1 no.
25	Specific gravity test apparatus.		2 no.
26	Density bottle-50ml capacity		2 no.
27	Glass cylinder 100 cc capacity (for Free Swell index test)		1 no.
28	Oven- thermostatically controlled to maintain a temperature 105-110c		
29	Relative Density test Apparatus	IS-2720 Part-14-1983	1 no.
30	Standard Penetration Test (SPT) Apparatus	IS- 2131- 1981(Reffeed- 1997)	1 no.
31	Nuclear Moisture Density Gauge (NMDG) Apparatus		
32	Note -Preparation of dry soil samples for various test	Follow IS–2720 Part-1- 1983	
33	Consumable Item		
34	Sieve brush		
35	Wire brush		
36	Sodium carbonate		
37	Sodium hexa meta phosphate.		
38	Kerosene		
39	Mercury		
40	Additional Equipment Hand auger 150mm dia with extension rod Sampling tube 100mm dia. And 450mm length		
41	All machines and equipments should have Calibration Certificate.		

APPENDIX- N
LIST OF RELEVANT I.S. CODES

Table-L.1

SL. NO.	I.S. CODE NO.	DISCRIPTION
1.	IS: 2720 -1983 Part-1 (Reaffirmed 2010)	Methods of test for soils. Preparation of dry soil samples for various tests.
2.	IS: 2720-1973 Part-2 (Reaffirmed 2015)	Determination of water content Methods of test for soils.
3.	IS: 2720-1980 Part-3 Section 1 (Reaffirmed 2011)	Methods of test for soils. Determination of specific gravity. Fined grained soils
4.	IS: 2720-1980 Part-3 Section 2 (Reaffirmed 2011)	Methods of test for soils. Determination of specific gravity. Section 2 Fine, Medium and coarse-grained soils.
5.	IS: 2720-1985 Part-4 (Reaffirmed 2015)	Methods of test for soils. Grain size analysis.
6.	IS: 2720-1985 Part-5 (Reaffirmed 2015)	Methods of test for soils. Determination of liquid and plastic limits.
7.	IS: 2720-1972 Part –6 (Reaffirmed 2011)	Methods of test for soils. Determination of shrinkage factors.
8.	IS: 2720-1980 Part-7 (Reaffirmed 2011)	Methods of test for soils. Determination of water content-dry density relation using light compaction.
9.	IS: 2720-1983 Part-8 (Reaffirmed 2015)	Methods of test for soils. Determination of water content-dry density relation using heavy compaction.
10.	IS: 2720-1992 Part-9 (Reaffirmed 2011)	Methods of test for soils Determination of dry density –moisture content relation by constant weight of soil method.
11.	IS: 2720-1991 Part-10 (Reaffirmed 2010)	Methods of test for soils. Determination of unconfined compressive strength.
12.	IS: 2720-1993 Part-11 (Reaffirmed 2011)	Methods of test for soils. Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure.
13.	IS: 2720-1981 Part-12 (Reaffirmed 2011)	Methods of test for soils. Determination of shear strength parameters of soil from consolidated undrained triaxial compression test with measurement of pore water pressure.
14.	IS: 2720-1986 Part-13 (Reaffirmed 2011)	Methods of test for soils. Direct shear test

15.	IS: 2720-1983 Part-14 (Reaffirmed 2015)	Methods of test for soils. Determination of density index (Relative density) of cohesionless soils.
16.	IS: 2720-1965 Part-15 (Reaffirmed 2011)	Methods of test for soils. Determination of consolidation properties.
17.	IS: 2720-1987 Part-16 (Reaffirmed 2011)	Methods of test for soils. Methods of test for soil. Laboratory determination of CBR.
18.	IS: 2720-1986 Part-17 (Reaffirmed 2011)	Methods of test for soils. Laboratory determination of permeability.
19.	IS: 2720-1992 Part-18 (Reaffirmed 2011)	Methods of test for soils. Determination of field moisture equivalent.
20.	IS: 2720-1992 Part-19 (Reaffirmed 2011)	Methods of test for soils. Determination of centrifuge moisture equivalent.
21.	IS: 2720-1992 Part-20 (Reaffirmed 2011)	Methods of test for soils. Determination of linear shrinkage. (with amendment No. 1)
22.	IS: 2720-1977 Part-21 (Reaffirmed 2016)	Methods of test for soils. Determination total soluble solids.
23.	IS: 2720-1972 Part-22 (Reaffirmed 2015)	Methods of test for soils. Determination of organic matter.
24.	IS: 2720-1976 Part-23 (Reaffirmed 2010)	Methods of test for soils. Determination of calcium carbonate.
25.	IS: 2720-1976 Part-24 (Reaffirmed 2015)	Methods of test for soils. Determination of cation exchange capacity.
26.	IS: 2720-1982 Part-25 (Reaffirmed 2015)	Methods of test for soils. Determination of silica sesquioxide ratio.
27.	IS: 2720-1987 Part-26 (Reaffirmed 2011)	Methods of test for soils. Determination of pH value.
28.	IS: 2720-1977 Part-27 (Reaffirmed 2015)	Methods of test for soils. Determination of total soluble sulphate.
29.	IS: 2720-1974 Part-28 (Reaffirmed 2015)	Methods of test for soils. Determination of dry density of soils in -place by the sand replacement method.
30.	IS: 2720-1975 Part-29 (Reaffirmed 2015)	Methods of test for soils. Determination of dry density of soils in- place by the core cutter method.

31.	IS: 2720-1980 Part-30 (Reaffirmed 2011)	Methods of test for soils. Laboratory vane shear test.
32.	IS: 2720-1990 Part-31 (Reaffirmed 2010)	Methods of test for soils. Field determination of california bearing ratio.
33.	IS: 2720-1971 Part-33 (Reaffirmed 2010)	Methods of test for soils. Determination of the density in- place by the ringand water replacement method.
34.	IS: 2720-1972 Part-34 (Reaffirmed 2010)	Methods of test for soils. Determination of dry density of soil in- place byrubber balloon method.
35.	IS: 2720-1974 Part-35 (Reaffirmed 2010)	Methods of test for soils. Part-35 Measurement of negative pore waterpressure.
36.	IS: 2720-1987 Part-36 (Reaffirmed 2010)	Methods of test for soils. Part-36 Laboratory determination of permeability ofgranular soils (constant head).
37.	IS: 2720-1976 Part-37 (Reaffirmed 2011)	Methods of test for soils. Part-37 Determination of sand equivalent value ofsoils and fine aggregates.
38.	IS: 2720-1976 Part-38 (Reaffirmed 2011)	Methods of test for soils. Part-38 Compaction control test (Hilf method).
39.	IS: 2720-1977 Part-39 Section 1 (Reaffirmed 2011)	Methods of test for soils. Direct shear test for soils containing gravel.Section 1 Laboratory test.
40.	IS: 2720-1979 Part-39 Section 2 (Reaffirmed 2011)	Methods of test for soils. Direct shear test for soils containing gravel.Section 2 in-situ shear test.
41.	IS: 2720-1977 Part-40 (Reaffirmed 2011)	Methods of test for soils. Determination of free swell index of soils.
42.	IS: 2720-1977 Part-41 (Reaffirmed 2011)	Methods of test for soils. Measurement of swelling pressure of soils.
43.	IS: 2810-1979 (Reaffirmed 2011)	Glossary of terms relating to soil dynamics.
44.	IS: 4434-1978 (Reaffirmed 2011)	Code of practice for in-situ vane shear test for soils.
45.	IS: 4968-1976 Part 1 (Reaffirmed 2011)	Method of subsurface sounding for soils. Part I Dynamic method using 50mm cone without bentonite slurry.
46.	IS: 4968-1976 Part 2 (Reaffirmed 2011)	Method of subsurface sounding for soils. Part II Dynamic method using cone and bentoniteslurry.

47.	IS: 4968-1976 Part 3 (Reaffirmed 2011)	Method of subsurface sounding for soils.Part III Static cone penetration test.
48.	IS: 5249-1992 (Reaffirmed 2015)	Method of test for determination of in-situ dynamic properties of soils.
49.	IS: 460-1985 Part 1 (Reaffirmed 2013)	Specification of test sieves.Wire cloth test sieves.
50.	IS: 460-1985 Part 2 (Reaffirmed 2013)	Specification of test sieves. Perforated plate test sieve.
51.	IS: 460-1985 Part 3 (Reaffirmed 2011)	Specification of test sieves. Part III Methods of examination of apertures of test sieves.
52.	IS: 1498-1970 (Reaffirmed 2011)	Classification and identification of soils for general engineering purposes.
53.	IS: 1607-2013	Methods for test sieving.
54.	IS: 4616-1968 (Reaffirmed 2017)	Specification for Sheep Foot roller.
55.	IS: 5421-2013	Glossary of terms relating to test sieves and test sieving.
56.	IS: 5500-2004 (Reaffirmed 2015)	Vibratory Roller - General Requirements
57.	IS: 5501-1969 (Reaffirmed 2017)	Specification for pneumatic tyred roller.
58.	IS: 5502-1988 (Reaffirmed 2017)	Specification for smooth-wheeled diesel road roller.
59.	IS: 1888-1982 (Reaffirmed 2011)	Method of load test on soils.
60.	IS: 1892-1979 (Reaffirmed 2011)	Code of practice for site investigations for foundations. (With amendment no. 1)
61.	IS: 2131-1981 (Reaffirmed 2011)	Method for standard penetration test for soils.
62.	IS: 2132-1986 (Reaffirmed 2011)	Code of practice for thin walled tube sampling of soils.
63.	IS: 10074-1982 (Reaffirmed 2010)	Specification for compaction mould assembly for light and heavy compaction test for soils.
64.	IS: 10077-1982 (Reaffirmed 2010)	Specification for equipment for determination of shrinkage factors.
65.	IS: 10379-1982 (Reaffirmed 2010)	Code of practice for field control of moisture and compaction of soils for Embankment and sub-grade.
66.	IS: 10837-1984 (Reaffirmed 2010)	Specification for moulds and accessories for determination of density index (relative density) of cohesionless soils.
67.	IS: 11196-1985 (Reaffirmed 2010)	Specification for equipment for determination of liquid limit of soils-cone penetration method.

68.	IS: 11229-1985 (Reaffirmed 2010)	Specification for shear box for testing of soils.
69.	IS: 11209-1985 (Reaffirmed 2010)	Specification for mould assembly for determination of permeability of soils.
70.	IS: 4081-2013	Code of Safety for Blasting and Related Drilling Operations
71.	IS: 3764-1992 (Reaffirmed 2012)	Code of Safety for Excavation Work
72.	IS: 2386 Part 4 – 1963 (Reaffirmed 2016)	Methods of test for aggregates for concrete – Mechanical Properties
73.	IS: 15869	Open weave Coir Bhoovastra specification
74.	IS: 15872	Application of Coir Geotextile
75.	IS: 14986 (Reaffirmed 2018)	Guidelines for Application of Jute Geotextile for Rain Water Erosion Control in Road and Railway Embankments and Hill Slopes

Note: Latest version of IS codes shall be referred to.

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SECTION – S.02 B
SPECIFICATIONS

Separate priced booklet containing Indian Railway/South Western Railway Standard Specifications for Materials and Works Civil, Electrical and Signalling and Telecommunication) are available in K RIDE office. These specifications shall be applicable for all works covered in this contract.

It is presumed that bidders have gone through the above (including latest correction slips issued up to the date 28 days prior to the deadline for submission of bids) before quoting the Lumpsum Price.

ADDITIONAL SPECIAL CONDITION & SPECIFICATION FOR SUPPLY, FABRICATION, ERECTION & LAUNCHING OF STEEL GIRDERS FOR RAILWAY AND ROAD OVER BRIDGES.

1.0 GENERAL

1.1. This specification covers **supply**, fabrication, assembling, erection and **launching** of **Steel superstructure(Girders) and bearings**.

1.2. The fabrication of steel girder bridges is being done by various Railway Workshops as well as through trade. The fabrication is governed by the provisions of;

- i) Indian Railway Standard specification for fabrication and erection of steel girder bridges and locomotive turntables. (B1-2001).
- ii) Indian Railway Standard Code of Practices for metal arc welding for structural steel bridges carrying rail cum road or pedestrian traffic (Adopted 1972 Revised 2001).
- iii) GUIDELINES ON FABRICATION OF STEEL GIRDERS FOR CONSTRUCTION/FIELD ENGINEERS BS –110 (R)- issued by RDSO.

1.3. **The scope of work shall include:**

- a. Supply, Fabrication, assembling and Erection of Open Web Steel Girders/Plate Girders and Composite Plate Girders for **Railway Bridges** (as per IR loading)and Bow String Steel Girders/ Composite Plate Girders (as per IRC loading) of specified span(s) as mentioned in GAD including erection and launching (with or without power and traffic power blocks, as applicable) for Rail/ **Road Over Bridges** (ROBs.)
- b. Providing and fixing in position standard fixed type POT bearing, free sliding type POT cum PTFE bearings, as per approved drawings including designs of bearings.
- c. Preparation of temporary Arrangement Drawings (TAD), Launching Scheme, Fabrication/Detailed Shop Drawings including drawing office dispatch lists(DODL) , and other documentation as required by K-RIDE.
- d. Preparation of Quality Assurance Plan (QAP) for super-structure including bearings.

e. Other miscellaneous works as listed in Schedules / GCC/ SCC.

1.3.1. The contractors/agencies and officials associated with fabrication work should have thorough understanding of both the codes under para 1.2 (i & ii). However, the “GUIDELINES ON FABRICATION OF STEEL GIRDERS FOR CONSTRUCTION/FIELD ENGINEERS BS-110” , help the field engineers associated with execution of the fabrication work through trade and cover various aspects which require close attention of the field engineers for ensuring quality of the fabrication work. These guidelines are just to facilitate and not to supersede the two codes specified in para 1.2((i) &(ii) above. All engineers associated with fabrication are advised to understand the provision of IRS B1-2001 and Welded Bridge Code and take help from guidelines specified in para 1.2 (iii) above.

1.4. Site Inspection

Tenderers are requested to inspect the site and carry out careful examination to satisfy them as to the nature of work involved and facilities available at the site. They should note carefully all the existing structures and those under construction through other agencies. They should also study the suitability of utilizing the different equipment and the machinery that they intend to use for the execution of the work. The tenderer should also select suitable sites for the purpose of locating their store yard, laboratory, staff quarters etc., and satisfy themselves with regard to the feasibility of transporting the trusses from the yard to the final site of placement etc.

2.0 FABRICATION

2.1 General

The fabrication of the girders and its accessories shall be carried out by the contractor in his factory premises or in a well-established fabrication workshop to be set up by the contractor at bridge site or any other location as approved by the Engineer. The workshop staff shall have requisite experience, proven skill and experience in the technique of fabricating large components.

2.1.1 For Steel Girders of all bridges, other than Important Bridges, (as defined in IRS Substructure Code) including ROBs, the tendering firm shall be from RDSO approved list of firms for Steel Bridge Girder; in case the tendering firm is not in the list of RDSO approved firms for Steel Bridge Girder, then he will have to get the Steel Girder manufactured through an RDSO firm in the RDSO approved premises only. Further subject to condition that tendering firm fulfills other Technical eligibility criteria, as prescribed by the Railways in the tender and the Steel Girder to be manufactured in the RDSO approved premises only.

2.1.2. For the Steel Girders of Important Bridges, (as defined in IRS Substructure Code)besides RDSO approved firms, the tendering firm will have to get the Steel Girder manufactured through an RDSO approved firm in the RDSO approved premises of firm. The agency will be permitted to set up a site fabrication workshop at site of work which meets the ‘ Standard Technical Requirements’ (STR) for Steel Bridge Girder issued by RDSO which is appended in **Clause 31** of this Additional Special

Condition and specification. The approval of the site fabrication workshop meeting with STR to be done by RDSO only and not by any other organisation.

- 2.1.3. Accuracy of fabrication shall be realized through controlled high precision jigs, fixtures and templates, which shall be inspected and passed by Inspection Agencies as specified in Clause 9.4 of this 'Additional Special Condition and specification'. The fabrication shall be preceded by **Quality Assurance plans** to be submitted by the contractor and every activity shall be documented in detail. The Quality Assurance Plans shall clearly indicate how individual processes such as cutting of raw steel, making, drilling, assembly riveting /welding, painting, handling etc. shall be monitored for quality. The quality parameters for monitoring shall be identified along with monitoring these identified quality parameters and shall also be specified in these quality plans. The contractor shall get these quality plans approved from Engineer before start of fabrication work. The Engineer shall be empowered to check the manufacturing process from time to time to ensure that the work is executed as per approved quality plans. The quality records shall be submitted to Engineer for record, after completion of fabrication work.
- 2.1.4. The works of fabrication in contractor's fabrication shop will at all times be open for inspection by Engineer or any other agency as nominated by Engineer. Before dispatch of fabricated steel work from the shops, the same will be inspected in the contractor's fabrication workshop by Engineer or any other authority/agency nominated by Engineer who will thereafter issue inspection certificate.
- 2.1.5. Any defect noticed during inspection in the execution of work shall be rectified or replaced by the contractor at his own cost. The decision of Engineer or any other agency nominated for inspection as to be rectified or replaced, shall be final and conclusive.
- 2.1.6. In the fabrication of girder, necessary arrangement and provision shall be kept for inspection facilities underneath the girder and also for carriage of service cables, pipe lines etc as per approved plans.

2.2 Fabrication Drawings

- 2.2.1. A set of latest approved drawings along with latest revisions should be available in the workshop/ with Agency. On the basis of standard drawings, Fabrication drawings shall be prepared by the fabricating Agency.
- 2.2.2. The contractor shall prepare detailed shop drawings including drawing office dispatch lists (DODLs) on the basis of design drawings supplied by Engineer in such size and in such details as may be specified by Engineer.
- 2.2.3. The shop drawings shall be submitted to Engineer in triplicate. One copy of which will be returned after flame cutting, machining to obtain correct length and shape, tolerance provisions. Welding sequence, type and size of welding. No work of fabrication will be started without such approval being obtained. Contractor has to arrange the proof checking of the working fabrication drawings from the nominated Institution/Consultant will be borne by the contractor. Nomination of the

Institution/Consultant for proof checking works will be decided by concerned Engineer/Con. Engineer will make all efforts to approve the drawings submitted by the contractor within reasonable time but no claim from contractor for any delay on this account shall be entertained by Engineer.

2.2.4 For Engineer's use and record, the contractor shall supply free of charge, four sets of prints on string paper and one set of neatly executed tracings of all approved detailed drawings and fabrication drawings, soon after communication of approval for use at site.

2.3 Maintenance of records by Fabricators

The records of fabrication shall be maintained in the registers as per the formats given in Appendix I of IRS BI - 2001.

2.4 Tolerance in Fabrication

Fabrication tolerance for girders shall be as stipulated in Appendix II of IRS-BI-2001.

Permissible deviation for driven rivets shall be as stipulated in Appendix IV of IRS-BI-2001.

3.0 BRIEF DESIGN DATA

- (i) Steel Girders of Track Carrying Bridges are designed for 25 T/32.5T axle loading as per Indian Railway Bridge Rules and Standard Specifications.
- (ii) The composite girders of road carrying bridges are designed as per code of practice for Road bridges.
- (iii) All panel joints are designed for vertical and transverse forces including secondary moments.
- (iv) The structure shall be fabricated to camber as per Steel Bridge Code and as provided in the approved drawings.
- (v) The deflection of girder is expected not to exceed the values as given in the approved drawing.
- (vi) All members of the girder and joints are to be either riveted or welded or bolted as shown in the approved structural drawing.
- (vii) No welding except where approved by the Engineer is to be carried out at site. All welding/riveting/bolting are to be carried out as per relevant IRS Specifications.
- (viii) The materials as well as execution of works shall be confirming to the following specifications and codes of practice (Latest Revision of the Specification /Codes & upto date correction slips to be referred).

3.1 INDIAN RAILWAY STANDARD CODES AND SPECIFICATIONS :

- (i) IR Specification for Fabrication of steel girder bridge & Locomotives turn tables (fabrication specification) - SERIAL NO.BI-2001 issued by RDSO, Reprint -2008 (Upto date)and BS-110 – **March 2016.**
- (ii) IRS : Bridge Rules (2008)
- (iii) IRS : Welded Bridge Code (1989)
- (iv) IRS : Steel Bridge Code (2003)
- (v) IRS : M-28 Specifications for electrodes.
- (vi) IRS : M-39 Specification for wire flux for SAW.
- (vii) IRS : Specification for Erection and Riveting of Bridge Girders.

3.2 INDIAN STANDARD SPECIFICATION

- (i) IS : 2062-2011 Specification for structural steel.
- (ii) IS : 813-1986 Scheme of symbols for welding.
- (iii) IS : 800-2007.
- (iv) IS : 9595-1996(R-2003) Manual for metal arc welding.
- (v) IS : 818-R 2003 Code of Practice for safety and Health requirements in electric and gas welding operations.
- (vi) IS : 2074, Ready mixed paints, Red Oxide Zinc chromate.
- (vii) IS : 2339-1963 : Aluminium paint
- (viii) IS : 2004-1991 Carbon steel forgings for general engineering purposes.
- (ix) IS : 1852-1985 Rolling and cutting tolerances for hot-rolled steel products.
- (x) IS : 1148 Rivet bars for structural purposes.
- (xi) IS : 1929-1982 Hot forged steel rivets for hot closing(12to36mm diameter)
- (xii) IS : 4353-1995 Recommendations of Sub-merged Arc welding of mild steel and low alloy steel.
- (xiii) IS : 3935 (shear connector)

3.3. INDIAN ROAD CONGRESS SPECIFICATION (ROBS)

- (i) IRC: 6 (loading & forces)
- (ii) IRC: 22 (Composite construction)
- (iii) IRC: 24 (Steel Road bridges)
- (iv) IRC: 83(ii) (POT PTFE bearing)

Note: All the codes mentioned under para 3.1,3.2 & 3.3 shall be used / followed with latest updates.

4.0 MATERIALS

4.1 Steel

- 4.1.1. Steel grade conforming to IS 2062-2011 (with latest amendment) shall be used for all components of steel girder for all spans with quality as specified in the approved structural drawings.

4.1.2. (i) Material for web, flange plate & end plate should be as per IS 2062 Quality.

(ii) No Re-rolled Steel should be used.

(iii) Steel should be procured only from approved manufacturers /venders by RDSO. The source of steel should be got approved by the Engineer / Employer . In support of purchase copy of vouchers are to be submitted.

4.1.3. It may be noted that quality of steel used for fabrication shall be the essence of the contract & shall be rigidly followed. Steel sections to be supplied by the manufacturers shall be ultrasonically tested as per codal provisions at the manufacturer's premises before dispatch. The contractor on receipt of supply in his factory premises/fabrication workshop may have to carryout random USFD testing as per standards laid down in various codes and verify them with the list received from manufacturers, if instructed by the inspection agency/ Site Engineer. Only tested steel shall be used for fabrication.

4.1.4. All rolled sections shall bear cast mark and shall be of such length as to avoid butt welded joints in components of truss. Such rolled sections shall be within rolling tolerances stipulated as per IS:1852 and shall be defects free.

4.1.5. The tenderer (s) shall supply information in the tender regarding source/manufacturers from where procurement of steel is proposed by him/them. However, the usage of type and grade of steel may vary during the execution of the work depending upon the design requirement and market availability. No claim shall be entertained from the contractor on this account and payment shall be as per relevant items as per Price schedule.

4.1.6. Steel for rivets shall conform to IS: 1148 for M.S and IS: 1149 for H.T.S. Welding consumables for Manual Metal Arc Welding (MMAW) shall conform to IRS-M-28, wire and flux combination for submerged arc welding to IRS M-3 and filler wires for CO2 welding to RDSO/M&C/Specification issued vide letter No. M & C/W/111/24 dated 1.1.1994/7.2.1994.

4.1.7. All welding consumables (electrodes, wire, flux etc.) shall be procured only from the manufacturers approved by RDSO subject to final approval by Engineer.

4.1.8. In an extreme eventuality of steel of particular section not being made available locally by Indian Steel manufactures, the tender/s may have to import steel. The imported steel shall be of equivalent specification. Use of built-up sections in place of rolled sections can be permitted. Working out the weight of steel for payment in such cases will be based on the actual sections used. Engineer will not take any responsibility of delays in importing the steel and no cognizance of the same will be given in the completion period.

4.1.9. Test Certificates

All materials for the work shall pass tests and/or analysis prescribed by the relevant IS specifications or such other equivalent specifications. For all materials including rivets and bolts, the Contractor shall furnish copies of test certificates from the manufacturers including proof sheets, mill sheets etc. showing that the materials have been tested in accordance with the requirements of various specifications and codal provisions.

4.1.10. In addition to the test certificate obtained from the steel producers/suppliers/dealers, for conformity sake, all materials/consumables, i.e. steel, rivets, welding electrodes, paints, etc. shall be got tested from the NABL approved labs/recognized labs. Proper record of all such test results shall be maintained. A copy of the same be given to client/K-RIDE as well. Test result of the supplier and that of the lab should match with each other. In case of major difference, matter has to be investigated. Decision of the K-RIDE shall be final in that regard.

4.1.11. Even satisfactory outcome of such tests or analysis shall in no way limit, dilute or interfere with the absolute right of the Engineer to reject the whole or part of such materials supplied, which in the judgment of the inspecting authority does not comply with the conditions of the contract. The decision of the Engineer in this regard shall be final, binding and conclusive for all purposes.

4.1.12. Rolled steel shall also be ultrasonically tested by the reputed firm. Only ultrasonically tested steel shall be used for fabrication work. Record of ultrasonically tested steel shall be maintained separately. All the testing work shall be done in accordance to the provisions of the relevant codes.

4.2.7. Regarding radiographic testing/x-ray testing of the welded joints, matter shall be finalized in consultation with the inspecting authority. Agreed to procedures shall be followed. Necessary arrangement for that has to be got done by the tenderer at their own cost. All testing work shall be got done by the contractor at their own cost. Nothing extra shall be paid. Tenderers should quote their rate accordingly.

4.3. Quality Assurance Plan (QAP) , WPSS and WPQR

4.3.1. Before fabrication of girder, a Quality Assurance Plan (QAP) is prepared by the Contractor based on RDSO guidelines for fabrication of girders (as per sample given in Annexure-I of BS-110 issued by RDSO) and submitted to Inspection Agency as specified in **clause 9** of this specification for approval to ensure proper quality of fabrication. The QAP shall indicate stage wise manufacturing process covering various steps, test checks and their frequency, sampling plan, authority for grant of clearance etc. for all activities. The QAP submitted by fabricating agency is scrutinized by Inspecting Agency on visiting workshop/ site, inspection of the manufacturing process and the same is approved for the particular work during currency of the work/contract before the Agency proceeding with the work.

4.3.2. QAP is to be scrutinized and approved by the Inspection Agency. The QAP should be signed by Fabricator and K-RIDE Officials [Minimum JAG Level] before submission to Inspection Agency. Field

Engineer should ensure that work is carried out strictly as per the approved QAP and no deviation takes place from QAP. All the stages should be studied in detail, prior to start of work.(BS 110-issued by RDSO.)

- 4.3.3. Girders should be got fabricated by a firm who has full-fledged fabrication workshop and should have valid certification of RDSO for fabrication of girders. Any another procedure will require approval of Engineer.
- 4.3.4. Scrutiny & Approval of Welding Procedure Spec. Sheet (WPSS) (final approval to be done by Inspecting Agency as specified in clause 9.4 of this document): WPSS is process sheet indicating plate/section used, welding process, type of joint, welding consumables quality, welding parameters, acceptance standard, tests applicable etc. Field Engineer should ensure that welding is carried out as per approved WPSS. Performa for WPSS is given in Appendix-V of IRS B12001. WPSS should be signed by fabricator and K-RIDE Officials before sending for approval of Competent Authority (Annexure-II).It is to be ensured that welding consumables to be used are from approved source and a proper record of their consumption is maintained. A sample Performa for record keeping of consumables is enclosed as Annexure–III.
- 4.3.5. Welding Procedure Qualification Records (WPQR) (final approval to be done by K-RIDE): WPQR is the document indicating approval of various welders who are to be deployed for carrying out welding work for fabrication. It contains Name of the welder with photograph, qualification, experience, qualification tests and records for each welding process and joint, welding parameter. Tests are conducted by Inspecting Agency before qualifying the welders and then approval is granted through WPQR Proforma given in Appendix-V of IRS B1-2001. WPQR should be signed by fabricator and K-RIDE Officials before sending for approval of Competent Authority in the prescribed format (Appendix V of IRS B1-2001).Field engineer should ensure that welding is done only by approved welders and no deviation takes place.

4.4. Handling and Storing of Steel Sections

- 4.4.1. All projecting plates or bars shall be kept in shape by timber or angle bars spiked or bolted to them and the ends of chord lengths, end posts etc. at their shipping joints shall be protected and stiffened so as to prevent damage or distortion in transit as the Engineer may direct.
- 4.4.2. All threaded ends and machined surfaces are to be efficiently protected against damage in transit. The parts shall be transported in convenient lengths.
- 4.4.3. All straight bars and plates except small pieces are to be transported in convenient bundles temporarily riveted or bolted together or bound with wrought iron or suitable wire as the Engineer may direct. All rivets, bolts, nuts washers, plates under 300mm square and small articles generally are to be packed separately for each span in cases each weighing when full not more than 350 kg or in strong petroleum casks, or barrels as approved by Engineer. If not entirely filled by the contents the space left shall be closely packed with wood shaving or other suitable material. Bolts

and rivets of different sizes shall be separately packed in bags, each bag having a label indicating its contents. A list of contents shall be placed on top of each case or cask.

- 4.4.4. All rolled steel received from supplier shall be carefully unloaded to avoid twisting, bending and damage to mill scale, stacking area shall be covered and the materials placed on a raised platform above ground level and every care taken to avoid contact with water in order to prevent rusting and pitting.
- 4.4.5. All sections damaged transit or handling shall be stacked separately and damaged portions shall be indicated by paint of distinct colour. Such materials shall be dealt with as per instructions of the Engineer. Badly damaged portions may require replacement. Slightly distorted parts or broken parts must be dealt with as the case demands and as directed by Engineer. The rectified sections shall be used for fabrication only after approval of Engineer.
- 4.4.6. Where the work has been passed in the manufacturers factory premises as strictly interchangeable. All members bearing the same marks can be stacked together without reference to any particular position. Care must be taken by the contractor that the parts at site are available in proper sequence. Every portion of work shall be distinctly stenciled with paint and marked with the punch not less than 15mm dia for guidance in erection in the field, and stamped with the letters specified in the drawings. In the case of non-interchangeable work, the system of marking shall be as shown in drawing. All field rivets for site riveting, service bolts and drift for assembly of girder, shall be stored under cover.
- 4.4.7. The contractor shall supply without charge, three complete lists of the rivets, bolts, service bolts, washers and drifts required for erecting the work at site, showing the parts of the work to which the various rivets and bolts belong and having each item marked so as to indicate the particular case in which it will be found. List of total rivets required for one girder stating length, numbers, and wastage allowance of 12.5% shall be prepared and supplied along with the span components, the requirements for service bolts = 45% and drifts = 15% covering 60% of field holes in one span plus wastage allowance of 12.5%. Actual requirement for the work shall be assessed by the contractor who shall arrange accordingly.

4.5. **Steel Tape**

- 4.5.1. Contractor shall use steel tape conforming to IS: 1269(Part 2:1997) duly tested and issued with certificate of accuracy by an accredited National testing house for templating, fabrication of drilling jig etc. The tape shall be calibrated under a tension of 1.8 kg at 16.7 degree C. All marking and checking of master gussets, camber layout, etc shall preferably be at the mean temperature of the fabrication zone.

4.6. **Straightening**

- 4.6.1. All rolled sections and plates shall be straight and free from defects like twists and bends before they are used for marking and cutting. If any rolled section of plate has minor defects, it shall with

the approval of the Engineer, be cold straightened by pressure with the help of plate and section straightening machine. Pressure applied for straightening shall be such a not to damage the surface or microstructure of grains in the steel member. Flattening, straightening and bending in hot condition shall not be carried out unless specified on drawings or approved by Engineer.

4.7. Cutting of Material

4.7.1. All edges shall be machined mechanically (by a sawing machine) or controlled torch oxy-acetylene flame cut after. All flame cut edges shall be ground to secure clean and square edges.

4.7.2. No shearing of section or plates is permitted. When flame cutting is deployed on a plate of long length, flame cutting shall be done by multi-torch mechanically controlled equipment to ensure a straight clean cut and prevent lateral distortion due to heat application. All flame cut edges shall be ground or machined to obtain reasonably clean square and true edges. Drag lines formed during flame cutting shall be removed.

4.7.3. While chalk marking for flame cutting, following cutting allowance shall be added to the prescribed dimensions:

Thickness	Cutting allowance
Up to 12 mm	+3mm
Above 12 and up to 25 mm	+5mm
Above 25mm	+7mm

4.7.4. Templates made from 3 to 4 mm thick steel plate shall be used for cutting Gussets. Long length cutting by marking with white chalk and string may be followed.

4.7.5. Minimum edge distance while preparing profile for gussets, cleats and edges of components from center of rivet hole to a flame cut edge shall be 1.75 times the diameter of hole, and for machined edge or rolled edge shall be 1.5 times the diameter of rivet holes, (machined edge means first edge distance kept 1.75 times diameter of hole for flame cutting and reduced to 1.5 times diameter of hold by removal of material by machining).

5.0 METHOD OF FABRICATION

Fabrication, Workmanship shall generally comply with current IRS specification No.B1-2001 and GUIDELINES ON FABRICATION OF STEEL GIRDERS FOR CONSTRUCTION/FIELD ENGINEERS BS -110 (R) with latest correction/amendments thereof unless otherwise specified in special conditions of this contract or as specially directed by the Engineer in writing.

- 5.1. The fabrication of the girders and its accessories shall be carried out by the Contractor in his factory premises or in a well-established fabrication workshop to be set up by the Contractor at bridge site or any other location as approved by the Engineer as shown below.

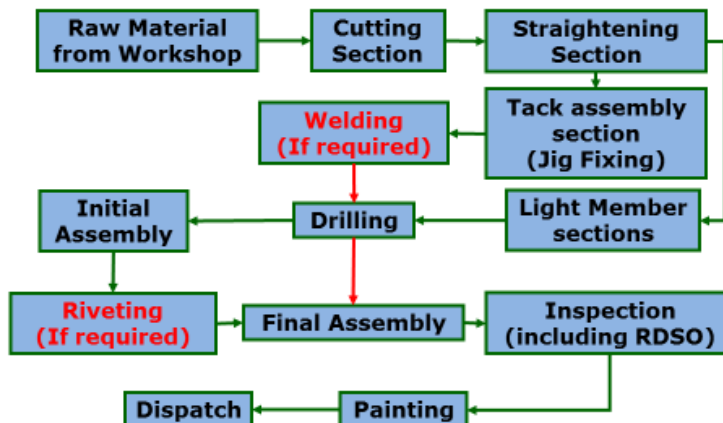
WELL EQUIPPED WORKSHOP

- **WORKSHOP MAINLY CONSISTS OF—**
 1. **TEMPLATE/JIG SECTION**
 2. **CUTTING SECTION**
 3. **TACK ASSEMBLY FIT-UP SECTION**
 4. **WELDING SECTION**
 5. **DRILLING SECTION**
 6. **INITIAL ASSEMBLY SECTION**
 7. **RIVETING SECTION**
 8. **FINAL ASSEMBLY SECTION**
 9. **INSPECTION**
 10. **PAINTING SECTION**
 11. **DISPATCH SECTION**

- 5.2. The workshop staff shall have requisite experience, proven skill and experience in the technique of fabricating large components. Accuracy of fabrication shall be realized through controlled high precision jigs, fixtures and templates, which shall be inspected and passed by Engineer / any other inspection agency as nominated by Engineer.

- 5.3. The following is a typical “Workshop Flow Chart for Fabrication.

WORKSHOP FLOW CHART FOR FABRICATION



- 5.4. Considering the length and height of span, jigs and fixtures shall be used to guide and support drilling of holes and fixtures during entire fabrication work assembly of components, before riveting / welding of components.
- 5.5 Drilling jigs shall be fabricated with the help of Master gussets fabricated as templates for all panel joints of truss. Jigs after manufacture shall be checked and approved by Engineer or any other Inspecting agency as nominated by Engineer/ Con. Only approved and stamped jigs shall be used for fabrication. First component after drilling of holes through approved jig for each specific component of truss, shall be checked with the help of Master gusset by the Inspecting Officer before further fabrication.

5.6. Tack Assembly

- 5.6.1. For fabrication of riveted construction, top and bottom chords of members shall be tack assembled for drilling of holes through jig. Tack assembly of members shall be done by stitch rivets after positioning the drilling jig in true position.
- 5.6.2. Drilling jig and tacked members shall be clamped to a fixture to avoid shifting of jig during handling and drilling.
- 5.6.3. Tack welding may be permitted only at ends or locations, which will eventually be cut and removed. No active part of the component shall be tack welded as this would initiate crack formation in service.

5.7 Template

The contractor shall supply and provide templates at his own cost. No separate payment shall be made for this and accepted Lumpsum Price shall be deemed to include this aspect. The templates used for the work shall be of steel of similar category as the member and shall be of tested quality. In case where actual materials from a bridge have been used as templates for drilling similar pieces the inspecting officer will decide whether these are fit to be used as part of finished structure.

5.7.1 Template Shop

Fully covered template shop consisting of uninterrupted steel or concrete floor as approved having true and correct level covering adequate area shall be provided by the contractor. Camber layouts shall be drawn to full scale from end of girder to half span. This camber layout once approved shall be used for fabrication of master gusset profiles and end profile of each member. It shall be used for working out the actual lengths of each member and checked to conform to the calculated length. Master gussets at every panel joint of top chord, bottom chord and middle web panel shall be marked accurately on camber layout drawn of template floor.

- 5.7.2. All precautions shall be taken while drawing camber layout for correct setting of angle of intersection of chord and web member and great accuracy shall be ensured while transferring the same on master gusset.

While marking centre point of field rivet holes on master gusset, if there is symmetry of holes on vertical axis, marking shall be made only on half the master gusset across vertical axis, and holes drilled by inscribing each hole. Subsequently remaining half portion shall be drilled through gusset using the same half portion master gusset. This will help realize symmetry of holes in gusset and fairing of field rivet hole during girder assembly.

- 5.7.3. Camber layout and fabrication of Master gusset at every panel joint requires highly skilled and trained staff experienced in accurate fabrication of large girders, drilling jigs and fixtures. At least one jig shall be required for each component. Each jig shall be numbered and a record kept in register for identification.

5.8. Drilling of Holes

- 5.8.1. Holes for riveting / bolting in members shall be carried out by drilling through jig only. No punching or hand drilling of holes is permitted. Sub-punching to a diameter 6mm less than that of finished holes may be permitted by Inspecting Officer except in the main truss members of open web girders.

- 5.8.2. When the holes are to be sub-punched they shall be marked off with a centre punch and made with a nipple punch or preferably, shall be punched in a machine in which the position of the hole is automatically regulated. The punching shall be so accurate that when the work has been put together before drilling, a gauge 1.5mm less in diameter than the size of the punched holes can be passed easily through all the holes.

- 5.8.3. Drilling jig should be provide with an internal turned and case hardened bush at all holes in jig, for retaining accuracy of all similar units fabricated. Bushes will have a tolerance of $- 0.0/+0.1$ mm for shop riveting. The tolerance shall be periodically checked & replaced when the tolerance exceeds $- 0.00/+0.4$ mm (for hardening). Before fixing to jig, bushes shall be checked with a plug gauge to ensure these tolerances.

- 5.8.4. Drilling of all holes through jig by radial drilling machine for fabrication of top and bottom chords of all members will be allowed. Web members and floor system having welded construction, field holes for riveting shall be drilled through jig.

- 5.8.5. Holes for countersunk heads of rivets, bolts or screws shall be drilled to the correct profile so as to keep the heads flush with the surface.

- 5.8.6. Holes for rivets shall be 1.5 mm greater than the diameter of rivet bars for rivets less than or equal to 25 mm and 2 mm greater than the diameter of rivet bars for rivets greater than 25 mm. Holes for turned bolts, for field connection, where specified on drawing shall be drilled in the

shop 1 mm less than diameter of holes shown on the drawing and should be reamed at site to suit diameter of turned bolt.

- 5.8.7. Drilling to enlarge un-faired holes is prohibited. The holes required to be enlarged shall be reamed provided the Engineer permits such reaming after satisfying himself about the extent of inaccuracy and the effect of reaming on the soundness of the structure. The Engineer reserves the right to reject all steel work if the holes are not properly matched.
- 5.8.8. On completion of drilling of holes in each component and before shifting the jig, it shall be ensured that all holes are drilled to their correct diameter to reconfirm quality of work.

5.9 Rivets & Riveting of Components

- 5.9.1. The work shall include supply of all rivets, bolts, nuts, washers etc. required for complete erection at site with allowance for wastage. The contractor shall be responsible for supplying site rivets of correct length. The length of such rivets shall be verified in the presence of Engineers representative by snapping a few rivets of each length to check whether the holes have been completely filled in by rivet material. Particularly in case of rivets with long grips (with grip exceeding 6 times the diameter), specimen rivets shall be cut to see if the holes are totally filled even though the rivets are tight under the usual hammer tests.
- 5.9.2. All rivets to be used shall be checked with profile gauge for its true shape, contours of head, concentricity of head, diameter as well as correct length to match the thickness of joint. Calibrated gauges for rivet dimensions and contours shall be provided by the contractor for use of the Inspecting Officer and the Engineer.
- 5.9.3. Service bolts and nuts, ordinary plates, washers and drifts for use in the erection of the work shall also be supplied by the contractor at his own cost. On completion of the work these materials may be taken back by the contractor.
- 5.9.4. The dimension on the drawings refer to the diameters of finished rivets and not the diameter of rivet holes. The rivets shall be made to relevant IS specification. The clearance i.e. the difference in diameter of rivet measured under head (before heating) and rivet hole shall not be less than 0.75 mm. The shanks shall be made of length sufficient to fill the holes thoroughly and to form the head.
- 5.9.5. Riveting shall not be started until such time as Engineer or his authorized representative has personally satisfied himself that the alignment of the girders is correct, the vertical members plumb correctly, all the mating surfaces are secure and in full contact with service bolts and field rivet holes in alignment.
- 5.9.6. All rivets shall be properly heated to straw heat for the full length of the shank, firmly backed and closed. The head of the rivet, particularly in long rivets, shall be heated more than the point and in no case shall the point be heated more than the head. Before placing the rivet in drilled holes the rivets shall be smartly jerked to shake off oxide scale. Where it is impossible to back up by

normal method of holding up, double gunning may be resorted to. Alternatively pneumatic holding device may be used.

- 5.9.7. Unless permitted by Engineer, all riveting shall be done by machine riveting using hydraulic riveters for sound & perfect riveting. Fabrication workshop should have Hydraulic Riveting facilities for fabrication of heavy duty bridge girders as per IRS/IRC specifications. Pneumatic riveters may be used subject to approval of Inspecting Officer/Engineer. The working pressure to be employed when using pneumatic or hydraulic tools shall be as per manufacturers specifications and approved by the Engineer. Hand riveting shall only be done when specifically allowed by the Engineer. In such cases means shall be adopted to ensure the rivets are sued for their entire length and fill rivet holes completely, the snap being used only to give the correct form of head.
- 5.9.8. All rivets when driven shall completely fill the holes, have the heads concentric with the shanks and shall be in full contact with the surface. Driven rivets when struck sharply on the dolly side head with a 110 gm rivet-testing hammer shall be free from movement and vibration. While riveting built up members, great care shall be exercised to ensure that the set of holes for field rivets in each flange of the built up member is aligned, dead square in relation to that in the other flange and not aborted. Use of special jigs shall be made to ensure this fit.
- 5.9.9. All sparking, loose and burnt rivets, and rivets with cracks, badly formed eccentric or deficient heads shall be cut out and replaced by others. Permissible deviation of driven rivets shall be as per IRS BI-2001. Rivets shall also be cut out when required for the examination of the work. The Engineer shall approve actual method of cutting out. Recouping and caulking shall in no circumstances be resorted to.
- 5.9.10. Service bolts shall be frequently retightened as the riveting proceeds, the number and position of the drifts used in the joints permitting this. All field rivets shall be tested as directed by the Engineer.
- 5.9.11. Care must be taken to use rivets of correct dimensions but burrs or lips around the rivet heads shall not be removed.
- 5.9.12. Rivets less than 10 mm diameter may be driven cold subject to approval of Engineer. Flattened rivet head may be used in certain places where clearance demands so.
- 5.9.13. When all the rivets at a joint have been finally passed they shall be painted as per specification.

5.10. Welding of Components

- 5.10.1. All welding work shall be as per IRS/IRC Standard and by such process that the workmanship is flawless. ALL welding shall be by automatic and semi-automatic submerged arc welding process, except where inaccessible. Site welding shall be avoided, but if necessary, shall be carried out

only on secondary members having low stresses to transmit across the joint for which approval of the Engineer shall be required.

5.10.2. Welded construction shall be carried out generally in accordance with provisions of the Welded Bridge Code and IS:9595 (Metal Arc Welding) and further subject to specifications as under:

a) Welding shall be done only by qualified and approved welding operators, whose competency has been verified and certified by Engineer/Inspecting Officer. Routine re-testing of welding operators may be required every six months if deemed necessary by the Engineer who also reserves the right to retest any welding operator at any time during the contract.

b) All long and continuous welds shall be carried out by automatic Submerged Arc Welding (SAW) process only, in order to obtain sound and uniform shape and cross section CO₂ or Manual Metal Arc Welding (MMAW) may be done for short lengths or for secondary connections where access to the location of the weld does not permit Submerged Arc Welding (SAW), subject to approval of Engineer.

Except for special types of edge preparation, such as single and double U, single and double J, the fusion edges of the plates which are to be joined by welding may be prepared by using mechanically controlled automatic flame cutting equipment and then ground to smooth finish. Special edge preparation should be made by machining or gouging.

c) The contractor shall appoint welding supervisors whose competence and qualification shall be subject to approval of TPIA (Third Party Inspecting Agency) like WRI-BHEL/Trichy or any other firms specifically approved in prior by Engineer/Con. All welds shall be carried out under their direction & supervision.

Welding position for fabrication of components shall be Flat or Horizontal position for SAW (flat position preferred) and Flat or Horizontal position for CO₂ or manual metal arc welding. To ensure above position for welding, component shall be placed in a manipulator, tack assembled and rotated in the manipulator to assist welding sequence and prevent distortion of member. In absence of manipulator, special jig and fixtures shall be provided for positioning and careful handling by crane.

5.10.3 **Welding Procedure**

The welding procedure shall be such as to avoid distortion and minimize residual shrinkage stresses. Properly designed jigs should be used for assembly. The welding techniques and sequences, quality, size of electrodes, voltage and current required shall be as prescribed by relevant codes. The contractor should submit full details of welding procedure in proforma given at Appendix-V of IRS BI-2001 (with latest correction slip).

5.10.4. Sequence of welding and welding pass

The sequence of welding and welding pass shall be done as per IRS BI-2001.

5.10.5. **Procedure Trials**

5.10.5.1. Where required by the Engineer/Inspecting Officer, welding and flame cutting trials as per following shall be carried out and completed before fabrication on representative samples of materials to be used in the work.

- i) The samples of material shall be selected and marked by the ENGINEER when the materials for the work are inspected at the mills.
- ii) The trials of flame cutting shall be carried out in material representative of all thicknesses to be used in the work.
- iii) The welding & flame cutting trials shall be commensurate to the satisfaction of Engineer/Inspecting Officer and the procedures to be adopted in the fabrication of work which shall include:
 - a) Welding procedure in accordance with relevant specification.
 - b) Heat control techniques required to ensure that the flame cut surface of steel are suitable for inclusion in welds.
- iv) The trials shall include specimen weld details from the actual construction which shall be welded in a manner simulating the most un-favourable instances of fit-up and preparation. After welding the specimens shall be held as long as possible at room temperature but in any case not less than 72 hours, and then shall be sectioned and examined for cracking. Six representative samples of each weld joint similar to joint used in fabrication of all components shall be prepared by qualified and certified welding operators.
- v) Following groups of tests shall be carried out:
 - (a) Butt welds: Transverse tensile test, transverse & longitudinal bend test with the root of weld in tension and compression respectively, charpy V-notch impact test.
 - (b) Fillet welds: Fillet weld fracture test.
 - (c) Track welds: Inspection for cracking.
 - (d) All welds: Macro examination.

Additional tests may also be carried out as per requirement and instruction of Engineer/Inspecting Officer, the cost of which shall be borne by the contractor.

Following tests are normally performed on welds.

(a) Non Destructive Tests (NDT):

- Visual inspection/profile gauge for dimensional check of size and throat thickness of weld.
- Etching test for penetration of joint.
- Magnetic particle or Ultra Sonic Pulse Velocity (USPV)
- Gamma Radiography & x-ray (only for butt welds)
- Dye penetration of all welds joints.

(b) Destructive Test :

- Tensile test
- Bend test
- Impact test
- Load test.

5.10.5.2. Once samples representing the weld joint used in fabrication of all components are tested and test results are found satisfactory, then approval shall be taken from the Engineer/Inspecting Officer for the welding of built up components by approved welding operators. Welding Procedure Qualification Records (WPQRS) shall include joint details, welding consumables (i.e. electrode/wire & flux combination), weld parameters (i.e. welding current, wire feed speed), welding position, welding equipment carriage speed (for SAW process), arc Length, arc voltage etc.

5.10.6 Precautions during welding

5.10.6.1. The Contractor shall submit list of weld joints of different combined thickness for approval of welding procedure for all members.

5.10.6.2. The welding of built up component shall be carried out only by approved welding operators and in accordance with Welding Procedure Qualification Records. WPQRs shall be prepared in advance and approved by the Engineer. Proper welding sequence shall be followed to avoid distortion and minimize residual shrinkage stress, and surface defects, within acceptable tolerance limits.

5.10.6.3. To ensure sound and defect free welding of built up members, record of welding adopted as per approved qualifying procedure shall be maintained in Performa prescribed in guidelines for welded fabrication issued by TPIA (Third Party Inspecting Agency) like WRI-BHEL/Trichy or any other firms specifically approved in prior by Engineer/Con.

5.10.6.4. Any change during welding for fabrication of built up member, such as welding sequence, welding process, positioning, wire and flux combination joint details, increase or decrease in

combined thickness of joint by 5 mm etc. shall be carried out only after representative samples test and procedure qualification, is accepted. In no case deviation from WPQRs without approval of Engineer shall be adopted.

5.11 Preparation of Faces

- 5.11.1. Preparation of joint face: Except for special types of edge preparation such as single or double 'U' & 'J' joints, the fusion edges of all plates which are to be joined by welding shall be prepared by using mechanically controlled automatic flame cutting equipment with the cutting allowance as per clause 4.7 and the extra length machined to obtain correct length.
- 5.11.2. It shall be ensured by Non-destructive tests that the fusion face and adjacent surface are free from cracks, notches or other irregularities that are likely to cause defects during service or interfere with deposition of the weld.
- 5.11.3. Fusion faces and the surrounding surface up to 50 mm shall be free from mill scale, moisture, oil, paint dirt or any other substance which may affect the quality of the weld, and same shall be removed by grinding or flame cleaning/grit blasting.
- 5.11.4. Details of joint, fusion faces, root face and gap shall be as per details given in fabrication drawing or as stipulated in IS:9595.

5.12 Welding Operation

- 5.12.1. Parts to be welded shall be assembled such that the joints to be welded are accessible and visible to the operator. Assembly jig and fixture shall be used for accuracy.
- 5.12.2. Manipulators should preferably be used to execute the sequence of welding without disturbance, in the most suitable position. Fixture shall maintain the alignment with minimum restraint in order to reduce the possibility of locked up stresses.
- 5.12.3. Run in and run out plate shall be provided for fabrication of built up members or truss to ensure that weld will start on run in plate and weld will stop on run out plate and thus avoid crater defects on the components.
- 5.12.4. The size and length of weld shall not be less than those specified in the drawing nor shall they be in excess of the requirement without prior approval of the Inspecting Officer. The location of weld shall not be changed without prior approval of the Engineer.
- 5.12.5. During design and detailing of component lengths, care is to be taken to avoid butt weld in built up members of truss. Therefore it is essential to use only nearest size and length or rolled sections that have been procured to scheduled sizes and lengths by proper planning. No butt weld shall be carried out without approval of Engineer.

5.12.6 Fabrication of components subject to dynamic loading in the structure need careful inspection during fabrication by qualified, experienced and certified Engineer from contractors side and final approval by Inspecting Officer. This inspection shall be carried out as stipulated in Indian Railway Welded Bridge Code before, during and after welding.

5.13 Additional Precautions during Welding

5.13.1. Following precautions shall further be observed during fabrication.

- All equipments shall be provided with calibrated gauges to observe limits of variation for parameters prescribed in WPQR'S for welding current, arc voltage, speed of travel of equipment etc.
- Covered shed for environmental control (particularly against dust, moisture and initiation in weld or under bed of weld (i.e. Heat Affected Zone HAZ). Also baking of flux use for submerged arc welding in oven for an hour at 200 degree C shall be carried out to ensure that no moisture is contained in flux during welding.
- All tack weld shall be carried out by qualified and approved welder only. As tack weld will become part of the final weld, it shall be free from all cracks and other welding defects.
- If multiple runs are used for fabrication of built up member, inter run cleaning shall be carried out and subsequent weld made only after approval o inspecting officer or his authorized representative. This is to check free defects in the weld. Also visible defects such as cracks, cavities, if any, shall be removed by grinding. It shall be ensure during welding that craters are avoided.
- Stray arcing of components, which cause local hard spots or cracking of parent metal, shall be avoided.
- Flux of approved quality will be permitted for use.
- The Auto melt grade wire spools of wires for Submerged Arc Welding and Carbon Dioxide (CO₂) consumables of only the approved quality will be permitted.
- Pre Heat Treatment will be given to the consumables to remove the moisture if any.
- No violation of welding procedure will be permitted on any account.

6.0 General : Riveting , Welding & Jointing with HSFG Bolts

6.1. Qualified trained, and experienced supervision is essential at all times during fabrication, and for maintenance of records.

- 6.2. After riveting of riveted components or welding of welded components, they shall be finished finally by grinding or matching with the help of a profile template. All the butting ends of components shall be faced in milling machine after members have completely fabricated. In the case of compression members, the face shall be machined so that the faces are of proper angle as shown in drawing and the joint when made will be in close contact throughout within a gap tolerance of less than 0.15 mm. The Inspecting officer may permit a tolerance of (-) 0.4 mm at isolated points in butting line.
- 6.3. **Jointing with HSFG Bolts** shall be as per Para 28.9 to 30.1 of IRS:B1-2001.

7.0 PAINTING

Specification for metallising and painting of bridge girders shall be as per IRS:B1-2001.

7.1 Surface Preparation

- 7.1.1 This is the most important factor in ensuring good performance of the steel girder. The surface should be clean, dry and free from contaminants and it should be rough enough to ensure adhesion of the paint film. However it should not be so rough that the film cannot cover the surface peaks.
- 7.1.2 The cleaning of the surface shall be done initially with the use of emery paper, wire brushes, scrapers etc. for spot cleaning to remove rust, scale etc. Subsequently, sand blasting of the surface shall be done to remove rust, mill scale along with some of the base metal. This will be achieved by high velocity impact of abrasive material against the surface in accordance with the provisions of IS:6586, which will also create a base for good adhesion. The abrasive material once used for cleaning heavily contaminated surface should not be reused even though re-screened. Washed salt free angular silica sand of mesh size 12 to 30 with a minimum of 40% retained on a 20 mesh screen shall be used for blasting. The material specifications and other requirements shall be as provided in Indian Railways Bridge Manual, 1998.
- 7.1.3 All site rivets, bolts, nuts and washers shall be thoroughly cleaned and dipped in boiled linseed oil. All machined surfaces are to be well coated with a mixture of white lead conforming to IS:34 and Mutton tallow conforming to IS:887 as per specifications before despatch to site. Nothing extra shall be payable to contractor on this account.
- 7.1.4 All the components in the floor and deck system in open web girders and all members in plate & composite girders shall be metalized as IRS specifications.

7.2 Metal Spraying

- 7.2.1 The sprayed coating shall be applied as soon as possible after surface preparation.
- 7.2.2 The wire method shall be used for the purpose of metallising, the diameter of the wire being 3mm or 5mm. Specified thickness of coating shall be applied in multiple layers and in no case less than

2 passes or the metal spraying unit shall be made over every part of the surface. The surface after spraying shall be free from uncoated parts of lumps of loosely spattered metal.

7.2.3 The composition of the aluminium to be sprayed shall be in accordance with BS 1475 Material 1-B(99.5%) aluminium otherwise as per IS:739 and IS:2590. However the selection of metal for spraying, i.e. Zinc or Aluminium shall be subject to final approval by the Engineer.

7.2.4 At least one layer of the coating must be applied within four hours of blasting and the surface must be completely coated to the specified thickness within 8 hours of blasting.

7.2.5 Minimum thickness of metal coating applied shall be 165 microns and average thickness shall be 200 micron. The specified thickness of coating shall be applied in multiple layers, not less than three. The metal coating shall be checked for thickness by approved magnetic thickness measuring gauge. At least one reading for each sqm of area painted shall be taken. The calibration of the gauge shall be checked against a standard of similar thickness within an accuracy of 10%.

7.2.6 For measurement of dry film thickness, following instruments may be used by the contractor:

- (i) Electronic coating thickness gauge,
- (ii) Elcometer (magnetic thickness gauge) Dial type.
- (iii) Surface profile gauge.

7.2.7 After metallising any oil, grease etc. shall be removed by thorough wash with a suitable thinner as approved by the Engineer and shall be allowed to dry for 15 minutes. The first coat shall be applied by brush/airless spray-one coat of epoxy micaceous Iron Oxide to RDSO specification No. M & C/PCN-103/86 to 100 microns minimum DFT and allowing it to hard dry.

7.2.8 The finishing coat shall be applied with two coats of poly urethane aluminium finishing to RDSO specification No. M& C/PCN-110/88 to 40 microns minimum DFT giving sufficient time gap between two coats to enable the first coat to hard dry. The finishing coats to be applied in shop and touched after erection if necessary.

7.2.9 The Engineer however reserves the right to select the scheme of painting of the girders and channel sleepers.

7.2.10 The Engineer also reserves the right to select the colour scheme for the third and fourth coats.

7.3 Miscellaneous

7.3.1 Final dry film thickness in case of metallising shall be average 150 microns and shall be measured before application of final finishing two coats.

7.3.2 Surface preparation shall not be done unless approved paints of sufficient quantity (both primer and finishing) are available in stock.

7.3.3 Special care should be taken in preparing corners, junctions of members, head and nuts of bolts, rivets, holes, areas less accessible, hidden pockets etc. Surface preparation at such locations shall not be inferior to that attained over the rest of the area.

7.3.4 Surface preparation shall not be carried out in the following conditions:

- In rainy season from June to September and from December to January.
- In extremely windy/misty/dust blowing conditions.
- At night.
- In winter before 8 A.M.
- In summer between 11 and 15 hrs, in areas, which are likely to be exposed to direct sunlight.

7.4 Inspection

7.4.1 **Adhesion:** The sprayed metal coating shall be subjected to an adhesion test using the method described in IRS BI-2001. If any part of the coating between the lines breaks away from the base metal, it shall be deemed to have failed the test.

Articles that have been rejected, shall have the defective sections blasted to clean off all sprayed material prior to re-spraying. Where the rejection has been solely due to too thin a coating, sprayed metal of the same quality may be added provided that the surface has been kept dry and is free from visible contamination.

7.5 Paints : Source & Quality

7.5.1 Paint and other accessories including those for metallising work will be supplied by the contractor. Paints manufactured by the following firms (or more) may be used subject to their being in the approved list of RDSO and final approval by the Engineer.

- M/s. Jenson Nicholson. Paints
- M/s. British / Barger paints.
- M/s. Shalimar Paints
- M/s. I.C.I. .paints
- M/s. Nerolac. Paints

7.5.2 The contractor shall furnish to the Engineer, the date of manufacture of paint as certified by the manufacturers with the necessary container marking and test certificate for paint conforming to relevant IS code. In addition to this, he shall also submit the necessary vouchers in respect of paint purchased by him.

7.5.3 The Engineer reserves the right to get the paint tested at contractor's expenses as considered necessary by the Engineer. If the test results do not conform to relevant IS specifications fully,

then the lot of paint shall be rejected and got removed from the contractor(s) storage. If the paint has already been applied it shall be removed.

7.5.4 In addition to above, the following tests are required to be carried out in the field.

- Weight per litre
- Consistency test
- Scratch test.
- Flexibility and adhesive test.

7.5.5 The Engineer reserves the right to reject the lot of paint even on the basis of field results.

7.6 **Painting - General Instructions**

7.6.1 Painting shall not be commenced till the surface preparation has been approved by the Engineer or his representative or inspecting officer.

7.6.2 Sealed containers of paint of approved brand shall be used. The paint drums must be rolled, turned upside down and shaken before opening. The paint must be stirred well before use. Over stirring which results in invisible air bubbles etc, shall be avoided.

7.6.3 Where brush painting is accepted, the paint must be applied by means of flat brushes not more than 75 mm in width having soft flexible bristles conforming to IS:384.

7.6.4 Round and oval brushes of approved quality conforming IS: 487 may also be used as per the instructions of the Engineer or his representative or inspecting officer.

7.6.5 All new brushes should be soaked in raw linseed oil conforming to IS:77 for at least 24 hours before use.

7.6.6 A little blue paint shall be added, in the first coat of aluminium paint to distinguish it from second coat. For paints of other colours for final and finishing two coats, suitable pigment shall be used as per instruction of the Engineer, to distinguish the first coat from the second coat.

7.6.7 The date of painting shall be marked with paint on the member.

7.7 **Cares during Painting**

7.7.1 Paint should be mixed in small quantities sufficient to be consumed within one hour in the case of red lead paint.

7.7.2 The applied coat of paint shall be uniform, and free from brush marks, sack marks, blemishes, scratching, non-uniform thickness, holes, log marks, fuel staining, cracking, scaling, and other defects.

- 7.7.3 Paint shall be applied only on dry and clean surface free from moisture or dust (including scrapping dust).
- 7.7.4 Paint should be used within the prescribed shelf life from the date of manufacture.
- 7.8 Each coat of paint shall be left dry till it sufficiently hardens before the subsequent coat is applied. Each coat of paint shall be inspected by the Engineer or inspecting officer and certified as satisfactory before applying subsequent coat.

7.9 **Payment**

The payment for complete painting of all components of girders including all accessories, painting of contact surface etc including all labour and material, is included in the accepted Lumpsum Price in the Price Schedule.

8.0 **ASSEMBLY & ERECTION**

8.1 **General**

- 8.1.1 The contractor shall provide at his own cost all tools, machinery, equipment and erection material, including all temporary works and shall assemble all components in every respect as stipulated in the contract and in accordance with approved drawings and specifications.
- 8.1.2 Before starting the work the contractor shall seek the Engineer's approval as to the method he proposes to follow and the type and suitability of equipment he proposes to use for assembly of girder components and launching of girder. The approval of the Engineer shall however not in any way relieve the contractor of the responsibility for the adequacy and safety of methods and/or equipment he proposes to use for carrying our work in full accordance with drawings and specifications.
- 8.1.3 All temporary works shall be properly designed and fabricated & erected with great care for the loads, which they will be called upon to support. Adequate allowance and provision for the effect of lateral forces and wind loads shall be made to meet unforeseen conditions.
- 8.1.4 When chains are used for lashing care must be taken to protect the edges of members from twisting and distortion, damage to paint and similar effects.
- 8.1.5 Temporary bracing shall be provided to take care of stresses caused by erection equipment or other incidental loads during erection.
- 8.1.6 The method use for lifting and slinging flexible members shall be brought to the notice of the Engineer and shall be subject to his approval.

8.1.7 The contractor shall observe sufficient accuracy in the assembly of every part of the work to ensure that all parts fit accurately together.

8.1.8 For erection of Open web Girder span, Appendix III of IRS B1- 2001 shall be followed. The launching of girders will be done very near to the existing bridge. Contractor shall take all necessary precautions for the safety of the substructure and superstructure of existing bridge, during assembling & launching works of the girders and nothing extra will be paid, owing to this. In addition, the contractor shall adopt all precautionary measures for safe plying of inland vessels, boats, crafts etc. and nothing extra will be paid, owing to this.

8.2 Procedure for Assembly in Workshop & Site

8.2.1 The contractor is required to undertake test assembly of the girders in his fabrication workshop to prove accuracy of templates and jigs. This assembly can be done in horizontal position. In case the fabrication workshop is set up by the contractor at bridge site itself the test assembly may be done at assembly platform and after testing of accuracy of jigs, fixtures & templates and the same assembly can be launched after riveting. The test assembly shall be certified by Inspecting agency of the Engineer.

8.2.2 Following procedure may be used by contractor subject to checking of design by contractor's consultant and final approval by the Engineer.

- i. The joints at the end of each top & bottom chord shall be drifted, bolted and preferably stitch riveted to their Geometrical outline.
- ii. The procedure during assembly shall consist of placing camber jacks in position to support the structure. The camber jacks shall be set such that they provide sufficient height to allow for lowering of panel points to obtain and maintain the required camber. Throughout the process of assembly, tilt, shift, twisting etc. shall be repeatedly checked. The jacks shall be spaced so that they will support the ends of the main girders and the panel points.
- iii. The bottom chord members shall then be placed on the camber jacks, carefully leveled and checked for straightness and the joints completed by riveting.
- iv. The vertical and diagonal web members, except the end verticals shall then be erected with gusset connection outward from centre in their proper position on the bottom chords. Temporary gussets with correct whole position as on master gusset shall be fixed to connect the top end of diagonals. Strainers shall be used to realize matching of holes in the gussets at top & bottom of the diagonals & verticals, to ensure that the angles between the members at the bottom joints are as given by the nominal outline of the girders. The verticals and diagonals shall then be riveted to the lower chord.
- v. All panel points, except the central one shall now be lowered by an amount sufficient to produce the correct camber on the main girders as shown on the camber diagram.

- vi. The top chord shall thereafter be erected piece by piece, working symmetrically outwards from the centre without loss of camber profile.
- vii. Temporary top gussets, if use, shall be replaced by permanent gussets outwards from the centre.
- viii. The ends posts shall be erected last. The upper end connection should preferably be made first and if there is not splicing in the end vertical, the final closure be made at the bottom connection. If there is splicing, it shall be made at the splicing.
- ix. Frequent checks shall be made of the camber of girders during erection and care taken that the correct camber is obtained when the camber is obtained when the girder is completely assembled.

8.3 Care during Assembly

8.3.1 Drilling & Drifting of Holes

8.3.2 Drilling of joints shall be avoided as far as possible and when necessary should be done with great care and under expert supervision. Hammers not exceeding 1kg (2 lb) in weight may be used with turned barrel drifts and a number of holes drifted simultaneously, the effect of drifting shall be checked by observation of adjacent unfilled hole.

8.3.3 Any apparent error in shop work which prevents the assembling and fitting of the mating parts by the proper use of drifts, shall be investigated immediately.

8.3.4 As all work is rigidly inspected at the fabrication shop before dispatch, these difficulties should not arise and the cause could possibly be due to the use of incorrect components. It is usually important that parts be correctly handed. Should errors still persist, the matter shall be immediately reported to the Engineer who will decide what action is to be taken.

8.3.5 **Reaming:** No reaming shall be undertaken without the written authority of Engineer or his authorized representative or Inspecting Officer except for under drilled holes meant for turned bolts. If approved by Engineer, the contractor shall supply at his own expense, special rivets as may be required. Records of all actions relative to the recourse to reaming and the use of oversize rivets shall be reported to the Engineer.

8.4 Service Bolts & Drifts

Joint shall normally be made by filling not less than 50 to 60 percent of the holes with service bolts and barrel drifts in the ration of four to one. The service bolts are to be fully tightened up as soon as the joint is assembled to secure full contact of the mating parts.

9.0 Inspection, Testing & Marking

- 9.1. All components shall be offered for inspection prior to painting. All approved components shall be stamped defect free, painted as per specifications prior to dispatch to bridge site.
- 9.2 On final finishing of each component, it shall be marked distinctly with paint with shipping mark for guidance, during assembly of component.
- 9.3 Stud shear connectors shall **conform to the standards specified in Clause 30 of this ' Additional Special Condition and Specification'** and the studs whose weld have failed the tests specified shall be replaced. All other aspects not stated above shall comply with IRS-BI-2001 and Welded Bridge Code.

9.4 Inspection of new Steel Bridge Girders

(a) Inspection of new Steel Bridge Girders including Composite Plate Girders for ROBs :

K-RIDE shall carry out inspection (including M&C) on its own by open line line/bridge organization or RDSO or may engage specialized third party like RITES, WRI or any other expert public sector undertaking e.g. CEIL etc. for fabrication inspection of girders to ensure the quality of fabrication.

- (b) **Inspection of Steel Bow String Girders for ROBs** : shall only be done by RDSO (both at workshop and site).
- (c) **Inspection of Non-standard Girders for ROBs:** shall be done by RDSO only.
- (d) The K-RIDE shall be responsible for nominating/selecting third party to ensure quality.
- (e) The various stages and corresponding Inspection/Approval agency for Rail & Rail-cum-Road

Bridge are as shown in Annexure-VII of BS 110 (R) are indicated below:

	(I) Prefabrication stage	Inspection/ Approval
	(1) Approval of Quality Assurance Plan (QAP) QAP is to be scrutinized and approved by the inspection agency.	K-RIDE/Railway/
	(2) Scrutiny of Welding Procedure Specifications Sheets (WPSS)	
	(3) Welders Qualification Test i.e. Welding Procedure Qualification Records (WPQR)	
	(4) Inspection and clearance of raw material	
	(5) Inspection of layout on template floor	

	(Nominal Camber)	RDSO / Third party engaged by Railway for inspection.
	(6) Inspection of jigs and fixtures with master plates	
	During Fabrication :	
	(1) Use of approved raw material	
	(2) Use of approved welding consumables	
	(3) Use of approved welders	
	(4) Use of approved welding procedures and parameters (WPDS) Welding Procedure Data Sheet to be maintained for all welds.	
	(5) Fabrication with approved set of jigs	
	After Fabrication :	
	(1) Inspection of welds	
	(2) Structural and dimensional inspection	
	(3) Trial assembly (First Girder)- Camber Values, Dimensions, Fairness of Holes by Go-No-Go Gauge, Butting of Flange in Top Chord.	
	(5) Inspection of Dismantled Components of 1st Trial Assembly – Check for elongation of Holes/Abnormal stress marks/cuts etc. & Removal of shortcomings noted during Trial Assembly.	
	(7) Inspect of only components for further spans- welding inspection & Dimensional checks.	
	(9) Metalizing/ Painting	

Note: During fabrication, internal inspection to be done by K-RIDE to ensure that only RDSO approved welders carry out welding as per approved WPSS, work is as per dimensional tolerances and other quality aspects and should satisfy itself before sending Inspection call to inspection agency for Trial Assembly or components Inspection.

10.0 Transports from Workshop & Stacking at Site

- 10.1 loading of various Components and parts of Girders shall be done at the fabrication workshop by the contractor. The contractor/s are required to take following precautions as well due care in the entire process of transportation including loading, carriage and unloading at work site etc.
- 10.1.1 It should be ensured that while loading of various girder components / parts, the heavier material are loaded first followed by lighter material on the top so as to avoid any damage

to lighter sections by heavy load or weight. All safety precaution is necessarily to be adhere- to as per extent instructions.

- 10.1.2 The contractor should provide all dunnage, rope and lashing in order to secure proper holding of material, for which no extra amount will be paid.
- 10.1.3 Proper wooden blocks, rubber pads shall be provided by the contractor/s so as to avoid direct contact of materials with trailer part which can cause damage to girder component.
- 10.1.4 All threaded ends and machine surfaces are to be efficiently protected against damage in transit.
- 10.1.5 Bolts, rivet, washer of different stages shall be separately packed in bag with label indicating its contents.
- 10.1.6 The payment will be made as per the relevant item of the works as per mode of payment specified in tender schedule after unloading and stacking the Girder components / parts at the site.
- 10.1.7 Utmost care should be taken during the transportation, loading / unloading etc. of the material viz. Girder components / parts. In case of any minor paint damage, proper patch painting should be done, according to relevant standard code, and for which no extra amount will be paid for any such rectification works.
- 10.1.8 The payment will be made as per the relevant item of the work in T/schedule after unloading and stacking at the site i.e. as per method of payment already prescribed in tender schedule.

10.2 INSURANCE:

- 10.2.1 Insurance:- Before commencing of works, it shall be obligatory for the contractor to obtain, at his own cost, insurance cover in the joint name of the contractor and employer from reputed companies under the following requirements:

10.2.2 Insurance against Injury to Persons and Damage to Property:

The Contractor, as insuring Party, shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except things insured under Sub-Clause 1.5.12 (b) [Insurance for Works and Contractor's Equipment]) or to any person / animal (except persons insured under Sub-Clause 1.5.12 (c) [Insurance for Contractor's Personnel]), which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

- 10.2.3 This insurance shall be for a limit per occurrence of not less than the Rs. 50 Lakh (Rs Fifty Lakh), with no limit on the number of occurrences. The insurances specified in this Sub-Clause: a. shall

be effected and maintained by the Contractor as insuring Party, b. shall be in the joint names of the Contractor and Employer, c. shall be extended to cover liability for all loss and damage to the Employer's property (except things insured under Sub-Clause 1.5.12 (b)) arising out of the Contractor's performance of the Contract

10.2.4 The insurance policy shall include a cross liability clause such that the insurance shall apply to the Employer, the Contractor and Subcontractors (wherever applicable) as separately insured.

10.2.5 The Employer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any Sub-Contractor (whether applicable), other than death or injury resulting from any act or default of the Employer, his agents or employees. The Contractor shall indemnify and keep indemnified the Employer against all such damages and compensation, other than those for which the Employer is liable as aforesaid, and against all claims, proceedings, damages, costs, charges and against all claims, proceedings, damages, costs, charges, and expenses whatsoever in respect thereof or in relation thereto.

10.2.7 **Insurance for Works and Contractor's Equipment:** The Contractor, as insuring Party, shall insure the Works, Plant, Materials and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit. This insurance shall be effective from the Date of Commencement, until the date of issue of the Taking-Over Certificate for the Works.

10.2.8 The Contractor shall maintain this insurance to provide cover until the date of issue of the Performance Certificate, for loss or damage for which the Contractor is liable arising from a cause occurring prior to the issue of the Taking-Over Certificate, and for loss or damage caused by the Contractor in the course of any other operations. The Contractor shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site plus 15% of replacement cost. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.

10.2.9 The insurances specified in this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties, who shall be jointly entitled to receive payments from the insurers, payments being held or allocated between the Parties for the sole purpose of rectifying the loss or damage,

(c) shall cover all loss and damage from any cause not listed as Employer's Risks,

(d) shall also cover loss or damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works, and loss or damage from the Employer's Risks, excluding (in each case) risks which are not insurable at commercially reasonable terms.

(e) may however exclude loss of, damage to, and reinstatement of:

- (i) a part of the Works which is in a defective condition due to a defect in its design, Materials or workmanship (but cover shall include any other parts which are lost or damaged as a direct result of this defective condition and not as described in subparagraph (ii) below),
- (ii) a part of the Works which is lost or damaged in order to reinstate any other part of the Works if this other part is in a defective condition due to a defect in its design, Materials or workmanship
- (iii) a part of the Works which has been taken over by the Employer, except to the extent that the Contractor is liable for the loss or damage.

10.2.10 **Insurance for Contractor's Personnel:** The Contractor shall effect and maintain insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel.

10.2.11 The Employer and the Engineer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.

10.2.12 The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.

10.2.13 **Automobile Liability Insurance**

The contractor shall effect and maintain an insurance covering use of all vehicle used by the contractor or its sub-contractors (whether or not owned by them) in connection with the design, construction, testing and commissioning of the facilities under the contract in accordance with statutory requirements.

10.2.14 **Professional Indemnity Insurance**

- (a) The Contractor shall provide evidence of professional indemnity insurance carried by its Designer for the Works. The professional indemnity insurance shall cover the risk of professional negligence in the design of the Works. This insurance shall be for a limit of not less than Rs. 50 Lakh and shall be maintained in full force and effect from the Commencement Date of the Works until 03 years after the date of completion of the Defect Notification period.
- (b) The Engineer will not issue any payment certificate until the Contractor has provided evidence of this insurance and its period of effectiveness. The contractor shall provide evidence to the

Employer / Engineer before commencement of work at site that the insurances required under the contract have been effected and shall within 60 days of the commencement date, provide the insurance policies to the Employer/Engineer, the contractor shall, whenever, called upon, produce to the engineer or his representative the evidence of payment of premiums paid by him to ensure that the policies indeed continue to be in force.

- (c) The Contractor shall also obtain any additional insurance cover as per the requirements of the Contract or Law of the Country.

The Employer/Engineer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or his subcontractor or petty contractor / other contractor working there. The Contractor shall indemnify and keep indemnified the employer / Engineer against all such damages and compensation for which the contractor is liable.

- (d) The Policies of the contractor shall remain in force throughout the period of execution of the works and till the expiry of the defect liability period except for any specific insurance covers necessary for shorter period.
- (e) If the Contractor fails to effect or keep in force or provide adequate cover as acceptable to the engineer in the insurance policies mentioned above, then in such cases, the engineer may effect and keep in force any such insurance or further insurance on behalf of the Contractor. The recovery shall be made at the rate of 1.5 times the premium/premiums paid by the engineer in this regard from the payment due to the Contractor or from the contractor's Performance security. However, the Contractor shall not be absolved from his responsibility and /or liability in this regard.

10.2.15 Accident:-(a) The contractor shall, in respect of all staff engaged by him or by his sub-contractor, indemnify and keep the employer at all times indemnified and protected against all claims made and liabilities incurred under Workman's Compensation Act, the Factories Act and the Payment of Wages Act, and rules made there under from time to time or under any other labour and Industrial Legislation made from time to time.

- (b) The contractor shall indemnify and keep the employer indemnified and harmless against all actions, suits, claim demands, costs, charges or expenses arising in connection with any death or injury sustained by any person or persons sustained due to the acts or omission of the contractor, his sub-contractors, his agents or his staff during the executions of this contract irrespective of whether such liability arises under the Workman's Compensation Act, or Fatal Accident Act or any other statute in force for the time being.
- (c) The contractor's liability to meet third party claims of the type outlined above will be applicable only in cases where accidents have been caused by workmanship, material, execution or negligence on the part of the contractor and further the liability of the contractor will be limited to Rs.50 lakh for any one accident without any limit on the number of accidents.

- (d) The contractor shall be responsible for all repairs and rectification of damages to completed works or works under execution due to DFCCIL accidents, thefts, pilferage or any other cause, without delay to minimize or to avoid traffic detentions, in a section until the installation are provisionally handed over to the employer.

11. **Assembly and Launching :**

- (i) After completion of fabrication, the girder components will be transported to the site and assembled on the specifically made assembly platform. Care must be taken by the contractor while transporting the materials to see that the parts at site are available in proper sequence.
- (ii) All girders will be launched using suitable capacity cranes.
- (iii) All temporary work shall be properly designed and substantial constructed for the loads which it will be called upon to support. Adequate allowance and provision of lateral forces and wind loads shall be made according to local conditions.
- (iv) Temporary bracing shall be provided to take care of stress from erection equipment or other loads carried during erection.
- (v) The blocks shall be arranged by K-RIDE. The contractor shall have to launch the girders within the block period.

11.1.1 **COMMENCEMENT OF THE ERECTION WORK AT SITE:** The contractor shall commence the erection work when and as soon as, but not until, he receives instructions from Engineer in-charge to do so. On such order being given, possession of site/authority shall be given to the contractor of such portion or portions of the site as the Engineer /Con may determine.

- (a) The assembling of components at site to required camber and grade along bridge axis, preceding additional temporary structures and accessories for launching of girders and all related matters shall be full responsibility of the contractor.
- (b) No pre-camber to be provided at the time of fabrication.
- (c) All members of the girder and joints are to be either riveted or welded or bolted with HSFG bolts as shown in the approved structural drawings. No welding except where approved by the Engineer is to be carried out at site. All welding and riveting are to be carried out as per relevant IRS Specifications.

11.1.2 The launching of girders shall be done as per approved drawings. For this purpose, the contractor shall submit in triplicate, detailed launching schemes of all the girders including design calculations, safety procedures and method statement with such plans, sketches and other details as may be necessary to determine the suitability and adequacy of the schemes proposed. The methods adopted shall not, under any circumstances, cause the stresses in

various members of girder spans to exceed permissible and safe limits at any stage of launching. One copy duly approved by the Engineer shall be returned to the contractor.

- 11.1.3 For the Engineer's use and record, the contractor shall supply free of charge, four sets of prints on strong paper and one set of neatly executed tracings on linen of approved detailed drawings for assembly and launching schemes for use at site.
- 11.1.4 The launching system & procedure shown on enclosed drawings are purely indicative of the method proposed for launching for which the permanent members of the girders are designed. The contractor shall provide full structural details of the temporary members and their connections to the girder, along with necessary design calculations not only justifying members sizes but also for the entire launching system adopted. Contractor shall provide full structural details of the temporary member and their connections to the girder, along with necessary design calculations not only justifying members sizes but also of the entire launching system adopted. Contractor will be responsible for getting approval of launching scheme submitted by him from the Engineer.
- 11.1.5 In order to ensure perfect fit of the temporary components, holes may be carefully drilled for the connecting members in between the girders in situ and T & F High tension grip bolts used.
- 11.1.6 The launching system shall be test tried if directed by the Engineer and no separate payment for this shall be made.
- 11.1.7 Nothing extra will be paid to the contractor for adopting any scheme for launching and the costs are to be covered in the relevant item in the Price Schedule. All temporary members shall be removed after launching and may be taken back by the contractor. Erection gussets provided for connecting the members may be cut and edges ground as required by the Engineer.

11.2 Temporary Strengthening

- 11.2.1 The launching arrangement may include fabrication of launching nose or restraining girders, sway restraining devices such as sway ropes, restraining cables etc. the supply and fixing of members for temporary strengthening of girder members to take care of erection stresses and strains and other relevant components for satisfactory and successful completion of the defined scope of work. Erection stresses must be kept within safe and permissible limits at every stage of erection.
- 11.2.2 The contractor has to make arrangements at his own cost for the steel for temporary arrangements including sway restraining devices for launching and temporary strengthening of girder, as may be required for the launching operations. The rate quoted should take into account these factors as nothing extra shall be paid.
- 11.2.3 Crane working:

- (a) The Contractor shall follow and comply with all prevailing Safety Rules of crane working, relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservation. In case of any conflict between statutory requirement and Safety Rules prescribed by the crane manufacturer, the former shall be binding on the Contractor unless the statutory provisions are more stringent.
- (b) Any loss or damage to property due to negligence of the crew employed by the contractor is attributable to the Contractor. K-RIDE shall not be responsible for any accident/injury to the Contractor's Crew/staff during operation or otherwise. Contractor has to assume full responsibility of the safety of their crew/staff and to comply with the prescribed security/safety regulations at site.
- (c) The contractor shall inspect the Site for space for crane working, it is the responsibility of the contractor to ensure that no existing structure is damaged. In case any structure like boundary wall, footpath etc. is damaged, it should be repaired by the contractor at his own cost to the satisfaction of the owner/K-RIDE.

Some issues that need to be addressed during the inspection/preplanning stage are:

1. The type of crane that can safely perform the lift;
 2. Access to the areas, staging areas, and the amount of space that is required to maneuver the equipment and materials;
 3. The proximity of overhead power lines near the work;
 4. A firm and adequate foundation for the crane;
 5. Proper use and extension of the outriggers;
 6. Guarding of the machine and all pinch points, especially the swing radius; and
 7. Congestion in the work areas.
- (d) The Contractor has to make their own arrangement for Accommodation, Transport and other amenities like Medical etc. for their crew/staff at Site at their own cost.
 - (e) All the statutory requirements as called for by the Labour Laws and other statutory authorities are to be met by contractor and proof of compliance should be made available to K-RIDE.
 - (f) Electrical Power/Illumination for Crane Operation/Maintenance works at Site shall be provided by the contractor at his own cost basis. However, the Crane should also have its own lights for movement/working in the working area at Site.
 - (g) The crane shall be operated by the certified trained operator only under the supervision of the qualified supervisor. The Contractor/crane supervisor shall ensure the cranes are set up and used properly on the construction site. He shall ensure right crane for the job, firm foundation, adequate clearances to handle the materials, guarding of moving parts, proper set up of the outriggers and basic crane operations such as two block, level, load charts, and

load moment. The operator/supervisor must calculate loads to ensure they do not exceed the limitations of the equipment and satisfy MRVC engineer before deploying and actually operating the crane.

11.3 Inspection and Rectification

- 11.3.1 During erection of girders, the contractor shall provide all facilities and permit the Engineer to inspect the field assembly, site riveting and erection of spans.
- 11.3.2 After inspection by the Engineer / Inspecting agency, the contractor shall identify cause of any defect, imperfection and/or fault noticed during such inspection and initiate corrective action as per the direction of the Engineer. All defects, imperfections or faults for which the contractor is liable under the contract, shall be made good by the contractor to Engineer's satisfaction and the cost of identifying and rectifying such defects, imperfection or faults shall be borne by the contractor.
- 11.3.3 A neat casting bearing the name of the contractor, the place and date of manufacture, the contact number and the standard of loading to be specified by the Engineer shall be bolted conspicuously on all girders. The drawing of the name plate shall be approved by the Engineer.

12.0 METHOD OF MEASUREMENT FOR PAYMENT

12.1 Measurement

- 12.1.1 For the purpose of payment, quoted Lumpsum Price apply to the weights of steel work calculated from final working drawings based on theoretical weights given in the producers hand books and using minimum square overall dimensions, no deductions being made for skew cuts, holes or notches. Each gusset shall be measured as equivalent to the dimension of the smallest enclosing rectangle. The wastage of steel in the form of skew cuts etc. shall be the property of the contractor.
- 12.1.2 The drawing office dispatch lists (D.O.D.Ls) when prepared according to procedure shall be submitted by the contractor to the Engineer for approval.
- 12.1.3 The payment for steel work as per item in the Price Schedule shall be released in stages as per Schedules and quantities executed, as mentioned in the tender schedule. The payment after receipt of material in fabrication shop shall be made on the basis of measurements contained in the suppliers vouchers, if required, these measurements shall be further verified by the representative of Engineer in charge by measuring dimensions/sizes of the sections and multiplying the same by standard weight. Sampling for actual weight of the sections shall also be done by him as per procedure and frequency prescribed by Engineer in charge.

13.0 CONTRACTOR(S) LIABILITY

- 13.1 Any fitting, accessory or apparatus which may not have been mentioned in this specification or the drawings, but which are usual or necessary in the execution of such work, are to be provided by the Contractor without extra payment. The whole work must be completed in all details, whether mentioned in this specification or not, with the exception of such work as has been specified in the schedule of items to be separately provided for in the Contract.
- 13.2 Notwithstanding the specifications and conditions stated in the contract, the contractor shall keep the Engineer/ Employer authority fully indemnified and free from all liabilities and risks consequential to any lapse on his part in respect of material quality, standard of workmanship, accuracy of fabrication and the like. He shall provide all labour and material required for execution of the work as per listed standards and in absence of any IRS & IS specifications.

14.0 Technical Organisation/tools, equipment and plants.

- (A) Contractor should have qualified and trained manpower suitable to do the work in terms of technical specifications and contract conditions.
- (B) Contractor should have suitable and adequate plants, machinery and equipments required to execute the work like:
- I. Cutting machine
 - II. Radial drilling machine.
 - III. Edge milling machine, end milling machines.
 - IV. Plate/structural steel straightening machine.
 - V. Pneumatic grinding machine, drilling machines, chipping machines and wrenches etc..
 - VI. Sand blasting equipment and metalizing equipments.
 - VII. Welding machines.
 - a. SAW
 - b. MIG/MAG
 - VIII. Welding transformers
 - IX. Cranes of adequate capacity.
 - X. Suitable digs and fixtures.
 - XI. To test the raw material and girders to conform to relevant specification, testing facilities, for the following should be available either in house or through outsourcing.
 - a. Elcometer for measurement of thickness of paints.
 - b. Steel measuring taps duly calibrated.
 - c. Ultrasonic flow detection testing facilities for checking internal flaws.
 - XII. Suitable Welding manipulator.
 - XIII. Macro etching/DP or MP testing facilities.
 - XIV. Tongue tester for measuring current and voltage.
 - XV. Gauges for checking weld size throat thickness and edge preparation etc..
 - XVI. All equipment must meet the requirements of corresponding IS, IRS or other international specifications.

- (C) Manpower: Adequate No. of trained qualified welders shall be available with the tenderer. The welder must be trained in accordance with the provision of IS: 817. They must be trained either from recognized welding institutes or by in house training, where proper training facilities exist. The welder must be tested as per requirements of IS: 7310 and proper records maintained.

List of equipments mentioned above is only indicated and not exhaustive. The firm shall be required to deploy all other machineries, tools & plants etc. required for successful completion of the work of fabrication, assembly and launching of the girders.

- 15.0** K-RIDE desires that successful tenderer should establish (at his own cost) the fabrication workshop near the site only for close monitoring of all the quality aspects of this contract work. Contractors request for establishing workshop/using workshop proposed/located away from the bridge site shall require prior approval.

- 16.0** Contractor shall establish fully equipped laboratory for all the tests required on materials/processes/products as per provisions of the contract, Specifications and the direction/approval of the Engineer. Costs of these are deemed to be included in the quoted Lumpsum Price. Prior approval of the engineer shall be obtained for non installation of such testing equipment which cannot be installed in normal course due to any reason. However, Engineer's decision (for installation non-installation) in this regard shall be final binding and conclusive.

17.0 SITE FACILITIES BY THE CONTRACTOR:

- 17.1. Contractor shall provide following office/site facilities at the bridge site/other locations for ensuring smooth and efficient communication and work execution. Cost of these facilities deemed to be included in the quoted Lumpsum Price and nothing extra shall be paid for this item.

- (i) Contractor shall supply round the clock electricity in site offices of K-RIDE located at the bridge during the entire contract work. Contractor shall also maintain the electric fittings/writings/plants of both the offices in the good condition.

- (ii) To provide proper communication the contractor shall (at his own cost) establish inter office communication system between K-RIDE offices, fabrication workshops and contractor's offices at site. Adequate number of intercom/ telephone/mobile sets or are similar suitable equipments as decided/approved by Engineer fully communicable shall be established in each of the above fabrication shops & at site of bridge work. The entire expenditure incidental to running and maintenance of above shall be borne by the contractor within quoted rates.

- (iii) Contractor shall (at his own cost) depute/nominate safety officers(s) for supervising safety aspects of all works/process including enabling arrangements for execution and inspection of the work. Safety systems/arrangements should be made for each activity of fabrication/erection and its inspection and same should be certified by nominated safety

officer. Special care/arrangements are required to be made for supervising the erection/launching process of such high girders and concreting in road deck: arrangements should facilitate satisfactory and fearless inspection of each activity of launching/erection.

18. Computerized Numerical Control(CNC)Machine:

A machine based on advanced technology in the fields of fabrication of steel members known as Computerized Numerical Control(CNC)Machine is preferably be used. By this machine, cutting, drilling can be done at required distance and in required patterns. This machine is guided by a computer programme and drawings of the joints and components to be fabricated are prepared in AUTOCAD and fed in the computer programme. This machine is capable of reading the drawings in 3D image and after giving command, this machine cuts the steel plates, angles, channels etc. in desired length and pattern duly measuring very accurately in parts of mm. Drilling of holes are also done at required pitch and pattern as per drawing and hence the use of Jigs are done away with; thus eliminating the human error in measuring and marking etc. and further to enhance production.

19. CONTRACTOR TO STUDY DRAWING & SPECIFICATION etc. and HIS LIABILITY:

The contractor shall be responsible for close scrutiny of the approved drawings supplied by the K-RIDE, For any discrepancies, error or omission in the drawings or other particulars indicated therein, the contractor shall approach the K-RIDE immediately for rectification of such discrepancies, errors and omission. If any dimension/figure/features etc. on approved drawings or plans differ from those drawings or plans issued to the tenderers at the time of calling the tender, the dimensions as figured upon the approved drawings or plans shall be taken as correct.

20. FURTHER DRAWING AND INSTRUCTIONS:

- (i) Engineer (Con) shall have full power to make and issue further drawings or instructions or direction from time to time as may appear necessary and proper to the contractor for efficient construction, completion and maintenance of the works. The contractor shall be bound by the same as fully as be if they had been mentioned or referred to in the contract, and the contractor shall not be entitled to any extra payment in respect of any work or materials shown or directed to be done supplied by such further drawings or instructions required for completion of unless the Engineer (Con) shall have given an extra order for the same in writing.
- (ii) The tenderer's rate should provide for cutting M. S. Plates for making out M. S. Flats from plates, in case M. S. Flats are not available, No extra payment for such cutting and rinding that may be necessary for converting M. S. Plates to Flats will be admissible.
- (iii) If the works are required to be done in by Rly. Yards and Tracks are to be crossed, the tenderer shall inspect the site and make himself thoroughly acquainted with site condition and quote proper rate including provision for making suitable facilities at site for the work.

- (iv) The work shall have to be done in such a manner that the normal working of the Railway within the railway yard does not get disturbed. Proper protection is not to be ensured by the contractor for allowing their labourers to cross the Railway lines with head-leads. No material/temporary structures should be kept adjacent to the running track within 3M from the centre line of track which may infringe rail traffic. The contractor shall take necessary precaution to prevent/cause damage to the Railway property & K-RIDE staff during the execution of the work.

21. CONTRACTOR TO SUBMIT HIS TIME TABLE:

The contractor shall submit a monthly progress of work done during the month by the 4th day of the following month. He will also give the programme of coming month by 25th of each month. The programme will be subject to alteration at the discretion of the K-RIDE officials.

22. ANY DOUBTED POINTS TO BE REFERRED TO THE Engineer/CN :

Should there be any doubt or obscurity as to anything to be done or not to be done by the contractor or as to these instructions or as to any matter or thing, the contractor must set forth such doubt or obscurity in writing and submit the same to Engineer (Con). Only such reply as the said Engineer (Con) may be in writing given shall be taken as the authoritative interpretation of the point in doubt or obscurity. Neither the Engineer nor any servant in the employ of the K-RIDE have or has any authority to make any representative or explanations to the contractor as to the meaning of the Form of contract. General Condition and specification, Lumpsum Price Shchedule, drawing or other documents or as to the conditions of the work or site or as to the works, or as to these instructions or as to any other matter or things.

23. LAND:

The K-RIDE Administration will at its discretion arrange free of cost land to the extent sparable for contractors office at sites, field work shop, stores, assembly and erection yard. Land required by the contractor for labour or staff colony or other purpose will have to be arranged by him at his own cost.

24. TRANSPORTATION AND HANDLING OF MATERIAL & PLANT:

The contractor shall be responsible to arrange at his own cost wagons (if required) for transportation of materials and stores (other than those which are being arranged by the K-RIDE) required for the works. The Railway / Client undertake no responsibility for delay in its supply. The contractor shall be responsible for all handling and timely loading and unloading as per Railway commercial rule for public.

25. Loading of Materials: Refer Clause 44.1 to 44.3 of IR Fabrication specification Serial BI-2001 issued by RDSO.

26. GUARANTEE AGAINST DEFECT:

- (a) The Contractor shall guarantee that all the works executed under this contract shall be free from all defects and faults in material, workmanship and manufacture and shall be of acceptable standards for the contracted work and in full conformity with the technical specifications, drawings and other contract stipulations, for a period of 24 months from the date of taking over by the Employer.
- (b) During the period of guarantee the Contractor shall keep available an experienced engineer /manpower to attend to any defective works / installations resulting from defective erection and/or defect in the installation supplied by the Contractor. This engineer shall not attend to rectification of defects which arise out of normal wear and tear and come within the purview of routine maintenance work. The contractor shall bear the cost of modifications, additions or substitutions that may be considered necessary due to faulty materials or workmanship for the satisfactory working of the equipment. The final decision shall rest with the Engineer his successor(s)/Nominee.
- (c) During the period of Guarantee the Contractor shall be liable for the replacement at site of any parts which may be found defective in the executed work whether such parts / structural elements of his own manufacture or those of his sub-contractor / supplier whether arising from faulty materials, workmanship or negligence in any manner on the part of the Contractor provided always that such defective parts as are not repairable at site are promptly returned to the Contractor if so required by him at his (Contractor's) own expenses. In case of parts of executed work detected during guarantee period, contractor should replace all such items irrespective of the fact whether all such items have failed or not. The Contractor shall bear the cost of repairs carried out on his behalf by the Employer at site. In such a case, the contractor shall be informed in advance of the works proposed to be carried out by the Employer.
- (d) If it becomes necessary for the Contractor to replace or renew any defective portion of the structural elements until the expiration of six month from the date of such replacement or renewal or until the end of the above mentioned period whichever is later. Such extension shall not apply in case of defects of a minor nature, the decision of the General Manager/ROB or CPM or his successor/nominee being final in the matter. If any defect be not remedied within a reasonable time during the aforesaid period the Employer may proceed to do work at the Contractor's risk and expense, but without prejudice to any other rights and remedies which the Employer may have against the Contractor in respect of such defects or faults.
- (e) The repaired or renewal parts structure shall be delivered / supplied and erected / executed on site free of charge to the employer.
- (f) Any materials, fittings, components or equipment / structure supplied under items for supplying / providing and fixing in schedule shall also be covered by the provisions of this paragraph. The liability of the Contractor under the guarantee will be limited to re-supply of components / structure installation and fittings.

27. INCLUSIVE PRICE:

- (i) The cost of all painting, temporary erection and testing at the Tenderer's workshop, Packing and delivery at the site of work as specified in the schedule, is to be included in the price quoted on the tender.
- (ii) Any fittings, accessories or apparatus which may not have been mentioned in the specification, but which are considered necessary for the execution of this work, are to be provided by the contractor without any extra payment. The work must be completed in all details.

28. Traffic Blocks / Power Blocks / Shut Down:

- 28.1. Railway / K-RIDE shall obtain Power / Traffic / Shut down as per the readiness and request of the contractor. Engineer/Engineer's representative will facilitate to make arrangements to obtain power blocks / shutdown (hereinafter referred to as blocks) for works to be carried out along or adjacent to the track work. Works such as foundations of abutments/piers shall generally be done without blocks. However if block is required due to safety considerations, the construction shall be done under block. The requirement of shut down, power blocks etc. shall be assessed by the contractor and will be submitted to the Engineer/Engineer's representative. All the erection of girders etc. shall be done under minimum power block/shut down. Contractor will arrange minimum two gangs of labours i.e. expert of TR line fitters, Semi-skilled fitters, labour, etc. with super visors and sufficient tools and tackles required as per site conditions. Work will be done day & night with war foot level with the approval of the Engineer/Engineer's representative. Block will be provided for each ROB individually.
- 28.2 Blocks will be granted during day & night hours continuous. The Contractor shall confirm that he will equip himself to carry out all construction during night blocks efficiently by suitable special lighting equipment without any extra cost.
- 28.3 Block period shall be counted from the time the TR-line is placed at the Contractors disposal at the work-spot till it is cleared by the Contractor.
- 28.4 Blocks will be subject to normal operating conditions and rules of the Railway. All formalities of exchanging private number etc. with the traffic control/traction power controller will be carried out by the Engineer staff and for this purpose the Engineer will depute a representative for each ROB, who will be responsible for imposing power blocks/shut down and also removing the same after men, material and equipment have been cleared by the Contractor from running tracks and the same declared safe for traffic by Engineer/Engineer's representative in case of works involving safety of running tracks.
- 28.5 The works required to be done under traffic block shall be carried out only in the presence of K-RIDE officials. The K-RIDE supervisor shall certify safe conditions for passage of trains before

resumption of traffic. The works to be done under traffic block shall be carried out under the provision of banner flag and protection of engineering flagman.

- 28.6 Any charges which may be levied by IR on account of "Possessions" shall be payable by the contractor but shall be reimbursed by the Employer. However penalties, if any, levied by Indian Railways caused due to any careless working or otherwise of violation of the Terms and Conditions of the track block, shall be payable by the contractor.

29. Declaration of designed fabrication/assembly yard as a part of site:

- 29.1. K-RIDE may issue necessary declaration on specific request of the contractor subject in the condition that the workshop area are earmarked exclusively for fabrication of girder components for this bridge with separate entry/exit arrangements. This is with further stipulation that such an arrangement should be acceptable to excise department by way of a no objection certificate. Necessary follow up with Excise Department will be solely the contractors responsibility. In the event of excise department not agreeing to such an arrangement, the contractor shall not have any claims whatsoever, and shall pay excise tax and other extant taxes as per extant rules within quoted Lumpsum Price and nothing extra would be payable to them on this account.

30. STUD SHEAR CONNECTOR:

In the case of Composite Girders wherein the steel structure of a bridge is fixed to the concrete structure of the deck so that the steel and concrete act together, so reducing deflections and increasing strength. This is done using 'shear connectors' fixed to the steel beams and then embedded in the concrete. Shear connectors can be welded on, perhaps using a 'stud welder', or better still on export work, by fixing nuts and bolts.

- 30.1 **Material:** The stud shear connector and ceramic ferrules shall conform to type SD1/UF as per BS EN ISO 13918-2008. The diameter of ceramic ferrule D 7 as per Figure 13/Table 18 of BS EN ISO 13918 shall be 26. Mechanical properties of stud shear connectors shall be as per ISO 6892/BS EN ISO 13918-2008. Shape of tip of stud shear connectors may be chosen by manufacturer. The stud tip shall be supplied with flux in the form of press fitted aluminum ball or Aluminum spray coating.
- 30.2 **Welding:** The welding of stud shear connectors shall be done by "Drawn arc stud welding with ceramic ferrule" Technique. The stud and the surface to which studs are welded shall be free from scale, moisture, rust and other foreign material. The stud base shall not be painted, galvanized or cadmium plated prior to welding. Welding shall not be carried out when temperature is below 10 degrees Celsius or surface is wet or during periods of strong winds unless the work and the welder are adequately protected. The welds shall be visually free from cracks and shall be capable of developing at least the nominal ultimate strength of studs. The procedural trial for welding the stud shall be carried out when specified by the Engineer.

30.3 Testing:-

- (a) Appearance test

1. The weld to a stud shear connector should form a complete collar around the shank and free from cracks, excessive splashes of weld material, free from injurious laps fins, seams, twist, bends or other injurious defects.
 2. Weld material should have a "Steel Blue" appearance.
- (b) Test to check the fixing of shear studs. All studs need to be checked by a ring test.
1. Ring Test: Involves striking the side of the head of the stud with a 2 kg hammer. A Ringing tone achieved after striking indicates good fusion whereas dull tone indicates a lack of fusion (BS 115).
 2. Bend Test: Test requires the head of a stud to be displaced laterally by approximate 25% of its height using a 6 kg hammer.
 - The weld should then be checked for signs of cracking or lack of fusion
 - Stud should not be bent back as this is likely to damage the weld
 - The testing rate should be 1 in 50 (BS 115).

30.4 **Measurements:** The work shall be enumerated. It's unit is "each".

30.5 Lumpsum Price :- The Lumpsum Price shall include the cost of material, labour, equipment, tools and plants, etc. complete required for all operations described above. The rate for Stud Shear Connected is not included in the respective item for girder fabrication, so separate payment for this item will be made.

31. SCHEDULE OF TECHNICAL REQUIREMENTS (STR) FOR FABRICATION OF STEEL GIRDERS. (Latest version to be followed)

A. Procedure for supply of steel girder:

1. For the steel girders of all bridges other than important bridges (as defined in IRS Sub Structure Code), the tendering firm shall be from RDSO approved list of firms for Steel Bridge Girders only further subject to the condition that the tendering firm fulfils other technical and financial eligibility criteria as prescribed by the K-RIDE in the tender and the steel girders to be manufactured by the tendering firm in RDSO approved premises only.
2. For Steel Girders of important bridges (as defined in IRS Sub Structure Code), besides RDSO approved firms, the tendering firm can also be other than RDSO approved firm for Steel Bridge Girders subject to the firm fulfilling technical and financial eligibility criteria as prescribed by the K-RIDE in the tender and the site fabrication workshop of the firm shall be set up at site of work which meet with the Schedule of Technical Requirement (STR) for Steel Bridge Girders issued by RDSO time to time. The approval of the site fabrication workshop meeting with the STR to be done by RDSO only and not by any other

organization. The existing system of approval by K-RIDE officer not below JA Grade is discontinued.

The tenderers besides satisfying similar work eligibility criteria and financial eligibility criteria have also to fulfill the following technical requirements.

B. The firm will ensure availability of

- i) The required infrastructure, machinery & plant.
- ii) Testing and measuring equipment duly calibrated.
- iii) Trained technical manpower and quality assurance programme.
- iv) Equipment meeting the requirements of relevant specifications.
- v) Space required for manufacturing, testing and storage viz. manufacturing floor, godown, store, office and test lab also.

C. General and Infrastructural Requirements for Steel Girders.

- i. The fabricator must have adequate organization including supervisors, skilled workers and adequate manpower to execute the fabrication work in competent manner.
- ii. A proper organization must exist to perform the functions of purchasing of various raw materials and consumables etc. and maintaining related inspection certificates, test certificates etc.
- iii. Previous experience of fabricating steel structures capable of withstanding dynamic loads such as bridge girders, microwave towers, heavy industrial steel structures etc. is essential.
- iv. A proper procedure for maintenance of records for receipt and consumption of raw material should be in vogue or developed so as to permit verification by K-RIDE representative.
- v. Adequate power supply should be available through distribution agencies and adequate backup shall be available through captive generation.
- vi. Covered pay area served by EOT cranes or by mechanically operated machines should be provided to handle day to day fabrication of girder components.
- vii. Enough area to store raw material, subassemblies and finished product should be available. The area provided should be enough to store raw material to execute the work order for requirement of steel. Suitable material handling facilities in form of EOT/mobile cranes should be available.
- viii. A separate line for inspection and testing of girders should be provided for final inspection and testing of bridge girders by K-RIDE inspecting engineers.

- ix. Covered shed area protected from rain, dust etc. should be provided for surface preparation/painting/metalizing of steel girders. As no part of the work shall be painted unless it has been finally passed and cleared by inspecting officer, adequate space for storing fabricated component awaiting painting shall be available.
- x. For full scale layout of drawings to which girders are to be manufactured, template shop with steel/concrete floor should be available. For symmetrical girders, central half of the layout may be done and for non-symmetrical girders full-length layout shall be required. Further, for development of jigs and fixtures this shop should have in – house jigs manufacturing facilities.
- xi. Sufficient space for trial erection of the girder after manufacture shall be available. For this purpose, proper handling equipment, stacking space and other facility shall be available.
- xii. An adequately equipped and staffed drawing office is required for preparation of fabrication drawings.

D. Machinery & Plants.

Following machinery and plants shall be available with the fabricator.

- (i) EOT/Portal/mobile crane of min.10t capacity or suitable material handling facility to serve the handling of material for fabrication of girders, unloading of raw material and loading of finished product.
- (ii) Compressors of adequate capacity suitable for riveting and for other simultaneous applications.
- (iii) Oxy – Acetylene gas cutting equipment.
 - a) Profile cutting equipment of adequate size.
 - b) Self-propelled straight cutting equipment preferably consisting of multiple torches.
- (iv) Radial drilling machines of adequate capacity to drill holes of 12 to 50 mm diameter.
- (v) End milling machine.
- (vi) Plate & structural sections straightening machine.
- (vii) Pneumatic/hydraulic yoke riveting machine.
- (viii) Adequate number of portable pneumatic tools such as grinders, drilling machines chipping machines, wrenches etc.
- (ix) Dumpy level or theodolite instrument for recording of camber/deflection of trial erected girder.
- (x) Facility for surface preparation/painting/metalizing as per IRS B-1 specification.

- (A) To test the raw material and girders to conform it for relevant specification, testing facilities for the following must be provided:
- a. Elcometer for measuring thickness of paint.
 - b. Steel measuring tape duly calibrated.
- (B) Following facilities for testing of material can be in house or may be arranged from external agencies:
- a. Equipment required for testing of mechanical properties, chemical composition and microstructure etc.
 - b. Ultrasonic flaw detection testing facilities for checking internal flaws and thickness of section.
- (xi) System of periodical maintenance of M& P must be in vogue and proper records maintained.

E. Quality Infrastructure.

- i. Fabricator shall have proper quality infrastructure to ensure the quality product as required under latest issue of IRS B1 specification and IRS Welded Bridge Code as applicable.
- ii. A system should be in force for analysis of defects noticed during internal and external inspections of the final product and sub-assemblies. A dynamic arrangement for a feed back to the source of defects and for rectification should be in vogue.
- iii. The fabricator should have adequate infrastructure and facilities like checking gauges, templates etc. during fabrication required from time to time so as to ensure that the finished product is as per requirement of IRS : B1 and Welded Bridge code.
- iv. Following specifications/codes commonly referred in connection with fabrication or riveted steel girders must be available with fabricator.

IRS B -1	Fabrication and erection of steel girder bridges
IRS	Steel bridge code
IS : 1148	Hot rolled steel rivet bars (up to 40 mm dia) for structural purpose.
IS: 1149	High tensile steel rivet bars for structural purpose
IS : 1852	Rolling and cutting tolerance for Hot Rolled Steel Products
IS : 2062	Hot rolled low, medium and high tensile structural steel.

The latest version of BIS Codes/Specifications referred herein including their amendments issued from time to time are to be followed:

- v. All equipment must meet the requirements of corresponding BIS or other international specifications.

F. Additional general and infrastructural requirements for fabrication of welded girders.

- i) The following facilities should be available for fabrication of welded girders.
 - a. Welding transformers/rectifier for Manual Metal Arc Welding(MMAW)
 - b. Inert gas (Carbon Dioxide) welding equipment sets.
 - c. Automatic sub – merged arc welding equipment.
 - d. Suitable welding manipulators.
 - e. Macro-etching/ Dye Penetrant or Magnetic Particle testing facilities.
 - f. Arrangement for radiographic test either in house or from external agency.
 - g. Tongue tester for measuring current and voltage.
 - h. Gauges for checking weld size, throat thickness and edge preparation etc.
- ii) Machine for edge preparation before welding.
- iii) Fabricators must ensure that welding and gas cutting equipment/accessories meet BIS or other international standard requirements. It will be fabricators responsibility to satisfy the inspecting engineer that all the welding equipment/accessories conform to the BIS standard or any other standard in the absence of proper marking on such equipment/accessories.
- iv) Only trained and qualified Welders shall be deployed for welding. The welders must be trained in accordance with the provisions of IS:817. They must be trained either from recognized welding institutes or by in – house training, if proper facilities exist. The welders must be treated as per requirements of IS: 7310 and proper records maintained.
- v) All welding shall be carried out under the overall supervision of a qualified welding supervisor who has been trained in ‘Welding Technology from any recognized welding institute.
- vi) Welding instructions shall be prominently displayed on the shop floor. Requirement of the job in hand must be clearly explained to the welder before he is permitted to work.
- vii) Following specifications/codes commonly referred in connection with fabrication of welded steel girders must be available with fabricator.

IRS WBC	IRS Welded Bridge Code
IS: 817	Code of practice for training and testing of metal arc welders.
IS : 818	Code of Practice for Safety and health requirements in electric and gas welding operations.
IS : 822	Code of Procedure for inspection of welds
IS : 4353	Recommendations for sub-merged arc welding of mild steel and low alloy steels.
IS : 7307 (Pt.I)	Approval tests for welding procedure.
IS : 7310 (Pt.I)	Approval tests for welders working to approved welding procedure – fusion welding of steel.
IS : 9595	Recommendations for metal arc welding of carbon and carbon manganese steel.

The latest version of BIS Code/Specifications referred herein including their amendments issued from time to time are to be followed. Wherever to the standards mentioned above appears in the specification it shall be taken as a reference to the latest version of the standa.

SECTION- S.02 C**SPECIFICATIONS****SPECIAL CONDITIONS & SPECIFICATION FOR BOX PUSHING TECHNIQUE****1. SUBMISSION OF PRELIMINARY DESIGN ALONG WITH TENDER:**

The Tenderer/Contractor shall submit along with his tender a preliminary design and a sketch showing the details of RCC box of required inside dimensions to be cast and pushed below the formation by jacking technique, size of thrust bed required along with the other works associated with thrust bed, methodology of pushing the RCC Box by Jacking Technique and other important details and features proposed, along with the tender documents to check the general adequacy of the section proposed and also to evaluate his offer along with other tenderers, without which the offer is liable for rejection.

The successful Tenderer shall be required to submit in triplicate detailed calculations and drawings of the RCC Box by Jacking/Pushing Technique to the Engineer-in-Charge who will have the same scrutinized/ checked. Comments on the design/drawing will be advised to the Contractor who shall there upon submit suitably corrected calculations/drawings for scrutiny and approval. Thereafter the Contractor shall supply to the Railway/K-RIDE free of charge one set of neatly executed approved drawing in reproduction film along with five sets of prints on strong paper done by an approved process and three neat copies of the calculations as finally accepted and approved.

Any further changes if still required due to site conditions shall also be done with the approval of Engineer-in- Charge. However the ultimate responsibility of the safety of the design shall rest with the Tenderer/Contractor.

The Contractor shall also engage one consulting Engineer who shall be well conversant and have adequate field experience in executing the RCC Box by Jacking/Pushing Technique (in addition to the overseer/Engineer mentioned in the relevant clause above) at his own cost and who will be responsible for RCC Box by Jacking/Pushing Technique work.

2. BOX PUSHING WORK:**SUBMISSION OF DETAILED DESIGN AND DRAWINGS FOR APPROVAL**

After award of the tender the contractor shall submit the detailed design calculations in 3 copies along with the drawings for Railway/K-RIDE Administration approval within a period of 30 days after issue of the acceptance letter.

It shall be responsibility of the tenderer/s to ensure continued attendance and assistance of design Engineer's representative and get the design and drawings approved by the GM/ K-RIDE/ Bangalore.

After the approval of designs and drawings by Railways/K-RIDE, the contractor is required to submit 6 copies of approved design, the original being typed on electronic typewriting machine on bond paper, the report being bound suitably. The final design report shall be comprehensive giving all the detailed design calculations, brief theory for the basis of design etc. as directed by Engineer-in-charge. The tenderer/s shall also submit 8 (eight) copies of approved detail drawings including one reproducible (tracing) media to the full drawing sheet size 71 x 66 cm as well as 4 sets of drawings reduced to (A4) size using the standard reduction procedures.

3. DESIGN AND DRAWINGS FOR TEMPORARY ARRANGEMENTS

The successful tenderer is also required to submit a detailed drawing showing the method of construction and temporary arrangements he proposes to make for allowing the Rail traffic above during the construction of Road Under Bridge. He shall be required to give detailed design, calculation for stresses and displacements etc, at various construction stages. These shall also be got approved from Railways/ K-RIDE and shall form part of the report as above. Nothing extra is payable for above and the cost of the same shall be deemed to have been included in the Lumpsum Price quoted for the various items of works.

The design and drawings after approval shall be the property of the Railway and Railway / K-RIDE shall have exclusive right to use and reuse it else-where. The contractor shall have no claim whatsoever in this regard.

In case computer programmes are used for analysis and design of the bridge structure, the same shall be used so as to give a format of output as would be for manual calculations. Copy of the computer programme shall be supplied. In such cases design calculations shall be validated by a sample manual calculation to the satisfaction of the GM/K-RIDE/Bangalore. Otherwise the entire calculations shall have to be carried out by detailed manual calculations.

The tenderer shall specially note that while every effort shall be made to approve the design and drawings expeditiously, no claim shall be entertained on account of delays in approval of design and drawings for whatsoever reasons.

Railway/K-RIDE may decide to get the detailed design checked by any independent agency or at Research Designs and Standards organization, Lucknow of Ministry of Railway. The contractor shall ensure the regular presence and assistance of the consultants for the checking of the designs by the above agencies in their offices.

The item for construction of one RCC box by box pushing technique:-

The following works would form part of this item as per the approved General arrangement drawings.

Procurement/fabrication of necessary plant and equipment like - jacking line jacks, pumps and other plants and equipment required for execution of this work.

Earthwork in excavation for thrust bed and box pushing, including shoring / sheet piling or any other arrangement to the satisfaction of Railway / K-RIDE required to protect the earth slopes / adjoining structures and disposal of the excavated earth as per the direction of Engineer-in-charge.

Casting of thrust bed as per contractor's design duly approved by the Railway / K-RIDE.

Drag sheet shall be provided by the contractor to minimize the friction and disturbance of the soil supporting the track during box pushing operations. Max. number of drag sheets as directed by Engineer-in-charge shall be provided based on actual requirement at site. All arrangements required in connection with drag sheet shall be provided free of cost and nothing extra will be paid. The contractor will be at liberty to utilize modern methods, of reducing skin friction etc as approved by the Engineer-in-charge.

Necessary provision of opening in the roof of boxes for benetonite pumping if required during the pushing operations.

Manufacturing and fabrication of the front end frame/cutting shield and intermediate jacking stations etc.

Pre-casting and curing of RCC box units including fixing of front and frame/cutting shield, with all fabricated work should be done in casting yard.

Jacking of precast boxes to form the opening under running railway traffic conditions. The maximum allowable deviation of the precast boxes at any time from the theoretical alignment will be limited to 200mm horizontal and 100mm in vertical direction. Box pushing work shall be done only in day-light hours and in the presence of K-RIDE supervisor. The contractor will further ensure the rate of box pushing such that it will not disturb the Railway tracks above and will be personally responsible for the safety of Railway traffic. However maintenance of track if any required during box pushing operations will have to be done by contractor at no extra cost. The number of man power required as decided by Engineer-in-charge will have to be arranged by the contractor. Further the provision of Engineering indicators required for imposing caution order including caution watchman also will have to be supplied by contractor at no extra cost.

Grouting of gaps with suitable material, having adequate structural strength at intermediate jacking stations after completion of pushing so that no leakage occur from the joints at intermediate jacking station during the service of the bridge.

Provision of M:30 PCC wearing coat on the floor of the box with design camber. Provision longitudinal drainage arrangements within the RCC boxes on either side of the box as approved by the Railway/K-RIDE.

Construction of footpaths, wheel guards boxes and parapet wall as per design to be submitted by the Tenderer for approval of the K-RIDE.

Electrical Fittings: Concealed conduit pipe shall be left on either side of the box during casting for laying of electrical cables/wires in it. Contractor shall provide 30 points for fittings lamps including provision for junction boxes. The scheme shall be got approved by the Department before construction of RCC box.

During the execution of work if any sub-soil water is met with, the contractor will make their own arrangements to bail out/pump out such water from the site, free of cost. Any un-foreseen accumulated rain water, during the progress of work, shall be bailed out/pumped out by the contractor free of cost and the Lumpsum Price quoted should include all these elements.

4. GENERAL RESPONSIBILITY OF CONTRACTOR:

Contractor shall be responsible for all the damages caused to the property, by his labour, public or animals caused during the execution of the work by him and shall indemnify the K-RIDE for such damages it is finally taken over by the Railways. He will be liable to be called upon to make good the damage or loss which may occur during such execution.

5. RCC BOX BY JACKING/PUSHING TECHNIQUE:

The rate to be quoted for the RCC BOX by JACKING/PUSHING TECHNIQUE shall be inclusive of cost of labour and materials (including ordinary portland cement Grade 43/Grade 53 and MS/Tor Steel for Reinforcement), design and drawings as stated elsewhere. The rate quoted shall also be inclusive of all fares and charges of materials (either by road or rail), plant, equipment, Octroi, toll, taxes and other levies, royalties and patent rights, incidental charges etc. and must be consolidated one for all items of work. The Tenderer shall quote in the tender a lumpsum amount for which he will undertake to do the whole work as above and subject to the conditions of contract.

1. STAGE PAYMENT FOR RCC BOX BY JACKING/PUSHING TECHNIQUE: TERMS OF PAYMENT

- (1) On completion of thrust bed, payment equivalent to 10% of the contract value of box pushing item.
- (2) On completion of casting of box for the complete length payment equivalent to 30% of the contract value of box pushing item will be payable.

However, prograssive payments can be made for the length of the box cast which will be payable as per the following formula:

$$\text{Payment due :} \left\{ \begin{array}{l} \text{(length of the box cast)} \\ \text{\{ (Total length of box for jacking/pushing) x 30\% of the} \\ \text{\{ } \} \text{ contract} \\ \text{value for} \\ \text{box pushing} \\ \text{item} \end{array} \right.$$

- (3) On completion of jacking/pushing of 50% of contract RCC box to the full length value for box pushing item

However progressive payment can be made for the length of box and jacked / pushed based on the formula below

Payment due=(Length of the RCC box jacked/pushed) x 50% of the
(total length of the RCC box jacked/pushed contract value
for box pushing item

- (4) The remaining 10% shall be paid after completion of finishing items for the correct corresponding alignment and level.

K-RIDE

SECTION- 03
STRUCTURAL CONCRETE

SECTION- S.03**3. STRUCTURAL CONCRETE: PLAIN, REINFORCED & PRESTRESSED**

These specifications shall be read in conjunction with the IRS Concrete Bridge Code, IS 456, MORTH and CPWD specifications 2013/2009 with correction slips / amendments upto date, and other relevant specifications described in the Section 1 of these Specifications.

3.1 Materials

Before bringing to the site, all materials for concrete including their source shall be approved by the Engineer. All approved samples shall be deposited in the office of the Engineer before placing orders for the materials with suppliers. The materials brought on to the works shall conform in every respect to the approved samples.

Fresh samples shall be deposited with Engineer whenever type or source of any material changes. The contractor shall check fresh consignment of materials as it is brought on to the works to ensure that they conform to the specifications and/or approved samples.

The Engineer shall have the option to have any of the materials tested at any time to find out whether they are in accordance with specifications at the contractor's expense. All bills vouchers and test certificates which in the opinion of the Engineer are necessary to convince him as to the quality of materials or their suitability shall be produced for his inspection when required.

If fly ash is used in concrete, the contractor shall demonstrate the quality control procedure including source of fly ash, its properties, handling as per the relevant IS & international codes etc. and shall use in slabs and walls only after "no objection" to the same has been obtained from the Engineer.

Any material which has not been found to conform to the specifications and not approved by the Engineer shall be rejected forthwith and shall be removed from the site by the contractor at his own cost within the time stipulated by the Engineer. In the event of contractor not being able to arrange the material conforming to specifications or in the event of failure of the contractor to get the sources approved within the agreed schedule submitted by contractor, the Engineer shall have the powers to cause the Contractors to purchase and use such materials from any particular source, as may, in the Engineer's opinion, be necessary for the proper execution of work. Nothing extra shall be payable to the contractor on this account.

Contractor shall also ensure that all constituents of exposed concrete shall be taken from same sources to achieve a uniform color and texture.

3.1.1 Cement

3.1.1.1 The cement used shall be of the following types:

43 grade Ordinary Portland Cement conforming to IS:-8112 for RCC & PCC works.

53 grade Ordinary Portland Cement conforming to IS: 12269 for RCC & PSC works.

IRST-40 Indian Railway standard specifications for special grade cement for use in concrete sleepers

For piling and foundation work, type of cement shall be as mentioned in section S-08 on Pile Foundations herein.

'Cement' means Ordinary Portland Cement conforming to IS 269 or slag cement conforming to IS 455 excluding mineral admixture/ additions as mentioned in para 5.2 of IS 456.

3.1.1.2 Whenever possible all cements of each type shall be obtained from one constant source throughout the contract. Cement of different types shall not be mixed together. Different brands of cement, or the same brand of cement from different sources, shall not be used without prior approval of the Engineer.

3.1.1.3 Packaged cement shall be delivered to the site in original sealed bags which shall be labeled with the weight, name of manufacturer, brand, date of Manufacture and type. Cement received in tor bags shall not be used. Cement shall be used in the order in which it is received. Cement in bags in storage for more than 3 months shall be retested before use. A sample taken once for every 1000 bags shall be tested.

Contractor may obtain cement in bulk and store it in suitable silos of adequate capacity. Each type of cement shall be stored in a separate silo and it shall be ensured, that cements of different quality are not mixed up.

3.1.1.4 All cement shall be fresh when delivered and at ambient atmospheric temperature.

3.1.1.5 In fair faced elements, the cement used in the concrete for any complete element shall be from a single consignment. All cement for exposed concrete shall be from the same approved source and uniform in colour.

3.1.1.6 With each and every delivery of cement consignment, the contractor shall provide manufacturer's certificate that the cement conforms to the relevant Indian standard. The contractor shall provide complete facilities at site for carrying out the following tests:

- (a) Setting time by Vicat's apparatus as per IS: 4031 and IS: 5513.
- (b) Compressive strength of cement as per IS: 4031, IS: 650, IS: 10080.

3.1.1.7 Total chloride content in cement shall in no case exceed 0.05 percent by mass of cement. Also, total sulphur content calculated as sulphuric anhydride (SO₃), shall in no case exceed 2.5 percent and 3.0 percent when tri-calcium aluminate per cent by mass is upto 5% or greater than 5% respectively.

3.1.2 Aggregates

Aggregates from natural sources shall be in accordance with IS: 383. The contractor shall submit to the Engineer certificates of grading and compliance for all consignments of aggregate. In addition, at site from time to time, the contractor shall allow for carrying out such tests and for supplying test records to the Engineer. The aggregates shall be procured from approved sources only as directed by the Engineer from time to time.

For fair faced concrete, the contractor shall ensure that aggregates are free from iron pyrites and impurities, which may cause discoloration. Aggregates shall be stored on paved areas in different compartments according to their nominal size.

3.1.2.1 Fine Aggregates

The contractor shall provide complete facilities at site for determining grading of aggregates by sieves as per IS: 383, IS: 460, IS: 1607, and IS: 2386. The fine aggregate shall be river sand pit sand, stone dust or other approved sand. It shall be free from clay, loam, earth or vegetable matter, salt or other harmful chemical impurities.

It shall be clean, sharp, strong, angular and composed of hard siliceous material. If considered by the Engineer as necessary, the sand shall be washed in screw type mechanical washers in potable water to remove silt, clay and chlorides. This shall be done at least one day before using it in concrete. The washed sand shall be stored on a sloping concrete platform and in such a manner as to avoid contamination. Such sand washing, storing, etc. shall be at the Contractor's cost. The grading of fine aggregate when determined as described in IS: 2386 (part I), shall be within the grading zones I, II, III.

Water absorption shall be less than 3% by weight (ASTM C 117)

The contractor shall provide complete facilities at site for carrying out the following tests:

- A) Proportion of clay, silt and fine dust by sedimentation method as per IS:2386 part II.
- B) Moisture content in fine aggregate as per IS: 2386 Part III.
- C) Bulk density/ Bulkage

3.1.2.2 Coarse Aggregates

The coarse aggregate shall be crushed stone. Coarse aggregate obtained from crushed or broken stone shall be angular, hard, strong, dense, non-porous, durable, clean and free from soft, friable, thin plate, elongated or flaky pieces and any deleterious material.

River gravel or pit gravel shall be sound, hard, clean, non porous, suitably graded in size with or without broken fragments and free from flat particles of shale, clay, silt, loam, and other impurities

Except where it can be shown to the satisfaction of the Engineer that a supply of properly graded aggregates of uniform quality can be maintained over the said period of the works, the grading of aggregates shall be controlled by obtaining the coarse aggregates in different sizes and blending them in correct proportions as and when required.

All coarse aggregates shall conform to IS: 383 and tests for conformity shall be carried out as per IS: 2386, Parts I to VIII.

The maximum size of coarse aggregates shall be such that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of formwork. Unless otherwise permitted by the Engineer the nominal maximum size shall not exceed 20 mm.

Water absorption shall be less than 3% by weight (ASTM C 117)

3.1.2.3 Chloride Content

The chloride content of aggregates shall be within the recommended limits stated in IS: 383 or BS 882 and the chloride content of the concrete mix shall be within the recommended limit of IS: 456 or BS 8110. Chloride levels shall be determined daily in accordance with the methods described in BS 812.

3.1.2.4 Alkali-Silica Reactivity

If aggregates contain any materials which are reactive with alkalis in any of the constituents of the concrete, or in water which will be in contact with the finished work, then the Contractor shall take samples of these materials every week. The Contractor shall ensure that the concrete mix complies with the requirements of this Specification regarding "Minimising risk of alkali-silica reaction in concrete", vide clause 3.4. The results of the Contractor's weekly monitoring tests shall be submitted in writing to the Engineer.

3.1.2.5 Sulphate Content

The total acid soluble sulphate content of the concrete mix, expressed as SO₃, shall not exceed the recommended limit in IS: 456 or BS 8110.

3.1.3 Water

Water used in the works shall be potable water and free from deleterious materials. Water used for mixing and curing concrete as well as for cooling and/or washing aggregate shall be fresh, clean and free from injurious amounts of oil, salts, acids, alkali, other chemicals and organic matter.

Water shall be from the source approved by the Engineer and shall be in accordance with clause 5.4 of IS: 456 However, chloride content in water shall not exceed 500 mg/liter.

Before starting any concreting work and wherever the source of water changes, the water shall be tested in accordance with IS: 3025 for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the Engineer. No water shall be used until tested and found satisfactory. Cost of all such Tests shall be borne by the contractor.

3.2 Blending of Aggregates

In order to obtain optimum workability, individual aggregates of nominal size 20 mm, 10 mm, 4.75 mm and 2.36 mm will be blended in such a way that the grading curve for all in aggregates will be a smooth curve from size 0.15 mm to 20 mm falling within the established envelope grading curve. Contractor shall establish envelope grading curve for each grade of concrete for given maximum size of aggregates and get it approved by Engineer before finalizing the mix design.

3.3 Admixtures

- 3.3.1 Chemical admixtures are not to be used until permitted by the Engineer. In case their use is permitted, the type, quantity/dosage and method of use of any admixture proposed by the Contractor shall be submitted to the Engineer for approval. The minimum cement content specified shall not be reduced on account of the use of the Admixtures.
- 3.3.2 The contractor shall further provide the following information concerning each admixture to the Engineer.
- a. Normal dosage and detrimental effects if any of under dosage and over dosage.
 - b. The chemical names of the main ingredients in the admixtures.
 - c. The chloride content, if any, expressed as a percentage by weight of admixture.
 - d. Whether or not the admixture leads to the entrainment of air when used in the manufacturer's recommended dosage.
 - e. Where two or more admixtures are proposed to be used in any one mix, the manufacturer's written confirmation of their compatibility
- 3.3.3 In reinforced concrete works, the chloride content of any admixture used shall not exceed 2 percent by weight of the admixture as determined in accordance with IS:6925 and the total chloride and sulphate contents in concrete mix shall not exceed 0.15 and 4.0 percent respectively by weight of cement.
- 3.3.4 The admixtures when used shall conform to IS:9103. The suitability of all admixtures shall be verified by trial mixes.
- 3.3.5 The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.
- 3.3.6 Retarding admixtures when used shall be based on ligneous-Phonates with due consideration to clause 5.2 and 5.3 of IS: 7861.

- 3.3.7 Fibre reinforcement will be Propex (Fibermesh 300-e3 / Fibermesh 150-e3) or equivalent make polypropylene fibres, shall be added to ready-mixed concrete wherever the material is to be used for parapet, box girder. Bar reinforcement is still considered primary reinforcement. Under normal condition, add to the ready-mix at the plant in the quantity recommended by the manufacturer subjected to the approval of engineer-in-charge. If job conditions warrant, fiber reinforcement may be added at the jobsite provided that fibers are evenly distributed mix.
- 3.3.8 Micro silica (Silica fume) when used as mineral admixture in to concrete shall be conforming to ASTM C 1240 latest standards, silica fume shall comply with requirements given in IS:15388, IS :456-2000, IRS-CBC to establish specified strengths, durability and to meet special design objectives.
- 3.3.9 Flyash according to IS:456 conforming to grade I of IS:381 may be used as part replacement provided uniform blending with cement is ensured.

3.4 Minimising the Risk of Alkali-Silica Reaction (ASR) in Concrete

1. Precautions against ASR in Concrete

Concrete mixes for use in the Permanent Works shall comply with one of the Subsections 2, 3 or 4. The Contractor shall notify the Engineer of his proposals for complying with this requirement.

2. The cementitious material shall have a reactive alkali content not exceeding a maximum value of 0.6% by mass when defined and tested as specified.

To combat the ASR, Microsilica shall be used in minimum 5% cement and shall not exceed 10% by the wt of cement in order to bind free alkalis early in plastic concrete and to reduce the permeability of concrete to prevent the moisture and external alkalis penetration.

OR

3. The total mass of reactive alkali in the concrete mix shall not exceed 3.0 kg/m³ of concrete when defined, tested and calculated as specified.

OR

4. The aggregate shall be classed as non-reactive in accordance with the definition in Subsection 14.

5. Cementitious Material (Hydraulic and Latent Hydraulic Binders):

6. The term alkali refers to the alkali metals sodium and potassium expressed as their oxides. The reactive alkali content of Portland cements shall be defined as the percentage by mass of equivalent sodium oxide (Na₂O) calculated from:-

% equivalent Na₂O = % acid soluble Na₂O + 0.658 x (% acid soluble K₂O)

7. The method used in determining the acid soluble alkali content of the materials shall be in accordance with BS 4550: Part 2: Subsection 16.2.
8. The Contractor shall make available the certified average acid soluble alkali content of Portland cement on a weekly basis.
9. The Contractor shall give immediate notice of any change which may increase the certified average acid soluble alkali content above the level used in the mix design for the concrete. A revised mix design for any concrete which would be affected by the increased alkali content shall be submitted for consent with notification of the change.
10. Minimising the Risk by Using Cementitious material containing less than 0.6% Reactive Alkali. The requirements of Subsection 2 will be met by Subsection 11 provided that the contribution of alkalis from other sources does not exceed 0.2 kg/m³ (see Subsections 14 and 21). Where alkalis exceed 0.2 kg/m³ the requirements of Subsections 12 to 15 shall apply.
11. The cementitious material shall be Portland cement complying with Indian Standard and shall have additionally a certified maximum acid soluble alkali content not exceeding 0.6%.

The Contractor shall provide on request weekly certificates which name the source of the cement and confirm compliance with the Specification.

12. Minimising the Risk by Limiting the Reactive Alkali Content of the Concrete to 3.0 kg/m³. The requirements of Subsection 3 will be met provided that Subsections 13, 14 and 15 are satisfied.
13. The reactive alkali content of the concrete contributed by the Portland cement to the concrete shall be calculated from:

Portland cement

$$A = \frac{C \times a}{100}$$

Where,

A = reactive alkali content of the concrete to the nearest 0.1 (kg/m³)

C = target mean Portland cement content of the concrete (kg/m³)

a = certified average acid soluble alkali content of the Portland cement (%).

14. Where reactive alkalis in excess of 0.2kg/m³ are contributed to the concrete from sources other than the cementitious material the limit of 3.0 kg/m³ from the cementitious material shall be reduced by the total amount so contributed.

The reactive alkali contributed by sodium chloride contamination of aggregates shall be calculated from:

$$H = 0.76 \times \{(NF \times MF) + (NC \times MC)\} \text{ (kg/m}^3\text{)}$$

Where H = equivalent alkali contribution made to the concrete by the sodium chloride
 NF = chloride ion content of the fine aggregate as a percentage by mass of dry aggregates and measured according to BS 812: Part 4

MF = fine aggregate content (kg/m³)

NC = chloride ion content of the coarse aggregate as a percentage by mass of dry aggregate and measured according to BS 812: Part 4: 1976 (now in draft as Part 117)

MC = coarse aggregate content (kg/m³).

The factor 0.76 is obtained from a consideration of the composition of sea water.

The chloride ion content of aggregate sources containing 0.01% of chloride ion by mass or more shall be determined weekly in accordance with BS 812 or another approved method. When the chloride ion level is less than 0.01% it shall be regarded as nil.

15. The Contractor shall provide certificates on request confirming compliance with the Specification and stating:

- (a) The target mean cementitious material content of the concrete.
- (b) The names of the works manufacturing the cement.
- (c) A weekly report of the cement alkali determinations in accordance with Subsection 6.
- (d) The certified average acid soluble alkali content of the Portland cement.

16. Minimising the Risk by Using Selected Aggregates

Fine and coarse aggregate material shall comply with the requirements of IS:383 (and/or AASHTO Standard Specifications M6 and M80 respectively) to be taken out to conform to 512(2).

17. Water

Water for use in the manufacture of concrete shall be obtained from a public utility undertaking supply or from a source approved by Engineer and shall be of potable quality, and comply with the requirement of IS:456 and or BS 3148.

18. Where a potable mains supply is not available the Contractor shall obtain confirmation of the quality and reliability of the proposed source from the appropriate water authority and shall thereafter seek consent from the Engineer to use the proposed source.

19. Water other than from a public utility undertaking supply shall be sampled at a frequency to be determined by the Engineer and tested in accordance with the relevant provisions of IS:3025 or BS 3148. The sodium oxide and potassium oxide content shall be declared and expressed as equivalent Na₂O and shall be taken into account when calculating the total reactive alkali content of the concrete mix.

20. Admixtures and Pigments

Admixtures and pigments shall comply with the requirements of IS 9103 and IS:6925 or BS 5075 and BS 1014. The manufacturer's declared equivalent acid soluble alkali content and the dosage rate of any admixture or pigment to be incorporated shall be included with details of all concrete mixes submitted for consent.

21. The alkali content of admixtures shall be taken into account when determining the total equivalent alkali content of the concrete mix.
22. Microsilica (silica fume) shall be used in 5% by the weight of cement and shall not exceed 15% by the weight of cement.

3.5 Batching Plants, Mixers and Vibrators

- 3.5.1 Unless otherwise specified in the schedule of items, for all structural concreting work the Contractor shall provide automatic weigh-batching plant of suitable capacity. The plant used shall conform to IS: 4925.
- 3.5.2 The Contractor shall provide Concrete mixers (IS: 1791 – Batch type concrete mixers, IS:2438 - Roller Pan Mixer) and Vibrators (IS:2505 - Concrete Vibrators Immersion Type, IS:2506 - Screed board concrete vibrators supplied by recognized manufacturers.

3.6 Grade of Concrete

The concrete is designated as follows:

Concrete M 25 / 20

The letter M refers to the mix

The number 25 represents the characteristic compressive strength of 15cm cubes at 28 days in MPa (Mega Pascal's: 1 MPa: 10 kg/cm² approximately). M25 concrete thus has a characteristic strength of 250 kg/cm². Other mix design will also be denoted in same way.

The number 20 represents the nominal size of the coarse aggregates in mm.

3.7 Mix Design

It is the complete responsibility of the Contractor to design the concrete mixes by approved standard methods as per IS 10262 and to produce the required concrete conforming to the specifications and the strength, workability requirements approved by the Engineer.

Mix Design once approved must not be altered without prior approval of Engineer. However, should the contractor anticipate any change in quality and/or change in source of future supply of materials than that used for preliminary mix design, he should inform the Engineer quite in advance and bring fresh samples sufficiently in advance, to carry out fresh trial mixes. Design mix will indicate by means of graphs and curves etc., the extent of variation in the grading of aggregates which can be allowed.

Notwithstanding to the stipulations in any code, limits of Cement content, Water/Cement ratio & mineral admixture shall be followed as per the Table 3.7.1.

Table 3.7.1 Limits of Water/ Cement ratio, Cement content & mineral admixtures in concrete mixes

S I. N o.	Description of Structural items/ elements	Applica ble code	Grade of Concr ete	Max. W/C ration	Min. cement content (kg/m ³)	Type/ Grade of Cement	Use of mineral admixture
Track supporting structure	PCC works	IRS CBC	M20	0.50	240	OPC 43 or OPC 53 grade conforming to IS:269	Not permitted.
	Pile	IS 2911 (Part 1 Sec 2)	RCC M35	Slump 150mm to 180mm	400	Slag Cement conforming to IS 455 or site blending OPC53+GGBS	In case slag cement not used, GGBS is permitted to be used for part replacement of OPC to max. 50% by weight.
	Pile cap/ footing/ raft foundation	IRS CBC	RCC M35	0.45	340	OPC 53 grade conforming to IS 12269	Permitted to use micro silica/ silica fumes or Flyash as per IS 456 over and above minimum cement content as per mix design requirement.
	Pier and pier cap		RCC M50	0.45	340		
	Slab & beams		RCC M50	0.45	340		
	Superstructure and PSC pier arms etc..		PSC M55	0.40	400	OPC 53 grade conforming to IS 12269	Not permitted
Other than track supporting structures	PCC works	IS 456 & IS 2911 Part 1 Sec 2	M20	0.50	240	OPC 43(IS8112) or OPC 53 grade conforming to IS:12269	Not permitted.
	Pile		RCC M35	Slump 150mm to 180mm	400	Slag Cement conforming to IS 455 or site blending	In case slag cement not used, GGBS is permitted to be used for part replacement

S I. N o.	Description of Structural items/ elements	Applica ble code	Grade of Concr ete	Max. W/C ration	Min. cement content (kg/m ³)	Type/ Grade of Cement	Use of mineral admixture
	Pile cap/ footing/ raft foundation/ underground structures	IS 456	RCC M35	0.45	340	OPC53+GGBS	of OPC to max. 50% by weight.
	RCC Columns		M35	0.45	340	OPC 53 grade conforming to IS:12269	Permitted to use micro silica/ silica fumes or Flyash as per IS 456 over and above minimum cement content as per mix design requirement.
	Slabs & beams		M35	0.45	340		

Maximum cementitious content in a mix which includes cement and mineral admixtures shall not exceed 500 Kg/m³. Where ever code/standards permits, the micro silica, flyash and GGBS shall be allowed.

Limits of Water and Cement Contents

Maximum water/cement ratio

- a) For RCC members including piles - 0.40
- b) For PSC members - 0.40

3.8 Cement Content

Ordinary portland cement (OPC) of 53 grade conforming to IS: 12269 shall be used. For pre-stressed concrete, cement conforming to codal specifications for OPC 53 grade cement shall be used.

As regards trial mixes, acceptance criteria, acceptance specification, lot size, sampling and testing and sampling size for piling work, PSC girders (cast-in-situ and precast post tensioned) and general work, the requirement of the relevant codes, standards and directions of the Engineer shall be followed.

3.9 Additional Tests for Concrete

As frequently as the Engineer may require, additional tests shall be carried out of concrete in addition to mandatory test specified in MORTH Specifications-2013(fifth revision), CPWD specifications -2009 and relevant IS Code.

3.9.1 Permeability test for Concrete:

The concrete will be verified for permeability by the following procedure and shall confirm to IS:3085-1965 - 'Permeability of Cement Mortar & Concrete'. Section 1716.5 of MORTH Specifications and DIN 1048.

1. The Engineer shall select random batches of concrete for examination at his discretion and sampling will generally be done at the point of discharge from the mixer and at placing point.
2. From the batches thus selected two concrete cylinders shall be made in accordance DIN 1048.
3. At least two cylinders shall be made on each day's concreting until 60 cylinders have been made for each grade of concrete. The cylinders will be tested as per the procedure, given in Clause 5 next.
4. All cylinders shall be made, cured, stored, transported and tested in accordance with clause 1716.5 of MORTH Specifications. The tests shall be carried out in a laboratory having NABL certification.
5. Test Procedure

The permeability of concrete will be verified by the following procedure:

- (i) Prepare a cylindrical test specimen 150 mm dia and 160mm high.
- (ii) After 28 days of curing, test specimen will be fitted in a machine such that the specimen can be placed in water under pressure up to 7 bars. The typical machine shall be similar to one shown in Appendix 1700/II of MORTH.
- (iii) At first a pressure of one bar is applied for 48 hours, followed by 3 bars for 24 hours and 7 bars for next 24 hours.
- (iv) After the passage of the above period, the specimen is taken out and split in the middle by compression applied on two round bars on opposite sides above and below.
- (v) The water penetration in the broken core is measured with scale and the depth of penetration assessed in mm (max permissible limit 25 mm).

6. Acceptability Criteria

The concrete shall pass the permeability test if it is properly compacted and is not considered permeable when tested as per DIN, and the water penetration in the broken core is less than 25mm as tested above.

No extra payment shall be made for this test and cost of the same should be included in the quoted rate for concrete work.

3.10 Batching of Concrete Ingredients

Unless permitted by the Engineer, all concreting shall be produced in computerized automatic weigh batching plant having printing facilities to print out records of each batch and installed at site. Under exceptional circumstances Ready Mixed Concrete (RMC) manufactured in computerized automatic weigh batching plant (as per specifications described above) by the approved agencies using the constituent materials from approved sources and approved mix design may also be used with prior approval from Engineer. Nothing extra shall be paid for such RMC used in the work including transportation, placing in position etc. However, in such cases the RMC production & transportation will have to be directly supervised by the qualified personnel of the contractor. (Contractor has to setup his own batching plant(s). RMC from market will be permitted only in exceptional circumstances and to be decided by the Engineer.)

3.11 Placing Temperatures

During extreme hot or cold weather, the concreting shall be done as per procedures set out in IS:7861, Parts I & II.

In hot weather with temperature exceeding 40 degree C, the stock piles of fine and coarse aggregates for concreting shall be kept shaded from direct rays of sun and the concrete aggregates sprinkled with water for a sufficient time before concreting in order to ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching equipment shall be also shaded and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as low as possible in warm weather and care shall be taken to protect freshly placed concrete from overheating by sunlight in the first few hours of its laying. The time of day selected for concreting shall also be chosen so as to minimise placing temperatures. In case of concreting in exceptionally hot weather the Engineer may in his discretion specify the use of ice either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case, the Contractor shall not be paid extra for cost of ice, additional labour involved in weighing and mixing etc. All salt and saw dust shall be removed from ice before use. Quality of water used for making ice shall confirm to IS: 456.

3.12 Transporting, Placing, Compacting and Curing

Transporting, placing, compacting and curing of concrete shall be in accordance with IS: 456.

3.12.1 Transporting

The mix after discharging from the mixer shall be transported by transit mixers, buckets, pumps etc. or as approved by the engineer without causing segregation and loss of cement slurry and without altering its desired properties with regard to water cement ratio, slump, air content, cohesion and homogeneity. It should be ensured that the concrete is moved to its final destination before it attains an initial set.

The transportation is to be done by agitating transit mixers, pumps or other approved methods.

3.12.2 **Placing:**

(i) Placing General

Concrete shall be placed in the position and sequence indicated on the Drawings, or as directed. Placing shall not be commenced until the fixing and condition of reinforcement and items to be embedded and the condition of the containing surfaces or formwork has been approved. 24 hours written notification shall be given of the intention to place concrete.

Concrete shall be transported by means which prevent contamination (by dust, rain etc.) segregation or loss of ingredients, and shall be transported and placed without delay.

Concrete shall be placed directly in its final position without segregation or displacement of the reinforcement, embedded items and formwork. Concrete shall not be placed in water, except as specified. Concrete shall not be dropped through a height greater than 1.5 metres.

(ii) Extent of Pours

The limit of individual pours and the height of lifts shall be as approved.

For walls, the length of panel placed at one time shall not exceed 6m; adjacent panels shall not be placed within 2 days, but shall be placed as soon as practicable thereafter. Subsequent vertical lifts shall not be poured within 2 days.

For piers and pier heads, portal columns the concreting is to be carried out in single stage i.e. in first stage concreting will be from kicker to just below pier head bottom and second stage of concreting will be pier head including shear key and cross girder (in station zone stages as given in drawings for all heights by using tremie/ pumps at the rate not more than 1.5m / hr or as approved by the Engineer.

Floors, roofs and ground slabs shall be placed in a sequence of pours to the approval of the Designer and the consent of the Engineer's Representative.

If the use of slip-forms or paving trains is permitted, these limits may be revised. The sequence of pours shall be arranged to minimise thermal and shrinkage strains.

(iii) Placing Equipment

Concrete shall generally be placed without segregation by pumping or bottom-opening skips. If chutes are used their slopes shall not cause segregation and spouts or baffles shall be provided.

(iv) Time for Placing

Concrete and mortar must be placed and compacted within 30 minutes of water being added to the mix or otherwise included via damp aggregates, unless admixtures are in use. Partially-set concrete shall not be used in the Works.

(v) Continuity of Placing

Placing in each section of work shall be continuous between construction joints. The Contractor shall make provision for standby equipment. If the placing of concrete is delayed due to breakdown then the Contractor shall erect vertical stop-ends and form a construction joint or remove the concrete already placed and restart after repair of the breakdown, as directed.

(vi) Placing in Inclement Weather

Placing shall not take place in the open during storms or heavy rains. If such conditions are likely to occur the Contractor shall provide protection for the materials, plant and formwork so that work may proceed. If strong winds are prevalent protection from driving rain and dust shall be provided.

(vii) Placing in High Temperature and Low Temperature

The temperature of concrete shall not exceed 32° nor below 5°C or the temperature stated in the table of Mixes whichever is the lower at the time of placing concrete. Also the maximum concrete temperature after placing shall not exceed temperature 50°C or 30°C above the concrete temperature at the time of placing whichever is the lower.

"Concrete in hot countries" published by FIP congress at New Delhi 1986 shall be complied with. The procedures the Contractor wishes to employ shall be subject to the Engineer consent

The Contractor shall supply suitable maximum/minimum thermometers and record the shade and sun temperatures at locations where concrete is being placed. Recommendations for cold weather concrete can be had from IS: 7861 (Part 2).

(viii) Placing at Night

If consent has been given for placing at night or in dark interiors, adequate lighting shall be provided where mixing, transportation and placing are in progress.

(ix) Placing Under Water

Underwater concrete shall be placed with minimum disturbance of the water. Running water and wave wash shall be controlled. The specified concrete grade shall be used and the mix design shall provide for good flowing ability.

Tremie pipes, bottom-dump skips or other approved placing equipment shall be used. Segregation shall be avoided.

Placing shall be commenced in approved sections and continued to completion.

The tremie pipe shall be buried in the concrete for at least 1.5m and the pipe must not be emptied until the pour is complete. If a bottom-dump skip is used, the contents shall be covered by canvas or similar before lowering into the water. The doors shall be opened when the skip is resting on the bottom with no tension in the support cable, and the skip shall be lifted gradually so that the concrete flows out steadily.

(x) Preparation Before Placing

Before placing concrete for reinforced work on the ground, the formation shall be compacted as specified and a screed of blinding concrete shall be applied to form a surface for construction.

Before placing concrete on or against rock, masonry, brickwork or old concrete, loose material shall be removed and the surface washed down; water seepage shall be stopped or channelled away from the work.

For mass concrete placed against masonry or brickwork the following shall apply:-

- a. The mortar joints in the facework shall have fully hardened.
- b. The water-cement ratio of the concrete shall be increased to compensate for the absorption of moisture by the existing work.
- c. The surface shall be soaked prior to placing.
- d. The concrete shall be worked around ties and bond stones and into open joints.

3.12.3 Compaction

Internal (needle) and surface (screed board) vibrators of approved make shall be used for compaction of concrete.

Internal vibrators shall be used for compaction of concrete in foundations, columns, buttresses arch section, slabs etc, and if required surface vibrators shall also be used. Depending on the thickness of layer to be compacted, 25 mm, 40 mm, 60 mm and 75 mm dia. internal vibrators will be used. The concrete shall be compacted by use of appropriate diameter vibrator by holding the vibrator in position until:

- i. Air bubbles cease to come to surface.

- ii. Resumption of steady frequency of vibrator after the initial short period of drop in the frequency, when the vibrator is first inserted.
- iii. The tone of the vibrated concrete becomes uniform.
- iv. Flattened, glistening surface, with coarse aggregates particles blended into it appears on the surface.
- v. Use of curing compounds may be permitted with specific approval of Engineer
- vi. After the compaction is completed, the vibrator should be withdrawn slowly from the concrete so that concrete can flow in to the space previously occupied by the vibrator. To avoid segregation during vibration the vibrator shall not be dragged through the concrete nor used to spread the concrete. The vibrator shall be made to penetrate, into the layer of fresh concrete below if any for a depth of about 150 mm. The vibrator shall be made to operate at a regular pattern of spacing. The effective radii of action will overlap approximately half a radius to ensure complete compaction.
- vii. To secure even and dense surfaces free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.
- viii. A sufficient number of standby vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.
- ix. Form vibrators whenever used shall be clamped to the sides of formwork and shall not be fixed more than 450 mm above the base of the new formwork and concrete shall be filled not higher than 230mm above the vibrator. The formwork must be made specially strong and watertight where this type of vibrator is used.
- x. Care must be taken to guard against over vibration especially where the workability of the concrete mix is high since this will encourage segregation of the concrete.
- xi. Plain concrete in foundations shall be placed in direct contact with the bottom of the excavation, the concrete being deposited in such a manner as not to be mixed with the earth. Plain concrete also shall be vibrated to achieve full compaction.
- xii. Concrete placed below the ground shall be protected from falling earth during and after placing. Concrete placed on ground containing deleterious substances shall be kept free from contact with such ground and with water draining there from during placing and for a period of seven days or as otherwise instructed thereafter. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, abrasion, vibrations, deleterious ground water, mixing with earth or other materials, and other influences that may impair the strength and durability of the concrete.

3.12.4 **Field Control**

Sampling at both, truck discharge and point of final placement shall be employed to determine the quality of concrete.

3.12.5 **Curing**

Curing of concrete shall be complete and continuous using potable water free from chlorides and sulphates water that is free of harmful amounts of deleterious materials that may attach, stain or discolor the concrete as per IS 456. Minimum wet curing will be for seven days by ponding water followed by moist curing by spraying water which shall be maintained up to a total period of at-least 14 days from the date of casting.

Immediately after compaction and completion of any surface finishes the concrete shall be protected from the evaporation of moisture by means of polythene sheathing, wet hessian or other material kept soaked by spraying. As soon as the concrete has attained a degree of hardening sufficient to withstand surface damage moist curing shall be implemented and maintained for a period of at least 15 days after casting.

- i. Method of curing and their duration shall be such that the concrete will have satisfactory durability and strength and members will suffer a minimum distortion, be free from excessive efflorescence and will not cause undue cracking in the works by shrinkage.
- ii. Steam curing with approved methodology can be adopted if required, for precast components. No extra payment will be made for adopting steam curing. Before concrete products are subjected to any accelerated method of curing, the cement to be used shall be tested in accordance with accepted standards (relevant IS codes) especially for soundness, setting time and suitability for steam curing. In the case of elements manufactured by accelerated curing methods, concrete admixtures to reduce the water content may be allowed to be as permitted by applicable codes of practice subject to the approval of the Engineer. The normal aeration agents used to increase the workability of concrete shall not be allowed. The steam curing of concrete products shall take place under hoods, under chambers or in tunnels. Use of insulated tarpaulin may be permitted. The steam shall have a uniform quality throughout the length of the member. The precast elements shall be stacked with sufficient clearance between each other and the bounding enclosure, so as to allow proper circulation of steam. The surrounding walls, the top cover and the floor of steam curing chamber or tunnel or hood shall be so designed as not to allow more than 1 kcal/m²/h/ deg C. The inside face of the steam curing chamber, tunnel or hood shall have a damp-proof layer to maintain the humidity of steam. Moreover, proper slope shall be given to the floor and the roof to allow the condensed water to be easily drained away. At first, when steam is let into the curing chambers, the air inside shall be allowed to go out through openings provided in the hoods or side walls

which shall be closed soon after moist steam is seen jetting out. Preferably, steam should be let in at the top of the chamber through perforated pipelines to allow uniform entry of steam throughout the chamber. In no case shall steam impinge directly on concrete products. The fresh concrete in the moulds shall be allowed to get the initial set before allowing the concrete to come into contact with steam. The regular heating up of fresh concrete product from 20 °C to 35 °C shall start only after a waiting period ranging from 2 to 5 hours depending on the setting time of cement used. The second stage in steam curing process shall be to heat up the concrete elements, moulds and the surroundings in the chamber. The airspace around the member shall be heated up to a temperature of 75°C to 80°C at a gradual rate, not faster than 30° per hour. This process shall continue 1 1/2 to 2 1/2 hours depending upon the outside temperature. The third stage of steam curing shall be to maintain the uniform temperature and pressure for a duration depending upon thickness of the section. This may vary from 3 to 5 1/2 hours. The fourth stage of steam curing shall be the gradual cooling down of concrete products and surroundings in the chamber and normalization of the pressure to bring it at par with the outside air. The maximum cooling rate, which is dependent on the thickness of the member, shall not exceed 30° per hour. In all these cases, the difference between the temperature of the concrete product and the outside temperature shall not be more than 60°C for concrete up to M 30 and 75°C for concrete greater than M 45. In the case of light weight concrete, the difference in temperature shall not be more than 60°C for concrete less than M 25. For concrete greater than M 50, the temperature differences may go up to 75°C. After the steam curing is completed, the elements shall be further water cured for about 3 to 7 days

- iii. Curing Compound shall be used with prior approval of Engineer. Clear, water based, non toxic, non film forming, reactive silicate treatment with indefinite shelf life suitable as complete replacement to any water curing procedures such as water soak ponding, blankets and plastic sheets for all horizontal and vertical surfaces. Manufacturer shall supply written proof of completed, successful projects for upto 30 years. After completion of curing process, there should not be an requirement of removal or special preparation for surface applied adhesives flooring, coatings, patching, concrete stains, etc. Curing compound should have been successfully tested by CRRRI as a replacement for water curing an accredited by IRC also. Material test result should be in compliance with ASTM C 309 and ASTM 1315". No curing compound is allowed for segmental box superstructure.
- iv. Water curing with sprinkler arrangement to be adopted for precast elements at Casting yard.

3.13 Joints

I. Construction Joints

Construction joints shall be located and the sequence of placing arranged as approved, to minimise shrinkage and thermal strains in the concrete.

Concrete placing shall not be interrupted except where joints occur, and shall continue after normal hours if necessary to achieve this.

Joints shall be formed square to the work with keyways included.

Before placing is resumed at a joint the set surface shall be roughened to remove laitance and expose the aggregate; the aggregate shall not be damaged. If damaging materials have come into contact with the surface of the joint the concrete shall be cut back and the roughened surface cleaned by compressed air or water jets and brushed and watered immediately before placing. If required the surface shall be coated with a layer of stiff cement-grout prior to placing the new concrete.

Chemical surface-retarders shall not be used.

Construction joints shall be sealed with an approved sealant at external and liquid-contact faces.

Construction joints in water-retaining structures shall incorporate an approved waterstop with approved methodology.

II. Expansion and Movement Joints

Expansion, contraction and other movement joints shall be incorporated in the works as shown on the Drawings.

Where shown on the Drawings approved, expansion joint fillers shall be supplied and installed. Filler material shall be stored flat on a dry surface adequately protected from rain or moisture in such a way that the material does not deteriorate. Filler material which has been damaged or has started to deteriorate shall not be incorporated in the works.

Movement joints shall be sealed with an approved sealant applied in strict accordance with the manufacturer's instructions to the dimensions shown on the Drawings. The surface of the concrete to which the sealant is to adhere shall be straight and cleaned of all filler material, dirt, oil, grease and other matter. The sealant shall be applied by methods recommended by the manufacturer so that the sealant is brought flush to the surface of structure and a smooth surface is achieved. Excess material and spillage shall be properly cleaned off and removed.

Dowel bars shall be installed and cast in across the movement joint where shown on the Drawings. The bars shall be straight with clean cut ends of the diameters and lengths as shown on the Drawings or in the Schedules. Cutting and cleaning of the dowel bars shall comply with the requirements of this Specification.

The bars shall be firmly supported in the positions shown on the Drawings so that they remain accurately parallel and are not displaced during the casting of the concrete in the first part of the structure. After the concrete has hardened and the formwork removed, the projecting ends shall be

cleaned of all concrete spillage and painted with two coats of an approved bituminous paint and caps shall be fitted to the free ends of the bars. Dowel bar end caps shall be of cardboard or other material, of correct diameter for the dowel bar and of sufficient length to allow the specified movement of the two adjacent concrete structures. They shall be manufactured expressly for this purpose by an approved manufacturer.

The Contractor shall take care to protect the projecting ends of dowel bars from bending or other damage prior to concreting the succeeding bay. The bituminous paint shall be applied as soon as practicable, but end caps shall not be fitted until immediately prior to the succeeding concreting operations.

III. Water-stops

The layout and installation of the water-stops shall be in accordance with the manufacturer's recommendation and shall be subject to the approval of Designer and consent of Engineer.

IV. Bolts, Inserts and Openings

All fixing blocks, brackets, built in bolts, holes, chases, etc., shall be accurately set out and formed and carefully sealed prior to the concrete being placed. No cutting away of concrete for any of these items shall be done without the permission of the Engineer.

Bolts and other inserts to be cast into the concrete shall be securely fixed to the formwork in such a way that they are not displaced during the concreting operations, and that there is no loss of materials from the wet concrete through holes in the formwork.

Unless shown otherwise on the Drawings or the Engineer has given consent reinforcement shall be locally moved so that the minimum specified cover is maintained at the locations of inserts, holes, chases, etc

Temporary plugs shall be removed and the threads of cast in bolts shall be proved to be free and shall be greased before handing over any part of the Works. Construction joints in all concrete work shall be made as directed by the Engineer. Where vertical joints are required, these shall be shuttered as directed and not allowed to take the natural slope of the concrete.

3.14 Cracks

If cracks, which in the opinion of the Engineer may be detrimental to the strength construction, develop in concrete construction, the Contractor at his own expense shall test the structure as specified in "Loading Tests" of these Specifications.

If under such test loads the cracks develop further, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto.

External Shrinkage crack width shall be restricted to 0.25mm on all viaduct structures and 0.30 mm on Station structures. If it is more than the above and in the opinion of Engineer may be detrimental

to concrete construction, the contractor should test and make good the structure at his own expense with prior approval.

3.15 Defective Concrete

Should any concrete be found honeycombed or in any way defective, such concrete shall be rectified as per approved methodology by the contractor at his expense. If Engineer feels that repaired structure will not be having same strength or shape or uniformity with other exposed surface as original desired structure / original structure, the same shall be rejected by Engineer and required to be dismantled and disposed off by contractor at his own cost, as instructed by Engineer. Decision of the Engineer shall be final binding in this regard.

3.16 Exposed Faces, Holes and Fixtures

On no account shall concrete surfaces be patched or covered up or damaged concrete rectified or replaced until the Engineer or his representative has inspected the works and issued written instructions for rectification. Failure to observe this procedure will render that portion of the works liable to rejection.

Holes for foundation or other bolts or for any other purposes shall be moulded and steel angles, holdfasts or other fixtures shall be embedded, according to the drawing or as instructed by the Engineer.

3.17 Finishes

Unless otherwise instructed, the face of exposed concrete placed against formwork shall be rubbed down immediately on removal of the formwork to remove irregularities. The face of concrete for which formwork is not provided other than slabs shall be smoothed with a float to give a finish equal to that of the rubbed down face, where formwork is provided. The top face of a slab which is not intended to be covered with other materials shall be leveled and floated to a smooth finish at the levels or falls shown on the drawings or as directed. The floating shall be done so as not to bring an excess of mortar to the surface of the concrete. The top face of a slab intended to be surfaced with other material shall be left with a spaded finish. Faces of concrete intended to be plastered shall be roughened by approved means to form of a key.

3.18 Concrete for Flooring on Grade

Concrete for flooring on grade shall be placed in alternate bays not exceeding more than 4 m x 4m or as specified in the drawings including forming the joints or adjacent bays. The stiff mix shall be thoroughly vibrated and finished to receive the floor finish.

3.19 Grouting of Base Plates & Bolt Holes

3.19.1 Mixing

Dry grout should be mixed in a mechanical mixer: the conventional 200/400-litre capacity concrete mixer can be used to mix four bags of dry grout; alternatively, paddle type mortar mixers can be used. The quantity of grout to be mixed at one time should not exceed that amount which can be placed in approximately 10 to 15 minutes.

3.19.2 Batching

Batching of grout by fraction of a bag is not allowed. The quantity of mixing water should be the minimum commensurate with workability, compaction, and filling of the grout in all corners and crevices. Mixing should be done for a minimum of three minutes to obtain a fluid grout of uniform consistency.

3.19.3 Cleaning and preparation of the surface

The base concrete should be clean and strong, and its surface should be properly hacked; all dust should be removed by suction or compressed air. The surface should be thoroughly wetted with water for several hours. Before the grout is poured, all free water should be removed and the flat surfaces coated with a thin cement slurry.

3.19.4 Restraint

Heavy back-up blocks of timber or concrete should be fixed on all sides of the base plate to prevent escape of the grout, when poured through the openings provided in the base plate. Adequate restraint must be ensured on all the sides for a period of 7 days to obtain effective expansion and shrinkage compensation.

3.19.5 Curing

The grout should not dry out where external restraint is provided in the form of form-work, the top opening and all stray openings should be covered with wet sack for at least 7 days.

3.19.6 Placing and Compaction

The grout should be placed quickly and continuously either through the holes in the base plates or from one side only to ensure complete filling without entrapment of air. Grout should be properly spread and compacted by rodding. Excessive vibration should be avoided.

Below the bed plates, the grout should be compacted using long pieces of doubled-over flexible steel strapping or chains. The forward and backward movement of the strap or chain will assist in

the flow of the grout into place. Steps must be taken to keep the grout in full contact with the underside of the bedplate until the grout sets; maintaining a small head of fresh grout in the forms.

3.19.7 Shrinkage Compensated Grout

Shrinkage compensated grout or non-shrinkable grout of approved manufacturer should be used. The batching shall be as per the manufacturer's specifications, other procedures being as above.

3.20 Pre-Cast Concrete

The provision in this section shall be considered supplementary to general provisions for reinforced concrete works.

3.20.1 Manufacture off the Site

1. Casting of members shall not begin until consent to the shop drawings, required computation, prestressing system (if required) and method of manufacture has been given and is approved by Engineer.
2. When the drawings and method of manufacture have been approved, no changes shall be made without the approval of designer and consent of the Engineer
3. The Contractor shall inform the Engineer in advance of the date of commencement of manufacture and casting of each type of member Concrete reinforcement and workmanship shall be as per IS:456.
4. A copy of all cube test results to the work shall be sent to the Engineer as soon it become available.
5. Where the Engineer requires tests to be carried out, no members to which the tests relate shall be dispatched to the Site until the tests have been satisfactorily completed and accepted.
6. All members shall be indelibly marked to show the Member Mark as described in the Contract, the production line on which they were manufactured, the date on which the concrete was cast and, if they are of symmetrical section, the face that will be uppermost when the member is in its correct position in the works. The markings shall be so located that they are not exposed to view when the member is in its permanent position.

3.20.2 Forms

1. The design and engineering of the forms and false work as well as their construction shall be the responsibility of the Contractor. Design of the false work for all concrete shall be done under the direction of a registered engineer based in Bangalore. All exposed surfaces of each element of the structure shall be formed with similar material to produce similar concrete surface textures, colour, and appearance. Forms shall be inspected and approved by the

Engineer prior to authorizing casting operations. Details shown on the Drawings shall be built into the forms. Worn, damaged, or otherwise unacceptable forms shall be repaired before casting of any member will be authorised.

2. The forms may be made either of steel or of plywood. If the Contractor selects to use plywood forms, it shall be a high quality plywood, 19mm minimum thickness, marine grade and it shall not be reused and shall be removed from site subject to the consent of the Engineer.
3. Forms shall be structurally adequate to support the members within permissible tolerances. The form design shall incorporate the method and the necessary hardware to adjust and maintain grade and alignment. Details of the hardware and adjustment procedure shall be included in the required plans.
4. Forms shall be coated with form release agent prior to use. Form release agent shall be a commercial quality form oil or other equivalent coating which will permit the ready release of forms and will not discolour the concrete. Excess form release agent shall not be allowed to stand in puddles in the forms nor shall coating be allowed to come in contact with reinforcing steel or hardened concrete.
5. Anchor devices may be cast into the concrete for later use in supporting forms, provided the arrangement is approved by the designer and consented by Engineer. The use of driven or drilled types of anchorages for fastening forms or form supports to concrete will not be permitted.3.18.3

3.20.3 Curing

The steam curing shall be at 100% relative humidity to prevent loss of moisture and to provide moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam, the ambient air temperature shall increase at a rate not to exceed 22°C per hour until the maximum temperature Curing shall comply with the requirements of specification.

Steam curing process may be used as an optional alternative to water curing at no extra cost to the employer. The casting bed for any unit cured with steam shall be completely enclosed to prevent steam escaping and exclude outside atmosphere. 2 to 4 hours after placing concrete and after the concrete has undergone initial set, the first application of steam shall be made, unless retarders are used, in which case the waiting period before application of the steam shall be increased to from 4 to 6 hours. Water curing methods shall be used from the time concrete is placed until steam is first applied.

Where the steam has been raised the maximum temperature shall be held until the concrete has reached the desired strength. In discontinuing the steam application, the ambient air temperature shall not decrease at a rate to exceed 22°C per hour until a temperature has been reached 10oC above the temperature of the air to which the concrete shall be exposed. The maximum curing temperature shall be from 60°C to 67°C. If the Contractor elects to cure by any other special

method, the method and its details shall be subject to the approval of the designer and consent by Engineer.

3.20.4 Storage

When members are stored, they shall be firmly supported only at the points specified by the Designer. The accumulation of trapped water and deleterious matter in the units shall be prevented. Care shall be taken to avoid rust staining and efflorescence.

3.20.5 Handling and Transport

1. Members shall be lifted or supported only at points specified by the Designer or otherwise agreed by the Engineer and shall be handled and placed without impact.
2. The method of lifting, the type of equipment and transport to be used, and the minimum age of the members to be handled shall be subject to the Designer's requirements.

3.20.6 Assembly and Erection

The method of assembly and erection described in the Contract shall be as practicable and be strictly adhered to on site. Immediately after a unit is in position, and before the lifting equipment is removed, temporary supports or connections between members, as necessary, shall be provided. The final structural connections shall be completed as soon as possible.

3.20.7 Forming Structural Connections

1. No structural connections shall be made until the Engineer's consent has been given.
2. Unless otherwise agreed by the Engineer, the composition and water/cement ratio of the in situ concrete or mortar used in any connection and the packing of joints shall be in accordance with the assembly instructions.
3. Levelling devices shall only be released or removed with the consent of Engineer.

3.20.8 Epoxy Grout for Structural Connections (if required)

1. Description

Epoxy shall be furnished as 2 components which shall be mixed together at the Site.

2. Sampling and Testing

All tests will be conducted in accordance with the latest test methods of the American Society for Testing and Materials, Federal Test Method Standard No. 141 or equivalent British Standard.

3. Packaging, Labelling and Storing

Each component shall be packaged in steel containers not larger than 20 litres in volume. When the components are to be mixed at a ratio of 2 parts A to one part B, by volume, the container containing component B shall be one half the volume of the container containing component A. The containers shall have lug type crimp lids with ring seals, shall be new, not less than 0.6 mm nominal thickness, and shall be of such character as to resist any action by the components. Each container shall be clearly labeled with the designation (Component A or B), type (Standard or Rapid) if applicable, manufacturer's name, date of manufacture, batch number (a batch shall consist of a single charge of all components in a mixing chamber), lot number, all directions for use specified elsewhere and the following warning

"CAUTION"

"This material will cause severe dermatitis if it is allowed to come in contact with the skin or eyes. Use gloves and protective creams on the hands. Should this material contact the skin, wash thoroughly with soap and water. **Backfill to Structures**

Do not attempt to remove this material from the skin with solvents. If any gets in the eyes, flush for 10 minutes with water and secure immediate medical attention." Attention is directed to the characteristic of some epoxy components to crystallize or thicken excessively prior to use when stored at temperatures below 2°C. Any material which shows evidence of crystallization or a permanent increase in viscosity or settling of pigments which cannot be readily redispersed with a paddle shall not be used.

4. Directions for Use

At the time of mixing, components A and B shall be at a temperature between 16°C and 29°C, unless otherwise specified. Any heating of the adhesive components shall be done by application of indirect heat. Immediately prior to mixing, each component shall be thoroughly mixed with a paddle. Separate paddles shall be used to stir each component. Immediately prior to use, the 2 components shall be thoroughly mixed together in the specified ratios. When mixed, all adhesives shall have a uniformly gray colour without black or white streaks. No solvent shall be added to any epoxy. After mixing, all epoxies shall be placed in the work and any overlaying or inserted be cleaned and it shall have moisture content of not more than 0.50% when tested. The maximum size of the aggregate shall not exceed that of material which is to be bonded to the work by the epoxy. It shall also be placed before thickening of the epoxy has begun. Surfaces upon which epoxy is to be placed shall be free of rust, paint, grease, asphalt, moisture and loose and deleterious material. When epoxy is used as a binder to make epoxy concrete or grout, the 2 components of epoxy shall be thoroughly mixed

together before the aggregate is added and, unless otherwise specified, the mix proportions shall consist of one part of binder to approximately 4 parts of aggregate, by volume. Aggregate for use in epoxy concrete and grout shall one-fourth of the thickness of the joint to be grouted. All surfaces against which epoxy concrete and grout are to be placed shall be primed with a coat of the epoxy used just prior to placing the grout. No more material shall be mixed than can be used within 20 minutes from the time mixing operations are started. Pot life of the epoxy mixture shall be 45 minutes.

5. Epoxy Grout Strength Requirements

The compressive strength of 38 mm cubes of epoxy grout tested in accordance with ASTM C39 after 10 hours of curing at 20°C shall be not less than the design strength of the precast number.

3.20.9 Temporary Supports and Connections

Temporary supports provided during erection should take into account all construction loads likely to be encountered during the completion of joints between any combination of precast and in-situ concrete structural elements. The supports should be arranged in a manner that will permit the proper finishing and curing of any in-situ concreting and grouting associated with the precast member being supported when the gaps of joints have to be filled with concrete or mortar. They should first be cleaned and faces of the joints should be wetted. The mixing, placing and compacting of cement and mortar should be done with special care. Mortar of a dry consistency should be in the proportion of 1:1½ (1 part of cement to 1½ parts of sand) and should be placed in stages and packed hard from both sides of the joint.

3.20.10 Tolerances

The following tolerances apply to finished precast products at the time of placement in the structure. The forms must be fabricated / constructed to give a casting well within these limits:

1. Overall dimensions of members should not vary by more than + 6 mm per 3 m length with a maximum variation of + 20 mm.
 2. Cross-sectional dimensions should not vary by more than the following:
 - + 3 mm for sections less than 150 mm thick
 - + 4 mm for sections over 150 mm & less than 450 mm
 - + 6 mm for sections over 450 mm to 1000 mm
 - + 10 mm for sections over 1000 mm
 3. Deviation from straight line in long sections should not be more than + 6 mm up to 3 m, + 10 mm for 3 m to 6 m, + 12 mm for 6 m to 12 m.
- (i) For tolerances on precast components, standard documents shall be followed

- (ii) Structural steel inserts/bolts for connecting precast concrete elements (Parapet to Box Girder)
Connection of precast concrete parapet with segmental box girder:

Square rods with internal threading and base plate/stiffener, shall be firmly fixed in the mould to the true line, level and alignment as shown in drawings. If required by engineer MS template may use for above purpose. The threaded hole/pipe shall be properly protected so as to prevent ingress of mortar etc (by providing dummy bolts, PVC cover, cotton waste etc). For connection of parapet with segmental box girder bolts of required length having threads at both ends shall be provided as shown in drawings. Grade of steel will be in accordance with the values specified in the drawing. Welding to bolts is not permitted. Grade of nuts will be same as grade of respective bolts. It is imperative to verify that that bolts can be threaded smoothly at all times. Dummy bolts shall be used in the stacking yard as a protection measure to keep the threads clean free of dust / rust. Threading, bolts materials, tests etc shall be as per IS: 1367part 1 to 16,18, IS: 1821-1987, IS: 4206.

Levelling bolts as shown in tender drawings are for facilitating alignment of the precast parapet.

3.21 Ready Mix Concrete and Pumping:

Ready-mixed concrete may be manufactured in a central automatic weigh Batching plant and transported to the place of work in agitating transit mixers.

The maximum size of coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipe used for pumping. Provision shall be made for elimination of over-sized particles by screening or by careful selection of aggregates. To obtain proper gradation it may be necessary to combine and blend certain fractional sizes of aggregates. Uniformity of gradation throughout the entire job shall be maintained.

The quantity of coarse aggregate shall be such that the concrete can be pumped, compacted and finished without difficulty.

Fine aggregates:

The gradation of fine aggregate shall be such that 15 to 30 percent should pass the 0.30 mm screen and 5 to 10 percent should pass 0.15 mm screen so as to obtain pumpable concrete. Sands, which are deficient in either of these two sizes, should be blended with selected finer sands to produce these desired percentages. With this gradation, sands having a fineness modulus between 2.4 and 2.8 are generally satisfactory. However, for uniformity, the fineness modulus of the sand should not vary more than 0.2 from the average value used in proportioning.

Water, Admixtures and Slump:

The amount of water required for proper concrete consistency shall take into account the rate of mixing, length of haul, time of unloading, and ambient temperature conditions.

Additions of water to compensate for slump loss should not be resorted to nor should the design maximum water-cement ratio be exceeded. Additional dose of retarder be used to compensate the loss of slump at contractor's cost, when permitted by Engineer. Retempering water shall not be allowed to be added to mixed batches to obtain desired slump.

Transportation:

The method of transportation used should efficiently deliver the concrete to the point of placement without significantly altering its desired properties with regard to water-cement ratio, slump, and homogeneity.

The revolving-drum truck bodies of approved make shall be used for transporting the concrete. The numbers of revolutions at mixing speed, during transportation, and prior to discharge shall be specified and agreed upon. Reliable counters shall be used on revolving-drum truck units. Standard mixer uniformity tests, conforming to ASTM standards C 94-69 "Standard Specifications for Ready Mix Concrete", shall be carried out to determine whether mixing is being accomplished satisfactorily.

Pumping of concrete:

Only approved pumping equipment, in good working condition, shall be used for pumping of concrete. Concrete shall be pumped through a combination of rigid pipe and heavy-duty flexible hose of approved size and make. The couplings used to connect both rigid and flexible pipe sections shall be adequate in strength to withstand handling loads during erection of pipe system, misalignment, and poor support along the lines. They should be nominally rated for at least 3.5 MPa pressure and greater for rising runs over 30 m. Couplings should be designed to allow replacement of any section without moving other pipe sections, and should provide full cross section with no construction or crevices to disrupt the smooth flow of concrete.

All necessary accessories such as curved sections of rigid pipe, swivel joints and rotary distributors, pin and gate valves to prevent backflow in the pipe line, switch valves to direct the flow into another pipe line, connection devices to fill forms from the bottom up, extra strong couplings for vertical runs, transitions for connecting different sizes of pipe, air vents for downhill pumping, clean-out equipment etc, shall be provided as and where required. Suitable power controlled booms or specialized crane shall be used for supporting the pipe line.

Field control:

Sampling at both truck discharge and point of final placement shall be employed to determine if any changes in the slump and other significant mix characteristics occur. However, for determining strength of concrete, cubes shall be taken from the placement end of line.

Planning:

Proper planning of concrete supply, pump locations, line layout, placing sequence, and the entire pumping operation shall be made and got approved. The pump should be as near the placing area as practicable, and the entire surrounding area shall have adequate bearing strength to support concrete delivery pipes. Lines from pump to the placing area should be laid out with a minimum of bends. For large placing areas, alternate lines should be installed for rapid connection when required. Standby power and pumping equipment should be provided to replace initial equipment, should breakdown occur. The placing rate should be estimated so that concrete can be ordered at an appropriate delivery rate. As a final check, the pump should be started and operated without concrete to be certain that all moving parts are operating properly. A grout mortar should be pumped into the lines to provide lubrication for the concrete, but this mortar shall not be used in the placement. When the form is nearly full, and there is enough concrete in the line to complete the placement the pump shall be stopped and a go-devil inserted and shall be forced through the line by water under pressure to clean it out. The go-devil should be stopped at a safe distance from the end of the line so that the water in the line will not spill into the placement area. At the end of placing operation, the line shall be cleaned in the reverse direction.

3.22 Additional Specifications for Concrete M60 and above

- (a) Mineral admixture in the form of micro silica or condensed silica fume shall be permitted in the design mix. It shall comply with ASTM C 1240 "Specifications for Silica Fume for use in Hydraulic Cement Concrete and Mortar". It shall be obtained from proven and reliable manufacturer/supplier to the satisfaction of the Engineer.
- (b) Adequate and complete dispersal of the micro silica during the concrete mixing shall be ensured.
- (c) When micro silica is used in powder form the contractor shall take all precautions against potential health hazards during handling of the material.
- (d) Chilled water and/ or ice shall be used in the concrete mix depending on the ambient temperature, dimensions of the concrete element, rate of pouring and design mix constituents.
- (e) Special profuse curing arrangements shall be made for dissipation of the heat of hydration. The water curing shall be continued for a period of 21 days.
- (f) The concrete design mix and arrangement for mixing, transportation, and curing of concrete shall be subject to the approval of the Engineer
- (g) IRC SP 47

3.23 Testing Concrete Structures for Water Tightness & Acceptance Criteria**Underground Structures, Pump Rooms and Sumps**

In the case of structures whose external faces are submerged and are not accessible for inspection, such as underground structures, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hours over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure.

A structure shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

Roofs

The roofs of liquid-retaining structures shall be water-tight and shall be tested on completion by flooding the roof with water to a minimum depth of 25 mm for 24 hrs. Where it is impracticable, because of roof falls or otherwise, to contain a 25 mm depth of water, the roof shall have water applied by a continuous hose or sprinkler system to provide a sheet flow of water over the entire area of the roof for not less than 6 hrs. In either case the roof shall be considered satisfactory if no leaks or damp patches show on the soffit. Should the structure not satisfy either of these tests, then after completion of the remedial work it should be retested in accordance with this clause. The roof insulation and covering should be completed as soon as possible after satisfactory testing. Contractor shall give warranty for leak tightness of joints for 10 years.

Measurement:

Unless otherwise specified the cost of formwork deemed to be included in concrete cost. The reinforcement cost is included in the quoted lumpsum Price Schedule.

The volume of concrete measured shall include that occupied by:

1. Reinforcement and other metal sections.
2. Cast in components each less than 0.01 m³ in volume.
3. Rebates fillets or internal splays each less than 0.005 m² in cross sectional area.
4. Pockets and holes not exceeding 0.01 m³ in volume.
5. For M-10 concrete no payment shall be made for any shuttering used.
6. Lumpsum Price for precast concrete shall include demoulding, handling, storing, transporting and erecting at site, including all clamping, bracing that may be required during erection including erection equipment.

3.24 Concrete Cube Tests:

The quality of hardened concrete will be verified by the following procedure:

1. The Engineer shall select random batches of concrete for examination without warning the Contractor and sampling will generally be done at the point of discharge from the mixer.
2. From the batches thus selected 6 concrete cubes shall be made in accordance with Indian Standards. However not more than 2 cubes may be made from any single batch. Of these 6 cubes thus made 3 cubes (each cube representing concrete of different batches) shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days.
3. All cubes shall be made, cured, stored, transported and tested in accordance with Indian Standards. The tests shall be carried out in a laboratory approved by the Engineer.
4. At least 6 cubes shall be made on each day's concreting until 60 cubes have been made for each grade of concrete. This is the initial period.
5. After the initial period, subject to the acceptance of the Engineer, the frequency at which the cubes shall be made may be reduced as follows :

(1 set = 6 cubes, each pair of cubes representing concrete from a different batch.) At least 1 set for each day's concreting consisting of :

- a) 1 set for every 10m³ or part thereof of concrete for critical structural elements like columns, parapet, segments, larger cantilever, plus .
- b) 1 set for every 40m³ or part thereof for all other elements.

If concrete is batched at more than one point simultaneously the above frequency of making cubes shall be followed at each point of batching. 3 of the cubes of each set shall be tested at

6. 6 days and the remaining 3 cubes shall be tested at 28 days from the day of casting the cubes.

3.25 Failure to meet specified Requirements:

1. If from the cube test results it appears that some portion of the Works has not attained the required strength, the Engineer may order that portion of the structure be subjected to further testing of any kind whatsoever as desired by the Engineer, including, if so desired by him, full load testing of the suspected as well as adjacent portions; of the structure as specified in the Conditions of Contract. Such testing shall be at the Contractor's cost. The Engineer may also reject the work and order its demolition and reconstruction at the Contractor's cost.

2. If the strength of concrete in any portion of the structure is lower than the required strength, but is considered nevertheless adequate by the Engineer so that demolition is not necessary, the Contractor shall be paid a lower rate for such lower strength concrete as determined by the Engineer.

K-RIDE

SECTION- 04
FORM WORK

SECTION- S.04**4. FORM WORK****4.1 General**

These specifications shall be read in conjunction with the MORTH specifications-2013 (fifth revision) and CPWD specifications - 2009 with correction slips / amendments upto date, and other relevant specifications described in the section 1 of these specifications.

4.2 Materials

Formwork shall be of timber, plywood (including marine plywood), steel or any other suitable material capable of resisting damage to the contact faces under normal conditions of erecting forms, fixing steel and placing concrete. The selection of materials suitable for formwork shall be made by the Contractor based on the quality consistent with the specified finishes and safety. For designated areas prominently in public view like piers, piers caps, portals, viaduct (cast-in-situ or pre-cast), parapet etc., only steel shuttering shall be used. Steel material shall be in good condition. It should not be corroded. Condition of material shall be decided by engineer and If find not as per Indian standards or not as per requirement it shall be replaced. Number of uses for steel shuttering shall be between 50 and 100. Uses shall be decided by engineer as per the condition of steel shuttering. Special finishes like grooves, logos, floral designs, engraving in inset and outset shall be provided by fixing monolithic rubber forms fixed on entire surface of the formwork. The minimum shore hardness of rubber shall be A-55 to ensure strength, flexibility & elasticity. The contours, design and edges of rubber form should be smooth to ensure minimal deposition of grime or dust. The material shall be approved by the Engineer before erected at site. However, the entire responsibility of planning, designing, erection, dismantling, shifting and safety of false work lies with the contractor.

All formwork and formwork supports (centering, props, scaffolds, ladders etc.) shall be in structural steel only and preferably of pipes conforming to IS: 806, IS:1161, IS:1239, IS:2750. Wooden ballies shall not be permitted as props/formwork supports. All props shall be properly braced using x & k bracings. Ladders to be used at site should have treads and shall be fabricated from structural steel. Wooden / bamboo / aluminum / pipe ladders shall not be permitted.

4.2.1 Timber

Timber used for formwork shall be easily workable with nails without splitting. It shall be stable and **not** liable to warp when exposed to sun and rain or wetted during concreting.

4.2.2 Plywood

Plywood used for formwork shall be minimum 12 mm thick. Shuttering quality plywood complying with IS:4990 and of make approved by the Engineer. Suitable stiffeners and walers shall be provided depending on the shuttering design.

4.2.3 Steel

Steel formwork shall be made of minimum 4 mm thick black sheets stiffened with angle iron frame made out of M.S. angles 40 mm x 6 mm supported at suitable spacing.

4.2.4 Design & Drawings

All temporary works such as formwork, false work, staging, launching girder, cantilever form traveler scheme etc. shall be designed by the Contractor. The permissible stresses in materials of formwork, false work, staging, launching girder & cantilever form traveler shall be same as for permanent structure. All calculations and drawings of the same including construction sequence shall be checked and verified by independent agency appointed by contractor. Only after the checking of the same, the calculations and drawings (along with soft copy in CD ROM) shall be submitted to Engineer for approval well in advance of work.

All temporary works shall be also inspected by the independent agency and independent report shall be submitted to Engineer. All temporary works shall be robust, safe and constructed such a way that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerances. It is the responsibility of the Contractor to obtain the results required by the Engineer, whether or not some of the work is sub-contracted. Approval of the temporary works by the Engineer shall not diminish the Contractor's responsibility for the satisfactory performance of the same, nor for the safety and co-ordination of all operations.

For pier formwork, it shall be ensured that total deflection (taking account of combined deflection of plate, stiffeners, walers or any other supporting arrangement) shall not be more than 3mm. All the formwork, launching truss and cantilever form traveler and other selected temporary works shall be tested for the load including factor of safety for which the truss/formwork is designed before use in works.

The design of false work should be such as to facilitate easy and safe access to all parts for proper inspection.

Methodology for removal of form should be planned as a part of total form work design process. In case of pre-stressed concrete work, careful consideration shall be given to re-distribution of loads due to pre-stressing.

4.3 Formwork for Exposed Concrete Surfaces

The facing formwork, unless indicated otherwise in drawings, or specifically approved by the Engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure:

- 4.3.1 Plain slab soffit, and sides of beams, girders, joists and ribs and side of walls, fins, parapets, pardis, sun-breakers, etc shall be made with:

- a. Steel plates not less than 4mm thick of specified sizes stiffened with a suitable structural framework and fabricated true to plane
- b. Timber planks of 20mm actual thickness and of specified surface finish, width and reasonable length,
- c. Plywood not less than 12mm thick (IS:4990 - Specification for Plywood for Concrete Shuttering Work) stiffened with a suitable timber frame work or 3mm thick plywood with a 20mm timber plank backing, of specified sizes stiffened with a suitable timber framework and bracing. At joints 6mm/10mm sponge to be provided.

4.3.2 Bottoms of beams, girders and ribs, sides of columns shall be made with

- a. Steel plates not less than 5mm thick of specified sizes stiffened with a suitable structural framework, and fabricated true to plane
- b. Timber planks of 35mm actual thickness and of specified surface finish, width and reasonable length,
- c. Plywood not less than 12mm thick (IS: 4990), of specified sizes stiffened with a suitable timber framework.

4.3.3 For Precast segments, piers, pier heads, portals etc. suitable steel form work is to be used unless otherwise specified by Engineer.

4.4 Formwork for Sloped Surfaces

4.4.1 Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration, inspection and finishing of the concrete.

4.4.2 The formwork shall be built in such a way so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 2 horizontal:1 vertical shall be formed as required herein.

4.5 Formwork for Curved Surfaces

4.5.1 The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form lumber shall be built up of laminated splices cut to make tight, smooth form surfaces.

4.5.2 After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature.

4.5.3 Formwork for Waffle Slab

4.5.4 Shuttering for Waffle Slab/ Coffered Slab shall be with Fibre Glass moulds of approved design. They can also be of Precast concrete unit as per design to form as part of structural concrete. The moulds shall be of uniform shape and dimension to give the desired shape of Coffered slab.

4.6 Erection of Formwork

The following shall apply to all formwork:

- 4.6.1 To avoid delay and unnecessary rejection, the Contractor shall obtain the approval of the Engineer for the design of forms and the type of material used before fabricating the forms. (Ref. ACI 347 Formwork for Concrete or equivalent I.S. Code).
- 4.6.2 All shuttering planks and plates shall be adequately backed to the satisfaction of the Engineer by a sufficient number and size of walers or framework to ensure rigidity during concreting. All shutters shall be adequately strutted, braced and propped to the satisfaction of the Engineer to prevent deflection under deadweight of concrete and superimposed live load of workmen, materials and plant, and to withstand pouring rate and vibration.
- 4.6.3 Vertical props shall be supported on wedges or other measures shall be taken so that the props can be gently lowered vertically during removal of the formwork. Props for an upper level shall be placed directly over those in the level immediately below, and the lowest props shall bear on a sufficiently strong area. Care shall be taken that all formwork is set plumb and true to line and level or camber or batter where required and as specified by the Engineer.
- 4.6.4 Provision shall be made for adjustment of supporting struts where necessary. When reinforcement passes through the formwork care should be taken to ensure close fitting joints against the steel bars so as to avoid loss of fines during the compaction of concrete.
- 4.6.5 If the formwork is held together by bolts, these shall be so fixed that no iron will be exposed on surfaces against which concrete is to be laid and within the concrete cover to the steel reinforcement. In any case wires shall not be used with exposed concrete formwork. The Engineer may at his discretion allow the Contractor to use tie-bolts running through the concrete and the Contractor shall decide the location and size of such tie-bolts in consultation with the Engineer. The tie bolts shall be so designed that their removal on de-shuttering does not leave any embedment with in the concrete cover to steel reinforcement. Holes left in the concrete by these tie-bolts shall be filled by the concrete repair material and the methodology as approved by the Engineer at no extra cost.
- 4.6.6 Provision shall be made in the shuttering for beams, columns, and walls for a port hole of convenient size so that all extraneous materials that may be collected could be removed just prior to concreting.

- 4.6.7 Formwork shall be so arranged as to permit removal of forms without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.
- 4.6.8 The formwork for beams and slabs shall be so erected that forms on the sides of the beams and the soffit of slabs can be removed without disturbing the beam bottoms or props under beams.
- 4.6.9 Surfaces of forms in contact with concrete shall be oiled with a mould oil of approved quality form releasing agent. If required by the Engineer the contractor shall execute different parts of the work with different mould oils to enable the Engineer to select the MoRT&H suitable. The use of mould oil which results in blemishes of the surface of the concrete including diesel, burnt oil and any other lubricating oil shall not be allowed. Mould oil shall be applied before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position. The formwork shall be kept thoroughly wet during concreting and the whole time that is left in place. Nothing extra shall be paid to contractor for oiling the moulds.
- 4.6.10 Immediately before concreting is commenced, the formwork and other related arrangements shall be carefully examined to ensure the following:
- a. Removal of all dirt, shavings, sawdust and other refuse by brushing, washing and compressed air / vaccume cleaning.
 - b. The tightness of joints between panels of sheathing and between these and any hardened core.
 - c. The correct location of tie bars, bracing and spacers, and especially connections of bracing.
 - d. Adequate cover blocks are in place
 - e. Straightness and plumbness of the form work
 - f. Side supports / restraints for the form work are enough and robust
 - g. Construction joint (wherever applicable) is properly prepared
 - h. That all wedges are secured and firm in position.
 - i. That provision is made for traffic on formwork not to bear directly on reinforcing steel.
 - j. Pouring platform along with its approach from ground is robust and safe for workers movement.
 - k. Arrangement for vibrators for compaction of concrete
 - l. Sequence of concrete pouring is well defined and is agreed upon by the Engineer and is explained to concrete pouring team
 - m. The Pouring area is well lit.
 - n. Curing arrangements are well planned and agreed upon by the Engineer.
 - o. The green concrete protection measures from sun & rain etc. are in place.
- 4.6.11 The Contractor shall obtain the Engineer's approval for dimensional accuracies of the work and for the general arrangement of propping and bracing. (IS:3696 - Safety Code of Scaffolds and Ladders, IS:4014 Steel Tubular Scaffolding I & II). All scaffolding and staging shall be either of steel tubes or built up section of rolled steel with adequate bracing at several levels in each perpendicular direction connecting each prop. In addition to this diagonal bracing should be provided in elevation ideally at 45 degrees or between 30 and 60 degrees. The Contractor shall be

entirely responsible for the adequacy of propping, and for keeping the wedges and other locking arrangements undisturbed through the de-centering period. (IS:8989 Safety code for erection of concrete framed structures).

- 4.6.12 Formwork shall be continuously watched during the process of concreting. If during concreting any weakness develops and formwork shows any distress the work shall be stopped and remedial action as directed by the engineer shall be taken.
- 4.6.13 Staging for portal girder and cross girder (in station zone) shall be in the form of portal frame. It shall be ensured that minimum two lanes of traffic with a restricted height of 4.5m can ply underneath it with adequate protection to portal legs from moving traffic.
- 4.6.14 For concourse floor over road, the contractor shall design and fabricate prefabricated type of staging and shuttering which can be erected in very short duration. Such erection will be only permitted in the night. In such case staging has to span the full width of the road in a portal shaped profile as shown in tender drawings. The portal frame shall have 4.5m (min) traffic clearance from the road for allowing safe movement of traffic below. In case no road runs beneath the concourse zone of station, the bidder may decide whether to use the above form of staging or any normal staging arrangement from the ground itself.

4.7 Concrete Finishes

This section deals with the surface of concrete on which forms had been fixed while concreting.

4.7.1 Formed Surface

Allowable deviation from plumb or level and from the alignment profile, grades and dimensions shown on the drawings is defined as "tolerance" and is to be distinguished from irregularities in finishes as described herein. Tolerances in concrete construction are specified elsewhere.

The classes of finish and requirements for finishing of concrete surface shall be as shown on the drawings or as hereinafter specified. In the event of finishing not being definitely specified herein or in the drawings, finishes to be adopted shall be as directed by the Engineer.

Completed concrete surface shall be tested, where necessary to determine whether surface irregularities are within the limits specified hereinafter.

Surface irregularities are classified as "Abrupt" or "Gradual". Offsets caused by displaced or misplaced form sheathing, or form sections or by loose knots or otherwise defective timber form will be considered as abrupt irregularities, and shall be tested by direct measurements. All other irregularities shall be considered as gradual irregularities and will be tested by use of template, consisting of a straight edge or the equivalent thereof for curved surfaces. The length of the template shall be 150 cm for testing of formed surfaces and 300 cm for testing of unformed surfaces.

The classes of finish for formed concrete surfaces are designated by one of the symbols F1, F2, F3 and F4. Unless otherwise specified or indicated on drawings, these classes of finish shall apply as follows:

Finish F1: This finish applies to surfaces where roughness is not objectionable, or surface that will otherwise be permanently concealed. Surface treatment shall be the repair of defective concrete, correction of surface depressions deeper than 25 mm and filling of tie rod holes. Form sheathing will not leak mortar when concrete is vibrated. Forms may be manufactured with a minimum of refinement.

Finish F2: This finish is required on surfaces permanently but not prominently exposed to public view for which other finishes are not specified except F1. Forms shall be manufactured in a workmanlike manner to the required offsets or bulges. Surface irregularities shall not exceed 5mm for abrupt and 8mm for gradual irregularities measured with a 1.5 m template.

Finish F3: This finish is required for coarse textured concrete surfaces intended to receive plaster, stucco or wainscoting. Surface irregularities shall not exceed 5mm for both abrupt and gradual irregularities.

Finish F4: This finish is designated for surfaces prominently exposed to public view where appearance is also of special importance. This shall include piers of bridges, viaducts, beams, parapets, railings and decorative features on the structure and on the bridges. To meet with requirements for F4 finish, forms shall be manufactured in a skilful, workmanlike manner, accurately to dimensions. There should be no visible offsets, bulges or misalignment of concrete. At construction joints, the forms shall be rightly set and securely anchored close to the joint. Abrupt and gradual irregularities shall not exceed 3mm. Irregularities exceeding this limit shall be reduced by grinding to a level of 1:20 ratio of height to length. Jute bag subbing or sand blasting shall not be used.

4.7.2 Unformed Surfaces

The classes of finish for unformed surfaces are designated by symbols U1, U2, U3 and U4. Unless otherwise specified or indicated on drawings, these classes of finish shall apply as follows:

Finish U1: This finish applies to unformed surfaces that will be concealed permanently or otherwise where a screeded surface finish meets the functional requirements. Finish U1 is also used as the stage of finishes for U2 and U3. Finishing operations shall consist of sufficient leveling and screening to produce an even uniform surface. Surface irregularities shall not exceed 10mm.

Finish U2: This is floated finish, and used on all outdoor, unformed surfaces. Finish U2 is also used as the second stage of finish for U3. Floating to be performed manually or mechanically on stiffened screed surface shall be minimum to produce textured surface. If finish U3 is to be applied, floating shall be continued till a small amount of mortar without excess water is brought to the surfaces so as to permit effective trowelling. Surface irregularities shall be removed as directed by the Engineer.

Finish U3: This is a trowelled finish and shall be used for tops of parapets, etc prominently exposed to view. When the floated surface has hardened sufficiently, steel trowelling shall be started. Steel trowelling on hardened, floated surface shall be performed with firm pressure to produce a dense uniform surface free from blemishes and trowel marks and having slightly glossy appearance. Surface irregularities shall not exceed 5mm.

Finish U4: This is a steel-trowelled finish, similar to finish U3, except that light surface pitting and light trowel marks such as obtained from the use of machine trowelling will be acceptable, provided that surface irregularities do not exceed the limits specified for finish U3.

Unformed surfaces which are nominally level shall be sloped for drainage as shown on drawings or as directed by Engineer unless the use of other slopes or level surface is indicated on drawings. Narrow surface such as tops of parapets, walls and kerbs shall be sloped approximately 1cm per 30cm of width. Broader surface such as roadways, platform and decks, shall be sloped approximately half centimeter per 30cm of width. Finishes of floor and roof slabs shall be sloped, if required, by the Engineer.

4.8 Exposed Concrete Work

Exposed concrete surfaces shall be smooth and even, originally as stripped without any finishing or rendering. Where directed by the Engineer, the surface shall be rubbed with carborundum stone immediately on striking the forms. The Contractor shall exercise special care and supervision of formwork and concreting to ensure that the cast members are made true to their sizes, shapes and positions and to produce the surface patterns desired. No honeycombing shall be allowed. Honeycombed parts of the concrete including the other surface defects in the concrete shall be removed by the Contractor as per the methods, which do not affect the strength of adjoining Concrete and as approved by the Engineer.

Part of defective concrete thus removed shall be re-cast using fresh concrete of same grade or approved quality concrete repair material depending upon the size, location, thickness of the defective concrete and structural behavior of the member having defective concrete as instructed by the Engineer without extra cost, For the purpose the Contractor shall prepare a comprehensive work procedure and get it approved from the Engineer. Nothing extra shall be paid for repair of the concrete. Contractor shall ensure that no air bubbles are formed on the exposed surface. Concrete pouring sequence, vibration methodology etc shall be planned to avoid air bubbles. All materials, sizes and layouts of formwork including the locations for their joints shall have prior approval of the Engineer.

4.9 Age of Concrete at Removal of Formwork

In accordance with CPWD Specifications 1996 / 2009 or IS:456. The Engineer may vary the periods specified if he considers it necessary. Immediately after the forms are removed, they shall be cleaned with a jet of water and a soft brush.

4.10 Stripping of Formwork

The work of form work removal should be planned and a definite scheme of operation worked out. Formwork shall be removed carefully without jarring the concrete, and curing of the concrete shall be commenced immediately. Concrete surfaces to be exposed shall, where required by the Engineer, be rubbed down with carborundum stone or bush-hammer to obtain a smooth and even finish. Where the concrete requires plastering or other finish later the concrete surface shall be immediately hacked lightly all over using approved methods and as directed by the Engineer. No extra charge will be allowed to the Contractor for such work on concrete surfaces after removal of forms.

4.11 Reuse of Forms

The Contractor shall not be permitted reuse of timber facing formwork brought new on the works for more than 5 times for exposed concrete formwork and 8 times for ordinary formwork. 5 or 8 uses shall be permitted only if forms are properly cared for, stored and repaired after each use. The Engineer may at his absolute discretion order rejection of any forms he considers unfit for use for a particular item irrespective of no of times the shuttering has been used and order removal from the site of any forms he considers unfit for use in the Works. Used forms brought on the site will be allowed proportionately fewer uses depending upon its condition and as decided by the Engineer. Use of different quality boards or the use of old and new boards in the same formwork shall not be allowed. If any other type of special or proprietary form work is used, the number. of times they can be used will be determined by the Engineer.

4.12 Formwork for Precast/ Prestressed Concrete

1. The provisions in this section shall be considered supplementary to the general provisions stated above and additional Technical Specifications for pre cast segments. Precast concrete members and panels shall be made in accurately constructed moulds, on a properly prepared casting bed. All aspects of the making, curing and erection of precast units shall be subject to the approval of the Engineer.

The contractor shall submit detailed drawings of formwork for the approval of the Engineer. Finishing with cement mortar shall not be allowed.

2. The formwork should be so designed that it does not restrain the shrinkage movements and possible shortening due to pre-stress of the concrete. The formwork shall be of sturdy construction with special considerations to shutter vibrators when used. All edges and joints of the formwork should be designed and sealed so that no cement grout can escape and there is no wedging or keying to the concrete. The effect of curing on the formwork should be given

special consideration. Depending on care, curing, erection and maintenance of the formwork after stripping, the following number of uses can be made with different types of formwork.

Plywood with timber backed formwork - As per satisfaction of Engineer
Steel moulds -do-

Number of uses of shuttering to be as per approval of the Engineer

In case concrete moulds can be satisfactorily provided by the contractor, the Engineer's approval shall be obtained before use on the works.

3. Stripping

As soon as the pre-cast units have attained sufficient strength, the formwork shall be stripped. The pre-cast unit shall be lifted uniformly out of the formwork without being subjected to tilting or restraint effects.

4.13 Special Architectural Finishes

Special approved architectural finishes like grooves, logos, engravings/projections in inset and out set as per the approved design shall be provided by fixing monolithic rubber forms or any other approved material fixed on the entire surface of the form work. The shore hardness of the rubber shall be $600 \pm 5A$ to ensure strength, flexibility and elasticity. The rubber shall be cold cured (preferably polyurethane based) and fixed to the formwork under controlled conditions in shade and air temperature.

The form liners should be shrinkage free, solvent free and should be impervious to abrasion by Concrete, resistant to concrete pressure and heat resistant upto 700 C dry heat. Formwork liner fixation should be factory made under close tolerances and stage inspections.

If proprietary system of formwork is used, detailed information as given below herein shall be furnished to Engineer for approval before use.

1) General

- i. The information which the manufacturer is required to supply shall be in such detail as to obviate unsafe erection and use of equipment due to the intention of the manufacturer not having been made clear or due to wrong assumptions on the part of the user.
- ii. the user shall refer unusual problems of erection/assembly not in keeping with intended use of equipment, to the manufacturer of the equipment.

2) The manufacturers of proprietary systems shall supply the following information;

- a) Description of basic functions of equipment.
- b) List of items of equipment available, giving range of sizes, spans and such like, with manufacturer's identification number or other references.
- c) The basis on which safe working loads have been determined and whether the factor of safety given applies to collapse or yield.
- d) Whether the supplier's data are based on calculations or tests. This shall be clearly stated as there may be wide variations between results obtained by either method.
- e) Instructions for use and maintenance, including any points which require special attention during erection, especially where safety is concerned.
- f) Detailed dimensional information, as follows:
 - i) Overall dimensions, depths and widths of members.
 - ii) Line drawings including perspectives and photographs showing normal uses.
 - iii) Self-weight.
 - iv) Full dimensions of connections and any special positioning and supporting arrangements.
 - v) Sizes of members, including tube diameters and thicknesses of material.
 - vi) Any permanent camber built into the equipment.
 - vii) Sizes of holes and dimensions giving their positions.
 - viii) Manner of fixing including arrangements for sealing joints.
 - ix) Method of de-stripping, storing & shifting.
- g) Data relating to strength of equipment as follows:
 - i. Average failure loads as determined by tests.
 - ii. Recommended maximum working loads for various conditions of use.
 - iii. Working resistance moments derived from tests.
 - iv. Working shear capacities derived from tests.
 - v. Recommended factors of safety used in assessing recommended loads and deflections based on test results.
 - vi. Deflections under load together with recommended pre-camber and limiting deflections.
 - vii. If working loads depend on calculations, working stresses should be tested. If deflections depend on theoretical moments of inertia or equivalent moments of inertia rather than tests, this should be noted.
 - viii. Information on the design of sway bracing against wind and other horizontal loadings.
 - ix. Allowable loading relating maximum extension of bases and/or heads.
 - x. Any restrictions regarding usage of any component or full assembly with regard to spans, heights and loading conditions

4.14 Measurement

Unless otherwise specified, the cost of form work etc., is included under relevant Concrete items of Price Schedule.

4.15 Information to be supplied by manufacturers of proprietary systems of form work

1. General

The information which the manufacturer is required to supply shall be in such detail as to obviate unsafe erection and use of equipment due to the intention of the manufacturer not having been made clear or due to wrong assumptions on the part of the user.

The user shall refer unusual problems of erection/assembly not in keeping with intended use of equipment, to the manufacturer of the equipment.

2. Information Required

The manufacturers of proprietary systems shall supply the following information;

- a) Description of basic functions of equipment.
- b) List of items of equipment available, giving range of sizes, spans and such like, with manufacturer's identification number or other references.
- c) The basis on which safe working loads have been determined and whether the factor of safety given applies to collapse or yield.
- d) Whether the supplier's data are based on calculations or tests. This shall be clearly stated as there may be wide variations between results obtained by either method.
- e) Instructions for use and maintenance, including any points which require special attention during erection, especially where safety is concerned.
- f) Detailed dimensional information, as follows :
 - i. Overall dimensions, depths and widths of members.
 - ii. Line drawings including perspectives and photographs showing normal uses.
 - iii. Self weight.
 - iv. Full dimensions of connections and any special positioning and supporting arrangements.
 - v. Sizes of members, including tube diameters and thicknesses of material.
 - vi. Any permanent camber built into the equipment.
 - vii. Sizes of holes and dimensions giving their positions.
 - viii. Manner of fixing including arrangements for sealing joints
- g) Data relating to strength of equipment as follows:
 - I. Average failure loads as determined by tests.
 - II. Recommended maximum working loads for various conditions of use.
 - III. Working resistance moments derived from tests.
 - IV. Working shear capacities derived from tests.

- V. Recommended factors of safety used in assessing recommended loads and deflections based on test results.
- VI. Deflections under load together with recommended pre-camber and limiting deflections.
- VII. If working loads depend on calculations, working stresses should be tested. If deflections depend on theoretical moments of inertia or equivalent moments of inertia rather than tests, this should be noted.
- VIII. Information on the design of sway bracing against wind and other horizontal loadings.
- IX. Allowable loading relating maximum extension of bases and/or heads.
- X. Any restrictions regarding usage of any component or full assembly with regard to spans, heights and loading conditions.

K-RIDE

SECTION- 05
REINFORCEMENT

SECTION- S.05**5. REINFORCEMENT****5.1 General**

These specifications shall be read in conjunction with the MORTH specifications -2013 (fifth revision) and CPWD specifications -2009 with correction slips / amendments upto date, and other relevant specifications described in the section 1 of these specifications.

Any steel specified for reinforcement shall conform in every respect to the latest relevant Indian Standard Specifications and shall be of tested quality under the ISI Certification Scheme.

All reinforcement work shall be executed in conformity with the drawings supplied and instructions given by the Engineer and shall generally be carried out in accordance with the relevant Indian Standard Specifications IS: 2502- Bending and Fixing of Bars for Concrete Reinforcement.

The reinforcement steel shall be from primary producers and no re-rolled steel shall be supplied and used.

5.2 Couplers Specifications

Only cold-forged, parallel threaded mechanical coupler system are recommended. All mechanical couplers shall be of Type 2 (or Class H as specified in IS-16172) and should be simple to install and which can be confirmed by quick visual inspection to have been correctly installed and to have achieved the required full strength connection.

The couplers shall be of standard parallel thread type. Ends of the reinforcement bars, which are to be joined, shall be enlarged by cold forging/upsetting, threaded in such a way that root thread diameter is not lesser than the parent bar to be joined. The coupler shall be of TYPE – II and qualified/Certified as per UK CARES, IS code 16172:2014, ACI 318, ASME, Section III, and Div.2, Caltrans.

Couplers installed shall be strictly in accordance with the manufacturer's recommendations.

All the couplers shall undergo quality checks on uniformity of threads, dimensional accuracy etc. Each coupler shall be clearly stamped indicating batch number and diameter. This number shall be traceable to the original cast. The relevant material mill certificate shall be submitted with supply of a particular lot. The certificate shall give salient material properties. The coupler manufacturer shall operate at least an ISO 9000 approved quality assurance programme or equivalent for the manufacture of couplers.

Threading of ends of the reinforcing bars:

This threading activity shall preferably be done at Site. The various stages involved in threading are as given below:

a) Cutting (Rebar End Preparation):

The ends of reinforcement bars shall be cut by mechanical means to get a perfect plain and surface perpendicular to the axis of the bar.

b) Cold forging & threading:

After cutting the ends of the bar shall be enlarged by cold forging such that the area of cross section after threading shall not be less than the area of cross section of the parent bar. The length of cold forging shall be adequate for proposed thread length as per manufacturer's design. Threading shall be done preferably on threading machine. The threads shall be square parallel type to suit the couplers. The thread length and depth shall be as per manufacturer's design. After threading is completed, the threaded length of the bars shall be protected by providing plastic end caps before taking the bars out of the shop.

c) Quality control in making of threads:

Double forging of bars is not permitted. In case of improper cold forging the forged of the bar shall be square cut and fresh cold forging shall be undertaken. The threading shall be checked with 'go' and "no go" gauges for the correctness of the thread profile on the rebar.

d) Qualification tests

The coupler shall be qualified as per IS code 16172:2014, ACI 318, ASME - Section III, and Div.2, Caltrans and must have conducted & qualified for the following tests :

i) Static tensile test

Mechanical connections shall be tested for all reinforcing rebar sizes. For each rebar size, a minimum of three connections (3 joints + 1 Parent bar) in each load direction shall be tested in accordance with ASTM A370 test method to meet code requirement. A tensile test on an unsliced specimen from the same bar used for the spliced specimens shall be performed to establish actual tensile strength. The tensile strength of an individual splice system shall not be less than the 125% of the specified minimum yield strength (f_y of rebar) of the spliced bar.

ii) Cyclic tension and compression test

Mechanical connections shall be tested in all reinforcing rebar sizes. For each rebar size, a minimum of three connections shall be tested for cyclic tension & compression test. Each

specimen shall withstand cycles of stress variation of the specified minimum yield strength of the reinforcing bar. The test should be carried out as per the table mentioned below:

Loading Stages and Cycles per stage for cyclic load test Stage	Tension	Compression	Cycles
1	0.95 f_y	0.5 f_y	20cycles
2	2 ϵ_y	0.5 f_y	4cycles
3	5 ϵ_y	0.5 f_y	4cycles

Note:

f_y is specified yield strength of the reinforcing bar.

ϵ_y is the strength of reinforcing bar at actual yield stress.

iii) Cyclic tensile test

Mechanical connections shall be tested in all reinforcing rebar sizes. For each rebar size, a minimum of three connections shall be tested for low cyclic tensile test. Each specimen shall withstand 100 cycles of stress variation from 5% to 90% of the specified minimum yield strength (f_y) of the reinforcing bar. One cycle is defined as an increase from the lower load to the higher load & return.

iv) Low cycle fatigue test (for 10,000 cycles)

Fatigue test shall be conducted on splice sample from +173 Mpa to -173 Mpa for 10,000 cycles. A sine wave form @ 0.5 Hz shall be followed for bar dia 36 mm & above and 0.35 Hz shall be followed for bar dia less than 36 mm. Test shall be conducted confirming to IS 16172:2014 & Caltrans specifications. Past certificates for low cycle fatigue test shall be accepted, however these should not be more than 3 years old.

v) High cycle fatigue test (for 2,000,000 cycles)

In high cycle fatigue test, the test specimen is subjected to an axial tensile load which varies cyclically according to the sinusoidal wave form of constant frequency in the elastic range, as accordance with IS-16172. Past certificates for high cycle fatigue test shall be accepted, however these should not be more than 10 years old.

vi) Slip test

Slip Test Shall be performed on each diameter coupler specimen as per ASTM A 370 section 10. Test shall be conducted confirming to IS 16172:2014 & Caltrans specifications. Total slip shall not exceed the max value of 0.1 mm. Refer table below for more details:

Bar diameter	Total Slip (μ m)
8 mm to 20 mm	250
25 mm to 28 mm	350
32 mm to 40 mm	450
45 mm	600
56 mm	

vii) Proof loading test

Every cold-forged, threaded bar end shall undergo a proof load test prior to leaving system supplier's workshop. Every threaded bar must be subjected to proof load testing to a minimum test loading of 75% of the characteristic strength (theoretical f_y). The system supplier shall essentially install a proof load tester equipment within its threading workshop premises and ensure to test each and every threaded bar. A positive indication shall be marked on the rebar to indicate that this operation has been carried out.

INSTALLATION OF COUPLERS IN THE FIELD:

The installation of couplers in the field, for joining reinforcing bars shall be undertaken by trained manpower and as per manufacturer's instructions. Threads of both the couplers and the bars shall be thoroughly cleaned just before installation. Where couplers are cast-in the concrete, but connection is not to be completed immediately, the couplers shall be internally greased and plastic capped to a protection detail acceptable to the engineer. This cap shall be removed only when next bar is to be attached, then the same to be cleaned before joining the next bar.

The contractor shall arrange for a suitably qualified manufacturer's representative experienced in mechanically connecting reinforcement to be present at site before the start of work for initial training of personnel, and also to demonstrate the equipment and techniques as necessary. The threading workshop is to be fully supervised by the manufacturer's representative.

The contractor shall submit to the Engineer, for his acceptance a method statement for mechanically connecting the reinforcement and for the installation and verification in the field. This shall take into account any special requirements for horizontal, vertical and inclined couplers and shall include a rectification procedure, if the connection is incorrectly made. It shall also cover the correct methodology for handling of tools and equipment for mechanical connection on site. The following information shall also be included:

- a. Requirements for cleanliness
- b. Equipment for threading bars
- c. Method of flocking the connections on both rebars
- d. Method of verification of final rebars alignment and coupler integrity

Each coupler shall be visually examined prior to use to ensure the absence of rust and of any foreign material on the inside surface. All completed couplers shall be inspected and verified in accordance with the approved QAP. The Contractor shall ensure the acceptance of the Engineer for a procedure for

documenting the inspection of the couplers. The contractor shall retain inspection records and shall submit copies to the engineer within 7 days. The Couplers that do not meet the acceptance shall be completely removed and the bars re-connected as required.

Reinforcement Coating

In order to offer adequate resistance against corrosion, reinforcement bars shall be provided with a coating of "Cement Polymer Composite Coating" OR "Fusion Bonded Epoxy Coating" as per IRS CBC clause 7.1.5 applicable for important and major bridges in aggressive environment (severe, very severe and extreme), which is the case for Bangalore environment.

5.3 Inspection & Testing

Every bar shall be inspected before assembling on the works and any defective pitted, brittle, excessively rusted or burnt bars shall be removed. Cracked ends of bars shall be cut out.

No work shall be commenced without the Engineer's approval of the bar bending schedule.

Manufacturer's test Certificate shall be supplied for each lot of supply.

Specimens sufficient for three Tensile Tests for each different size of bar for each consignment delivered, or for 10 tonnes of supply of that size, whichever is less shall be sampled and tested by the Contractor. Batches shall be rejected if the average results of each batch are not in accordance with the specifications.

5.4 Bar Bending and Bar Bending Schedule

All bars will be carefully and accurately bent by approved means in accordance with IS: 2502, and relevant drawings. It shall be ensured that depth of crank is correct as per the bar cutting and bending schedule. Bent bars are not straightened for use in any manner that will injure the material.

Prior to starting bar bending work, the Contractor shall prepare bar bending schedule from the structural drawings supplied to him and get the same approved by Engineer. Any discrepancies and inaccuracies found by the Contractor in the drawings shall be immediately reported to the Engineer whose interpretation and decision there to, shall be final.

5.5 Splicing (Laps, couplers, welds, etc)

Couplers:

These specifications cover threaded couplers to be used for joining reinforcement bars, in lieu of laps/welding/mechanical splicing.

SPECIFICATIONS

GENERAL

The couplers shall be of standard parallel square thread type. Ends of the reinforcement bars, which are to be joined, shall be enlarged by cold forging, threaded in such a way that thread diameter is not lesser than the parent bar to be joined. The material of the coupler shall be of same quality or of superior quality than the quality of material of the parent bars (i.e. reinforcement bars to be joined). The joint shall have guaranteed bar break i.e. when the joint is tested in universal tensile testing machine, the bar shall fail away from the coupler i.e. not within the coupler as well as within 2 times the diameter of bar from the ends of the coupler, which can be considered as affected zone. The Guaranteed Bar break condition is not mandatory, if the failure load of coupled specimen is higher than 1.15 times of its minimum specified yield stress. The coupler shall be qualified as per ASME, Section III, and Div.2. Additionally, it shall meet all the requirements of “Class H” type coupler as specified in IS 16172. The safety margin in coupler design shall be such that guaranteed bar break is ensured even if 15% of the total threads length are out of coupler during installation.

The hand tightening of coupler shall be sufficient in the field and no mechanical means shall be essential for tightening. During testing, the coupler should only be hand tightened.

The process of manufacturing of the coupler, cold forging and threading including testing shall be carried out as per ASME approved quality assurance programme. The manufacturer of coupler shall hold a valid Quality System Certificate (QSC) from ASME. Installation of the coupler and supervision shall be done by the qualified personnel.

MANUFACTURING OF COUPLERS

All the couplers shall undergo quality checks on uniformity of threads, dimensional accuracy etc. Each coupler shall be clearly stamped indicating batch number, heat number and diameter. This number shall be traceable to the original cast. The relevant material mill certificate shall be submitted with supply of a particular lot. The certificate shall give salient material properties.

THREADING OF ENDS OF THE REINFORCING BARS

This threading activity shall preferably be done at site. The various stages involved in threading are as given below

CUTTING

The ends of reinforcement bars shall be cut by mechanical means to get a perfect plain end surface, perpendicular to the axis of the bar.

COLD FORGING & THREADING

After cutting, the ends of the bar shall be enlarged by cold forging such that the area of cross section after threading shall not be less than the area of cross section of the parent bar. The length of cold forging shall be adequate for proposed on lathe machine. The threads shall be square parallel type, to suit the couplers. The thread length and depth shall as per manufacturer's design. After threading is completed, the threaded length of the bars shall be protected by providing plastic caps, before taking the bars out of the shop.

QUALITY CONTROL IN MAKING OF THREADS

The work in shop shall be fully supervised by the Manufacturer representative. Double forging of bars is not permitted. In case of improper cold forging, the forged end of the bar shall be square cut and fresh cold forging shall be undertaken. The threading shall be checked with 'go' and 'no go' gauges.

For threaded coupler systems, every prepared bar end shall undergo a load test prior to actual use. The minimum test loading shall be equivalent to 80% of specified yield strength of bar. For this purpose contractor shall deploy the machine having facility of integrated load testing. The "Integrated" means that the testing operation is performed automatically by the same machine used to prepare the bar ends. A positive indication shall be punched on the rebar to indicate that this operation has been carried out and bar end has qualified for specified strength.

INSTALLATION OF COUPLERS IN THE FIELD

The installation of couplers in the field, for joining reinforcing bars, shall be undertaken by trained manpower and as per manufacturer's instructions. Threads of both the couplers and the bars shall be thoroughly cleaned with acetone or any other solvent, just before installation.

Where couplers are cast-in the concrete, but connection is not to be completed immediately, the couplers shall be internally greased and plastic capped to a protection detail acceptable to the engineer. This cap shall be removed only when next bar is to be attached & then cleaned before joining the next bar.

The contractor shall arrange for a suitably qualified manufacturer's representative, experienced in mechanically connecting reinforcement, to be present at site before the start of work for initial training of personnel, and also to demonstrate the equipment and techniques as necessary.

The contractor shall submit to the Engineer, for his acceptance, a method statement for mechanically connecting the reinforcement and for the installation and verification in the field. This shall take into account any special requirements for horizontal, vertical and inclined couplers

and shall include a rectification procedure, if the connection is incorrectly made. It shall also cover the correct methodology for handling of tools and equipment for mechanical connection on site. The following information shall also be included:

- (a) requirements for cleanliness
- (b) equipment for threading bars
- (c) method of locking the connections on both rebars
- (d) method of verification of final rebar alignment and coupler integrity.

Each coupler shall be visually examined prior to use to ensure the absence of rust and of any foreign material on the inside surface. All completed couplers shall be inspected and verified in accordance with the approved QAP. The Contractor shall ensure the acceptance of the Engineer for a procedure for documenting the inspection of the couplers. The contractor shall retain inspection records and shall submit copies to the engineer within 7 days. The Couplers that do not meet the acceptance standards shall be completely removed and the bars re-connected, as required.

QUALIFICATION TESTS

The splices shall be qualified as per ASME Section III Div-2, IS 16172 and by conducting following tests:

STATIC TENSILE TEST

Mechanical connections shall be tested in all reinforcing rebar sizes. All rebar transition connectors shall also be tested. For each rebar size, a minimum of six connections in each load direction shall be tested in accordance with ASTM A370. A tensile test on an unspliced specimen from the same bar used for the spliced specimens shall be performed to establish actual tensile strength.

The average tensile strength of the splices shall not be less than the followings:

- (a) 90% of the actual tensile strength of the reinforcing bar being tested.
- (b) 100% of the specified minimum tensile strength

The tensile strength of an individual splice system shall not be less than the 115% of the specified minimum yield strength of the spliced bar.

CYCLIC TENSILE AND COMPRESSIVE TEST

Cyclic tensile and compressive test: Mechanical connections shall be tested in all reinforcing rebar sizes. For each rebar size, a minimum of three connections shall be tested for low cyclic tensile test. Each specimen shall withstand 100 cycles of stress variation from 5% to 90% of the specified minimum yield strength of the reinforcing bar. One cycle is defined as an increase from the

lower load to the higher load & return. The test shall be performed as per Annexure D of IS 16172.

PERCENTAGE ELONGATION

The minimum uniform elongation (Elongation at maximum force) in the reinforcement bar outside the length of mechanical splice as measured as per Annexure B of IS 16172 shall be 3 % before failure of test piece.

SLIP TEST

The total slip value when measured in accordance to test procedure described in Annexure C of IS 16172 shall not exceed 0.10 mm.

TEST FOR AVOIDANCE OF STAGGERING

The strain measured over the full length of the splice at 90% of the specified minimum yield strength of the bar shall not exceed that of a bar that is not mechanically-spliced by more than 50%. The test shall be performed for all diameter of couplers.

LOW CYCLE FATIGUE TEST

The mechanical splice shall withstand 10000 cycles of alternating tension & compression load, when tested as per Annexure E of IS 16172.

HIGH CYCLE FATIGUE TEST

The mechanical splice when tested accordance to Annexure E of IS 16172 shall withstand 2 million cycles (2000000 Nos)of varying axial tensile load with a stress range of 60 MPa with upper stress in the test equal to 0.6fy.

PRODUCTION TESTS & ACCEPTANCE CRITERIA FOR A LOT

Static Tensile tests, as per ASTM A370, shall be conducted on each bar size & grade for each lot as follows. The criteria mentioned below are in variance with the above referred codes.

SI. No.	No of Coupler in the Lot	No of Sample to be Tested	Acceptable Defective Couplers
1	Upto 500	14	NIL
2	501 - 1200	20	NIL
3	1201-3200	32	1
4	3201-10000	50	2

5	10001 and above	50+ 2 for each 1000 Nos beyond 10000	Not more than 4% of the samples tested
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The lot is defined as the group of couplers which are of same size, type, class, material traceable to same cast and manufactured under similar conditions of production. All the tests shall ensure guaranteed bar break at a load not lower than the specified tensile strength of the bar. The quoted rate shall be inclusive of carrying out above tests and no separate payment shall be made for these tests.

The Contractor shall submit to the engineer for acceptance a report on these Proving Tests, within seven working days of the tests. The report shall provide full details including:

- (a) Results of all tests
- (b) Details of dimensions, geometry. (c) Details of test procedures
- (c) Description of test rig/load cell
- (d) Description of load monitoring, strain measurements
- (e) Calibration certificates.

From each test on the coupler and control bar specimens, the following information shall be provided:

- (a) Stress-Strain (or Load Displacement) curves b) Yield Load & Yield Strength
- (b) Elongation of the mechanical connection
- (c) Ultimate load & Ultimate Tensile Strength e) Mode of failure
- (d) Gauge length used for strain measurement and statement of how gauge length was determined.

Lapping will not be permitted anywhere other than piles for bar dia of 20 mm and above.

5.6 Spacing, Supporting and Cleaning

All reinforcement shall be placed and maintained in the positions shown on the drawings.

The Contractor shall provide approved types of supports for maintaining the bars in position and ensuring required spacing and correct cover of concrete to the reinforcement as specified on the drawings. Cover blocks of required shape, size and strength M.S. Chairs and spacer bars shall be used to ensure accurate positioning of reinforcement. Cover blocks shall be cast well in advance and shall consist of approved proprietary pre-packaged free flowing mortars having the strength same as that of concrete for the member for which they are to be used. They shall be circular in shape for

side cover and square for bottom cover. Cover blocks shall be cast and compacted using plate vibrator or any other approved method and shall be cured so as to achieve the desired strength. The cost of cover blocks and chairs/spacers shall be deemed to have been included in the Lumpsum Price.

Bars must be cleaned, before concreting commences, of all scale, rust or partially set concrete which may have been deposited there during placing of previous lift of concrete.

Cleaning of HYSD Bars

Only TMT bars complying to IS:1786 shall be provided

18 gauge 2 ply G.I. wire shall be used for binding reinforcement and as well as for tying cover blocks.

5.7 Welding

1. Wherever specified all lap and butt welding of bars shall be carried in accordance with IS: 2571. Only qualified welders duly tested and certified by the contractor shall be permitted to carry out such welding.
2. For cold twisted reinforcement welding operations must be controlled to prevent supply of large amounts of heat larger than that can be dissipated. The extreme non twisted end portion shall be cut off before welding. Electrodes with rutile coating should be used.
3. Bars shall be free from rust at the joints to be welded.
4. Slag produced in welding after each run should be chipped and removed by brush.
5. Electrode should not be lighted by touching the hot bar.
6. The welding procedure shall be approved by the Engineer and tests shall be conducted to prove the soundness of the welded connection.
7. E7018 electrode shall be used for Fe415 grade and E8018 electrode shall be used for Fe500 above as per AWS (American Welding Society) standards.

Sl. No.	Bar Dia (mm)	Standard sectional weight in Kg./ m
1	6	0.222
2	8	0.395
3	10	0.617
4	12	0.888
5	16	1.578
6	18	2.000

7	20	2.466
8	22	2.980
9	25	3.854
10	28	4.830
11	32	6.313
12	36	7.990
13	40	9.864
14	45	12.490

5.8 Measurement

The Payment of reinforcement steel is included in the lumpsum price of price schedule.

The cost quoted should cover all welding, providing mechanical couplers, all types of laps, stiffners, hooks, spacer bars, U-bars, standard laps, chair, bend deduction as per IS code, as required and nothing extra is payable on this account and also in case if it is recorded in bar bending schedule, payment will not be made for these bars. Payments shall not be made for butt welding and reinforcement bars used for lifting, hooks, handling, etc., as cost towards these is deemed to be included in the lumpsum price schedule

List of Approved Make/ Likely Suppliers

All the materials and products shall conform to the relevant Standard Specifications, IS codes and other relevant codes etc. and shall be of approved make and design.

The list of approved makes for products and materials is given below. Other equivalent manufacturer can only be considered with prior approval of the Employer subject to testing of the material for equivalent specification and properties.

1. Cement Ultratech, ACC, Gujarat Ambuja, Shree Lakshmi, JK Cement and Grasim.
2. Reinforcement bars Primary sources viz. TISCO, SAIL, JSW, RINL. In case of shortfall of above particular diameter, their approved conversion Agents viz. SRMB, Ramsarup Utpadak, Usha Rathi, Shyam steel.
However the billet has to be procured from the primary producers on and proper quality control to be ensured.
3. Epoxy FOSROCK, MBT, SIKA QUALCRETE, Araldite,CIBA,GEIGY.
4. Expansion Joints Empanelled Suppliers as per Ministry of Road Transport & Highways letter no. RW/NH-34059/1/96-S&R dated 20 Feb 2001 & any amendments to the same.
5. Admixtures FOSROCK, MBT, Asian Lab, MC Baucheme, Sika, BASF, Pidilite.

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| 6. | Waterproofing system | CICO, FOSROC, MBT, SIKA, SUPREME, SILTECH chemicals, Krypton Build mat Co., Pidilite. |
| 7. | Pile Integrity Test | BRI, FUGRO-KND, Pile Dynamic, AIMIL, Geotech, Geo Dynamic Struct Geotech Research Laboratories Pvt Ltd., Bangalore. |
| 8. | Anchor Fastener | HILTI, BOSCH, Tyrolite. |
| 9. | Structural Steel | TATA, SAIL, JSW, Jindal, RINL. |
| 10. | Pre- stressing Strand | TATA SSL Ltd, Indore Wire (LRPC), Usha Martin, Sumitomo Wire Corporation. |
| 11. | Pot/Elastomeric Bearings | a) Prequalified Manufacturers as per Ministry of Road Transport & Highways Letter No. RW/NH-34057/1/95- S&R dated 2 Nov 2002 & any amendments to the same
b) RDSO, Lucknow Prequalified/approved manufacturers. |
| 12. | Horizontal Tie bars / Shear key system & Hold-down devices. | BB Bars System, ETIC system, Macalloy System |
| 13. | Formwork Release Agent | FOSROC, MBT, MC Baucheme |
| 14. | Prestressing System | Freyssinet, BBR, VSL, Dynamic, Killick, Nixon, Tensacciai (Italy), Macalloy, Dwyidag, Ushamartin. |
| 15. | Reinforcement Couplers | Usha Ismal, Dextra, BBR, Moment. |
| 16. | Form work suppliers | Pranav, L&T, Maruthy Fab (Pune), Dywidag (Grips India), Ideb India Ltd., Bangalore, Giri Engineering, (Yelanka, Bangalore) |
| 17. | Micro silica | Elkem, Fosroc, 20 Microns India Ltd. |
| 18. | Non-Shrink Compound | Fosroc, Roff, Sika |
| 19. | Testing labs | Civil AIDS, Karnataka test house and any other engineering College |
| 20. | Pile Testing | Civil Aid, Geo Dynamics22. MS rounds/hollow sectors Bihar Fabs Ltd. |
| 21. | Curing Compound | Fosroc, Sika. |

Materials are to be supplied from Approved suppliers list only. In exceptional circumstances suitable alternatives can be permitted by K RIDE at its discretion on sufficient reason and details to be furnished by the contractor for such change. Engineer's decision is final in this regard and binding to the contractor.

SECTION- 06
PRESTRESSED CONCRETE

SECTION- S.06**6. PRESTRESSED CONCRETE**

Structural concrete containing prestressed steel reinforcement to introduce pre-compression is termed as prestressed concrete.

6.1 General

The work shall be carried out in accordance with the drawing and these specifications or as approved by the Engineer.

Concrete and un tensioned steel for the construction of prestressed concrete members shall conform to the requirements of sections respectively in so far as the requirements of these Sections apply and are not specifically modified by requirements set forth herein.

Contractor shall ensure that different components of prestressing such as jacks, bearing plates, wedges, anchorages, strands and HDPE ducts are compatible to one another and the same shall be exchanged in between all the suppliers to ensure the same.

6.2 Scope of Work:

The general scope of work will include:

- i. Providing and placing cement concrete with all ingredients and admixtures if and as required.
- ii. All arrangements needed to keep the reinforcement bars, pre-tensioned strands and sheathing in position with due spacing & cover blocks
- iii. Providing steel shuttering, staging, scaffolding, erection & eventual removal.
- iv. Providing and placing in position and fixing permanent specialized bearings with the super structure, with their anchor bolts as per detailed specifications/instructions as stipulated, supplemented by manufacturer's specifications and directions of Engineer including grouting of holes etc. if any, with suitable grouts as approved by the Engineer.
- v. Installation of expansion joints in stages over the viaduct deck as per approved drawings and as per manufacturer's specifications/directions of Engineer.
- vi. Contractor to furnish facility for fixing/embedding all necessary electrical or other fixtures by the designated contractors at site.
- vii. Providing and mixing cement concrete with all ingredients and admixtures if and as required.
- viii. Casting, curing, with steam/water as adopted, stacking at casting yard including all handling, re-handling and interim storage operations as required for precast girders.
- ix. Loading at casting yard, transportation to site in accordance with the prevailing traffic rules and regulations, unloading and stacking at site for precast girders.

- x. Provision of necessary & suitable packing to maintain the required gap between precast girders.
- xi. Protection of reinforcement, required to be left for Integration of the precast unit with top deck slab cast in place and bending the reinforcement to required shape after precasting & till their embedment in concrete.
- xii. Transporting precast segment to the location of placement, hoisting & placing in correct position, including all handling operations.
- xiii. The operation of placing precast segment over brackets/pier arms on teflon/neoprene pads/tar paper including the cost of all operations involved, appropriate setting of superstructure.
- xiv. Fixing/embedding any fixture supplied by the Employer.
- xv. The handling, carriage and storage of HT strands as per manufacturers' specification.
- xvi. The H.T. strands will be procured by the Contractor. The extra pieces of HT strands cut after the stressing of the cable will be the liability/property of the Contractor.
- xvii. Cost of all other items of materials, plants and equipment and works (not specifically excluded above) for proper prestressing operation of the strands in accordance with the provisions contained elsewhere in the tender documents will be included in the cost of this item.
- xviii. Providing/supplying and operating etc. of jacks and power pumps for prestressing, recording of data, tabulating the same in necessary formats for submission. The item will also include corrective measures that may be necessary and required by the Engineer.

6.3 Materials

6.3.1 Sheathing

Material for all pre-stressing sheathing duct shall be HDPE in the form of corrugated.

The Thickness of the HDPE sheathing ducts shall be as per conforming to IRS Concrete Bridge Code-1997 & IRC -112:2011 , with modifications as stated below).

For Anchorage system 19 K K 15, HDPE ducts of 124mm OD/ 107mm ID (tolerance + 1mm) with minimum thickness of ducts 3.00 mm

For Anchorage system 12 K K 15, HDPE ducts of 100 mm OD/ 85 mm ID (tolerance + 1mm) with minimum thickness of ducts 2.50 mm

For Anchorage system 7 K K 15, HDPE ducts of 84 mm OD/ 69 mm ID (tolerance + 1mm) with minimum thickness of ducts 2.50 mm

The material for the ducts shall be high-density polyethylene with more than 2 percent carbon black to provide resistance to ultra-violet degradation and shall have the following properties:

Density (IS 2530): 0.94 – 0.96 g/cm³ at 230C

Tensile Strength at yield (BS EN ISO 527-3): 20-26 N/mm²

Shore Hardness D (BS EN ISO 2039-1) : 3 sec – 60 min, 15sec – 58min

Elongation at Yield (BS EN ISO 527-3): 7 % (min)

Melt Flow Index (MFI) (IS: 2530) : 0.4 - 0.6 g /10 minutes (Temperature 190° C under a mass of 5 kg.)

Charpy Impact strength of notched specimen (BS EN ISO 179) At 23°C: 10 kJ/m²-40°C: 4 kJ/m²
 Coefficient of Thermal Expansion for 20°C – 80°C (DIN 53 752): 1.50 x 10⁻⁴ / °C
 Environmental Stress Crack Resistance (ASTM D-1693) at 70°C: 192 Hrs

The residual wall thickness after loss (wear resistance) shall not be less than 1.5mm for ducts upto 85mm diameter and 2mm for ducts diameter above 85mm as per IRC –112:2011.

The ducts shall be corrugated on both sides. The duct shall transmit full tendon strength from the tendon to the surrounding concrete over a length not greater than 40 duct diameters. Material and formulation of sheathing ducts shall conform to test and acceptance criteria of Appendix 1B of IRC: 18-2000.

These ducts shall be joined by adopting any one or more of the following methods, as convenient to suit the individual requirements of the location, subject to satisfactory pressure tests, before adoption.

- Screwed together with male and female threads
- Joining with thick walled HDPE shrink couplers with glue. This can also be used for connection with trumpet, etc
- Welding with electro-fusion couplers.

The joints shall be able to withstand an internal pressure of 0.5 bar (0.05 MPa) for 5 minutes as per water loss test procedure given in Appendix-B of IRS Concrete Bridge Code-1997 (Addendum & corrigendum Slip No.5 Dated 19.11.2001).

The initial acceptance tests such as bond test; compression test are required to be performed as acceptance criteria for system. In addition to above, friction test as given in FIB bulletin.No-7 are also required to be performed as acceptance criteria. Test conducted by supplier in the past shall not be regarded as acceptance criteria.

The routine test such as workability test, transverse load rating test, tension load test and water loss test shall be applicable for both post threading and pre - threading system of cables. Loads to be imparted on the 107mm ID sheathing during transverse load rating test and tension load test shall be extrapolated from values given for smaller dia sheathing. At least 3 samples for one lot of supply (not exceeding 3000 metre length) shall be tested.

In viaduct constructed by precast segmental construction, cables shall be threaded after application of temporary prestressing. In continuous unit, constructed by cantilever construction techniques the cantilever cables will be stressed as various segments are cast progressively. Such cables shall be threaded after concreting. In such cases a temporary flexible PVC tube of 90 mm O.D shall be homed through sheathing which will provide adequate stiffness to sheathing during concreting and also prevent blockage of sheathing in case of possibility of leakage. The temporary PVC tube shall be pulled out before threading of the permanent cables.

6.4 Anchorages

6.4.1 Anchorages shall be procured from authorised manufacturers only. Anchorages shall conform to BS: 4447.

Load transfer test and anchorage efficiency shall be conducted as defined in FIP-1993. Engineer in-charge shall select at random, the required anchorage / wedges sample from completed lots for testing by the manufacturer. The concrete unit of required size/R/F will be made by contractor using same design mix of concrete which will be required for the load transfer test. The load transfer test shall be conducted at the strength of concrete at which stressing are proposed in the drawings.

No damaged anchorages shall be used. Steel parts shall be protected from corrosion at all times. Threaded parts shall be protected by greased wrappings and tapped holes shall be protected by suitable plugs until used. The anchorage components shall be kept free from mortar and loose rust and any other deleterious coating.

After completion of pre-stressing and grouting of cable in PSC girders, the extra length pre-stressing strands projecting outside the anchorage are required to be cut at the anchor end and anchor end is to be sealed.

Swages of prestressing strand shall develop strength of at least 95 per cent of the specified breaking load of the strand.

Un-tensioned Steel reinforcement, around anchorages shall be furnished by prestressing system supplier. Requirement of the same should be job specific and based on edge distance of anchorage and strength of concrete at the time of stressing of cables as defined in drawings. The same R/F shall be provided in unit required for load transfer test.

Minimum 3 tests each are required to be conducted for load transfer test and anchorage efficiency test. The manufacturer shall complete the required testing and determine compliance the result with FIP-1993 recommendations before transporting the lot to site.

6.5 Prestressing Steel

Uncoated stress relieved low relaxation steel conforming to IS: 14268, class - 2 shall be used. Nominal dia shall be 15.2 mm with minimum breaking strength of 260.7 KN and minimum 0.2 % proof load of 234.6 KN. various tests as recommended in IS: 14268 shall be conducted before transporting the lot to site. Apart from 1000 hrs relaxation test conducted by manufacturer, at least two such tests are required to be conducted by independent agency in the beginning of the project.

6.5.1 Prestressing Strands/Wires Storage

All high tensile steel for prestressing work shall be stored about 30cm above the ground in a suitably covered and closed space to protect it from dampness. It shall also be invariably wrapped in gunny

cloth or tar paper or any other suitable material, as per approval of Engineer. Even if it is to be stored in an area at the site for the short time during transportation it shall be suitably covered. Protection during storage and repacking or application of washable protective coating to the H.T. steel shall be given by the contractor at no extra cost if the packing of H. T. Strand/wire during unloading and storage / handling in the stores gets damaged.

Stock piling of H. T. Steel on the work site shall not be allowed any time, especially before and during the monsoon.

Strand shall be stored in large diameter coils.

Engineer-in-Charge or his authorized representative shall always have an easy access to the store-yard for inspecting the H.T. Wire / strands / Bars and satisfying themselves regarding the condition thereof. Any modification regarding storage suggested by Engineer shall scrupulously be followed by the contractor. During monsoon days, H.T wires/strands shall be kept in reasonable air tight store, if required by the Engineer, at no extra cost.

6.6 Testing of Prestressing Steel and Anchorages

Contractor should submit friction and wobble coefficient of prestressing system proposed to be used. GFC will be based on the above data

All materials specified for testing shall be furnished free of cost and shall be delivered in time for to be made well in advance of anticipated time of use.

All strands to be transported to the site shall be assigned a lot number and tagged for identification purposes. Anchorage assemblies to be transported shall be like-wise identified.

All samples submitted shall be representative of the lot to be furnished and in the case of strand, shall be taken from the same master roll. The Contractor shall furnish samples of at least 5.0m length selected from each lot for testing. Also, two anchorage assemblies, complete with distribution plates of each size or type to be used, shall be furnished along with short lengths of strands as required.

6.7 Workmanship

6.7.1 Cleaning

Tendons shall be free from loose rust, oil, grease, tar, paint, mud or any other deleterious Substance.

Cleaning of the steel may be carried out by immersion in suitable solvent solutions, wire brushing or passing through a pressure box containing carborundum powder. However, the tendons shall not be brought to a polished condition.

6.7.2 Straightening

High tensile strand shall be supplied in coils of sufficiently large diameter such that tendons shall retain their physical properties and shall be straight as it unwinds from the coil. Tendons of any type that are damaged, kinked or bent shall not be used.

The packing of prestressing strand shall be removed only just prior to making of cable for placement. Suitable stands shall be provided to facilitate uncoiling of strands without damage to steel. Care shall be taken to avoid the possibility of steel coming into contact with the ground.

6.7.3 Positioning

i. Post-Tensioning

- Prestressing tendons shall be accurately located and maintained in position, both vertically and horizontally, as per drawings.
- Tendons shall be so arranged that they have a smooth profile without sudden bends or kinks. Pull-in or push-in of the prestressing strands shall be mechanized,
- The location of prestressing cables shall be such as to facilitate easy placement and vibration of concrete in between the tendons.
- Sheathing shall be placed in correct position and profile by providing suitable ladders and spacers. Such ladders may be provided at intervals of approximately 1.0 m. Sheathing shall be tied rigidly with such ladders/spacer bars so that they do not get disturbed during concreting.
- The method of supporting and fixing shall be such that profile of cables is not disturbed during vibrations, by pressure of wet concrete, by workmen or by construction traffic.
- Each anchorage device shall be set square to the line of action of the corresponding prestressing tendon and shall be positioned securely to prevent movement during concreting.
- The anchorage devices shall be cleaned to the satisfaction of the Engineer prior to the placing of concrete. After concreting, any mortar or concrete, which adheres to bearing or wedging surfaces, shall be removed immediately.

6.7.4 Cutting

Cutting and trimming of wires or strands shall be done by suitable mechanical or flame cutters. When a flame cutter is used, care shall be taken to ensure that the flame does not come in contact with other stressed steel. The location of flame cutting of strand shall be kept beyond 75 mm of where the tendon will be gripped by the anchorage or jacks.

In post-tensioning, the ends of prestressing steel projecting beyond the anchorages shall be cut after the grout has set.

6.7.5 Protection of Prestressing Steel

Prestressing steel shall be continuously protected against corrosion, until grouted. The corrosion protector shall have no deleterious effect on the steel or concrete or on the bond strength of steel to concrete. Grouting shall conform to these specifications or as directed by the Engineer.

6.7.6 Sheathing

- The joints of all sheathings shall be water-tight. Special attention shall be paid to the junction at the anchorage end, where the sheathing must tightly fit on the protruding trumpet end of anchorage and thereafter sealed preferably with adhesive water proof tape as per approved manufacturer.
- The sheathing and all joints shall be water-tight. Any temporary opening in the sheathing shall be satisfactorily plugged and all joints between sheathing and any other part of the prestressing system shall be effectively sealed to prevent entry of mortar, dust, water or other deleterious matter. Sheathing shall be neatly fitted at joints without internal projection or reduction of diameter.
- Enlarged portions of the sheathing at couplings or anchorages shall be of sufficient length to provide for the extension of the tendons.

6.7.7 Grout Vents

Grout vents of at least 20 mm diameter shall be provided at both ends of the sheathing and at all valleys and crests along its length. Additional vents with plugs shall also be provided along the length of sheathing such that the spacing of consecutive vents do not exceed 20m. Each of the grout vents shall be provided with a plug or similar device capable of withstanding a pressure of 1.0 MPa without the loss of water, air pressure or grout

6.7.8 Anchorages

All bearing surfaces of the anchorages shall be cleaned prior to concreting and tensioning. Anchor cones, blocks and plates shall be securely positioned and maintained during concreting such that the centre line of the duct passes axially through the anchorage assembly.

The anchorages shall be recessed from the concrete surface as per drawings.

After the prestressing operations are completed and prestressing strands are cut, the surface shall be painted with two coats of epoxy of suitable formulation having a dry film thickness of 80 microns per coat and entire recess shall be filled with concrete or non-shrink/pre-packaged mortar or epoxy concrete.

6.7.9 Handling and Storage

Care shall be taken to avoid mechanically damaging, work-hardening or heating prestressing tendons while handling. All prestressing tendons shall be stored clear of the ground and protected from the weather, from splashes from any other materials, and from splashes from the cutting operation of an oxy-acetylene torch, or arc-welding processes in the vicinity.

In no circumstances shall prestressing tendons after manufacture be subjected to any welding operation, or 'on-site' heat treatment or metallic coating such as galvanising. This does not preclude cutting as specified.

All wires, strands or bars stressed in one operation shall be taken, where possible, from the same parcel. Each cable shall be tagged with its number from which the coil numbers of the steel used can be identified. Cables shall not be kinked or twisted. Individual wires and strands for which extensions are to be measured shall be readily identifiable at each end of the member. No strand that has become unraveled shall be used.

6.7.10 Supervision

All prestressing and grouting operations shall be undertaken by trained personnel only. A representative of supplier of the prestressing system shall be present during all tensioning and grouting operations and shall ensure, monitor and certify their correctness.

6.8 Post-Tensioning

Tensioning force shall be applied in gradual and steady steps and carried out in such a manner that the applied tensions and elongations can be measured at all times. The sequence of stressing, applied tensions and elongations shall be in accordance with the approved drawing or as directed by the Engineer.

It shall be ensured that in no case, the load is applied to the concrete before it attains the strength specified on the drawing or as stipulated by the prestressing system supplier, whichever is more.

After prestressing steel has been anchored, the force exerted by the tensioning equipment shall be decreased gradually and steadily as to avoid shock to the prestressing steel or anchorage.

The tensioning force applied to any tendon shall be determined by direct reading of the pressure gauges or dynamo-meters and by comparison of the measured elongation with the calculated elongation. The calculated elongation shall be invariably adjusted with respect to the modulus of elasticity of steel for the particular lot as given by the manufacturer.

Parallel measurement of prestressing force by load cell in combination with direct reading of pressure gauge shall be preferred. In any case such parallel measurements by load cell shall be made for at least 10% of the cables stressed during any tensioning operation

The difference between calculated and observed tension and elongation during prestressing operations shall be regulated as follows:

- a) If the calculated elongation is reached before the specified gauge pressure is obtained, continue tensioning till attaining the specified gauge pressure, provided the elongation does not exceed 1.05 times the calculated elongation. If 1.05 times the calculated elongation is reached before the specified gauge pressure is attained, stop stressing and inform the Engineer.
- b) If the calculated elongation has not been reached at the specified gauge pressure, continue tensioning by intervals of 5kg/sq.cm until the calculated elongation is reached provided the gauge pressure does not exceed 1.05 times the specified gauge pressure.
- c) If the elongation at 1.05 times the Specified gauge pressure is less than 0.95 times the calculated elongation, the following measures must be taken, in succession, to determine the cause of this discrepancy:
 - i) Check the correct functioning of the jack, pump and leads.
 - ii) Detention the cable. Slide it in its duct to check that it is not blocked by mortar which has entered through holes in the sheath. Retension the cable if free.
 - iii) Re-establish the modulus of elasticity of steel for the particular lot from an approved laboratory. Contractor may suggest other remedial measure for approval of the Engineer.
If the required elongation is still not obtained, further finishing operations as cutting or sealing, should not be undertaken without the approval of the Engineer.
- d) When stressing from one end only, the slip at the end remote from the jack shall be accurately measured and an appropriate allowance made in the measured extension at the jacking end.

A complete record of prestressing operations along with elongation and jack pressure data shall be maintained in the format given in Appendix 1800/II of MORT&H Specification.

- e) Any breakage of individual strand / groups of strands during tensioning shall require immediate destressing of all strands and replacement of the all the strands by fresh strands.

6.9 Grouting of Prestressed Tendons

Prior to grouting, all cables shall be tested with water pressure of 0.5 Bar (0.05 MPa) for approximately 5 minutes, to investigate leakages and connectivity of ducts. Where directed by the Engineer, the Contractor shall perform full scale site test to determine the adequacy of grout mix, equipment and grouting method. The Contractor shall submit a method statement detailing the test procedure.

All other aspects of grouting of cables shall be governed by. MORTH Specifications. A record of grouting operations shall be maintained in the format as given in Appendix 1800/IV of MORTH Specifications.

Handling and Storage

Care shall be taken to avoid mechanically damaging, work-hardening or heating prestressing tendons while handling. All prestressing tendons shall be stored clear of the ground and protected from the weather, from splashes from any other materials, and from splashes from the cutting operation of an oxy-acetylene torch, or arc-welding processes in the vicinity.

In no circumstances shall prestressing tendons after manufacture be subjected to any welding operation, or 'on-site' heat treatment or metallic coating such as galvanising. This does not preclude cutting as specified.

All wires, strands or bars stressed in one operation shall be taken, where possible, from the same parcel. Each cable shall be tagged with its number from which the coil numbers of the steel used can be identified. Cables shall not be kinked or twisted. Individual wires and strands for which extensions are to be measured shall be readily identifiable at each end of the member. No strand that has become unraveled shall be used.

All prestressing and grouting operations shall be undertaken by trained personnel only. A representative of supplier of the prestressing system shall be present during all tensioning and grouting operations and shall ensure, monitor and certify their correctness.

6.10 Tensioning Equipment

The tensioning apparatus shall meet the following general requirements:-

- i. The means of attachment of the tendon to the jack or tensioning device shall be safe and secure.
- ii. Where two or more wires or strands are stressed simultaneously, they shall be approximately of equal length between anchorage points at the datum of load and extension measurement. The degree of variation shall be small compared with the expected extension.
- iii. The tensioning apparatus shall be such that a controlled total force is imposed gradually and not dangerous secondary stresses are induced in the tendons, anchorage or concrete.
- iv. The force in the tendons during tensioning shall be measured by direct-reading load cells or obtained indirectly from gauges fitted in the hydraulic system to determine the pressure in the jacks. Facilities shall be provided for the measurement of the extension of the tendon and of any movement of the tendon in the gripping devices. The load-measuring device shall be calibrated to an accuracy within $\pm 2\%$ and checked at intervals to the approval of the

Engineer. Elongation of the tendon shall be measured to an accuracy within 2% or 2 mm, whichever is the more accurate.

- v. The tensioning equipment shall be calibrated before the tensioning operation and at intervals of the months or as approved by the Engineer. Any indication in the loss of strength in tendons during the tensioning operation shall be brought to the attention of the Engineer. Any corrective measures which may be required in procedures and/or material shall be approved by the Engineer.

When friction must be reduced, water soluble oil may be used subject to the approval of the Engineer. This oil may be flushed from the duct as soon as possible after stressing is completed by use of water pressure. These ducts shall be flushed again just prior to the grouting operations. Each time the ducts are flushed, they shall be immediately blown dry with oil-free air.

6.11 Testing by Contractor

For the purpose of accurately determining the tendon elongations while stressing, the Contractor shall bench test two samples of each size and type of strand tendon to determine the modulus of elasticity prior to stressing the initial tendon. The bench should be at least 6 metres long, with concrete anchorage blocks having a constant area end section of at least four times that of the anchorage assembly area. The tendon shall be straight and centered on the cross-sectional area of the bench. The test procedure shall consist of stressing the tendon at an anchor assembly with the dead end consisting of a load cell. The test specimen shall be tensioned to 80 percent of ultimate to 0 in 10 increments. For each increment, the gauge pressure, elongation and load cell force shall be recorded. The data shall be furnished to the Engineer. The theoretical elongations shown on the post-tensioning working drawings shall be reevaluated by the Contractor using the results of the tests and corrected as necessary. Revisions to the theoretical elongations shall be submitted to the Engineer for approval. Apparatus and methods used to perform the tests shall be proposed by the Contractor and be subject to the approval of the Engineer. After the initial testing, five (5) more tests shall be performed. These tests shall be spaced evenly throughout the duration of the Contract.

6.12 Pretensioning

Where pretensioning methods are used, the tension shall be fully maintained by some positive means during the period between tensioning and transfer. The transfer of stress shall take place slowly to minimize shock.

i. Straight Tendons

In the long line method of pretensioning, sufficient locator plates shall be distributed throughout the length of the bed to ensure that the wires or strands are maintained in their proper position during concreting. Where a number of units are made in the line, they shall be free to slide in the direction of their length and thus permit transfer of the prestressing force to the concrete along the whole line.

In the individual mould system the moulds shall be sufficiently rigid to provide the reaction to the prestressing force without distortion.

ii. Deflection Tendons

Where possible the mechanisms for holding down or holding up tendons shall ensure that the part in contact with the tendon is free to move in the line of the tendon so that frictional losses are nullified. If, however, a system is used that develops a frictional force, this force shall be determined by test and due allowance made as agreed by the Engineer.

For single tendons the deflector in contact with the tendon shall have a radius of not less than 5 times the tendon diameter for wire or 10 times the tendon diameter for a strand, and the total angle of deflection shall not exceed 15° . Where the radius is less than 5 times the diameter of the tendon and the angle of deflection exceeds 15° , the loss of strength of the tendon shall be determined by test and due allowance made.

The transfer of the prestressing force to the concrete shall be effected in conjunction with the release of hold-down and hold-up forces as approved by the Engineer.

6.13 Pre Tensioning

- a) Pre-stressing strands shall be of diameter as per drawing, uncoated stress relieved low relaxation steel & from approved source
- b) Stock piling of HT Strands at site shall not be done especially during before & after monsoon season.
- c) HT Strands shall be stored about 30cm above the ground in a suitably covered & closed space to protect it from dampness.
- d) It shall also be wrapped with any suitable material for its protection against moisture & unwanted materials.
- e) The number of uncoated strands shall be placed in the reinforcement cage as per the span length mentioned in the approved drawings.
- f) In a number of strands, the number of fully bonded and partially bonded strands shall be identified as per the drawings.
- g) The partially bonded strands shall be a set of strands having a de-bonded length that shall be measured from the face of recess at the end of the pre cast element.
- h) The length of de-bonded strands from recess face shall be as per approved drawings.
- i) Strands shall be initially stressed with small pre-stressing force to remove slackness of the strands.
- j) After removal of slackness, strands & de-bonding tubes shall be thoroughly examined to ensure correct alignment.
- k) The strands shall be stressed at the stressing force as approved.
- l) Stressing shall be done with Stressing jacks by approved stressing agency.
- m) Stressing of strands shall be done either by single pull or multi pull jack, in case of single pull jack it shall be ensured that the strands shall be stressed symmetrically with respect to the centre line of the pre cast element.

- n) Stressing with multi pull jack shall also be done in proper sequence so that the transfer of stresses to concrete portion shall be uniform.
- o) A complete record of prestressing operations along with elongation and jack pressure data shall be maintained in the format given in MORT&H Specification

6.14 Post-tensioning

i) Arrangement of Tendons

Where wires, strands or bars in a tendon are not stressed simultaneously, the use of spacers shall be in accordance with the recommendations of the system manufacturer.

ii) Anchorages

- (a) Anchorages shall be tested in accordance with the requirements of BS 4447.
- (b) For each anchorage system used in the Works, the characteristic value for anchorage efficiency shall be not less than 90%.
- (c) Proprietary anchorages shall be handled and used strictly in accordance with the manufacturer's instructions and recommendations.

iii) Deflected Tendons

The deflector in contact with the tendon shall, have a radius of not less than 50 times the diameter of the tendon, and the total angle of deflection shall not exceed 15 degrees unless otherwise agreed by the Engineer.

iv) Tensioning Procedure

Before tensioning, the Contractor shall demonstrate that all tendons are free to move in the ducts unless the geometry of the ducts makes this impracticable as agreed by the Engineer. Tensioning shall be carried out in such a manner that the stress in the tendons increases at a gradual and steady rate.

Unless otherwise described in the Contract, concrete shall not be stressed until it has reached at least the age at which 2 test cubes taken from it attain the specified transfer strength. The test cubes shall be made and tested as described in BS 1881. They shall be cured in similar conditions to the concrete to which they relate in a manner approved by the Engineer.

The Contractor shall cast sufficient cubes to demonstrate that the required strength of the concrete at transfer has been reached.

The Contractor shall ensure that those carrying out the stressing are provided with particulars of the required tendon loads, order of stressing and extensions. Allowance shall be made during stressing for the friction in the jack and in the anchorage, although the former is not necessary when using load cells.

Any allowance for draw-in of the tendon during anchoring shall be in accordance with the Engineer's instructions.

Stressing shall continue until the required extension and tendon load are reached or are approved by the Engineer.

The extension shall allow for any draw-in of the tendon occurring at the non-jacking end, but measurement shall not commence until any slack in the tendon has been taken up.

Immediately after anchoring, the forces in the prestressing tendons shall not exceed 70% of their characteristic strength. During stressing the value may exceed 70% of their characteristic strength, with the approval of the Engineer, but shall not exceed 80%.

After the tendons have been anchored, the force exerted by the tensioning apparatus shall be decreased gradually and steadily so as to avoid shock to the tendon or the anchorage.

Full records shall be kept of all tensioning operations, including the measured extensions, pressure-gauge or load-cell readings, and the amount of draw-in at each anchorage. Copies of these records shall be supplied to the Engineer within 24 hours of each tensioning operation.

Unless otherwise agreed by the Engineer tendons shall not be cut less than 3 days after grouting.

6.15 Prestressing Tendons - Protection and Bond

The prestressing tendons shall be protected in their permanent positions from both mechanical damage shall be applied to all unbounded prestressing tendons within 28 days of installation of the tendon in the duct.

The tendon protection compound applied to the and corrosion as described in the Contract and the following sub-clauses.

The exposed tendons at the anchorages and the anchorages themselves shall be sealed within a closed box and protected from both mechanical damage and corrosion. Suitable access shall be left for jacking equipment for the later removal of the strands of unbounded tendons. The means of protection shall be designed by the prestress supplier and approved by the Engineer.

A tendon protection compound tendons shall be a micro-crystalline wax (petrolatum) base material containing additives to enhance the corrosion inhibiting, wetting, and moisture displacing properties, as well as the ability to form a polar bond with the tendon steel.

The compound Manufacturer shall provide test data verifying that the following properties are met for the service life of 120 years and temperature range of 0°C to 50°C evaluation and acceptance by the Engineers:

- a. freedom from cracking and brittleness;
- b. continuous self-healing film over the coated surfaces;
- c. chemical and physical stability;
- d. non reactivity with the surrounding and adjacent materials such as concrete, tendons, and ducts;
- e. moisture displacing characteristics.

Additionally it shall remain flexible to allow removal and replacement of the tendons. The tendon protection compound and its method of installation shall be approved by the Engineer.

Provision shall be made for expansion of the tendon protection compound during the lifetime of the structure.

Before installing the tendon protection compound it shall be demonstrated that the ducts, U-bend anchorage and anchorages are clean and free of water and chlorides.

The tendons, internal face of the steel u-bend anchorage, stressing anchorages and any other metallic components of the prestressing system shall additionally be pre-treated with a protection compound before delivery to site. The protection compound shall be applied to each strand of the tendon and shall be compatible with the tendon protection compound injected into the ducts. The protection compound shall be approved by the Engineer.

The supplier of the tendon protection compound shall submit for the Engineer's approval proposals which shall describe how the tendon protection compound can be removed and re-injected into ducts, including buried ducts, within the permanent works.

All materials used in the prestressing systems shall not give off toxic fumes at temperatures below 50°C and shall not support combustion.

6.16 Ducts for Bonded Tendons

Ducts for longitudinal, transverse or vertical tendons embedded into the concrete may be of flexible, semi-rigid, or rigid galvanized, ferrous metal capable of withstanding concrete pressures without deforming or permitting the entrance of cement paste during casting of the member. They must retain their shape and be capable of transferring bond stresses. The semi-rigid duct must be rigid enough to remain straight when supported at 1200 mm maximum intervals but flexible enough to allow 3600 mm radius curves. Flexible duct shall be secured or supported at not more than 300 mm intervals.

6.17 Grouting of Prestressing Tendons

1. General

The Contractor shall undertake grouting trials when required by the Engineer

2. Materials

Unless otherwise directed or agreed by the Engineer as a result of grouting trials, the grout shall consist only of Ordinary Portland

Cement and water. The water/cement ratio shall be as low as possible consistent with the necessary workability, and under no circumstances shall the W/C ratio exceed 0.45 by weight.

The grout shall not be subject to bleeding in excess of 2% after 3h or 4% maximum when measured at 25°C or such other temperature as may be approved by the Engineer, in a covered cylinder approximately 10mm diameter with a height of grout of approximately 100 mm, and the water shall be reabsorbed by the grout during the 24h after mixing.

Admixtures may be used with the written permission of the Engineer and shall be applied strictly accordance with the manufacturer's instructions. Admixtures shall not contain chloride ions in excess of 0.25 percent by weight. Dry materials shall be measured by weight.

Dry materials shall be measured by weight.

3. Ducts

Air vents shall be provided at any crests in the duct profile and elsewhere as specified. All ducts shall be thoroughly clean before grouting. Ducts formed without metal sheathing shall be provided with effective drainage and, unless otherwise directed by the Engineer, shall be flushed with water before grouting. All surplus water shall be removed by compressed air injection. All anchorages shall be sealed or fitted with grouting connections.

4. Grouting Equipment

The mixing equipment shall produce a grout of homogeneous consistency and shall be capable of providing a continuous supply to the injection equipment. The injection equipment shall be capable of continuous operation with little variation of pressure and shall include a system for recirculating the grout while actual grouting is not in progress. Compressed air shall not be used.

The equipment shall have a sensibly constant delivery pressure not exceeding 1 N/mm². All piping to the grout pumps shall have a minimum of bends, valves and changes in diameter. All baffles to the pump shall be fitted with 1.18 mm sieve strainers. All equipment, especially

pipings, shall be thoroughly washed through with clean water after every series of operations and at the end of use for each day. The interval between washing shall not exceed 3h.

The equipment shall be capable of maintaining pressure on completely grouted ducts and shall be fitted with a valve that can be locked off without loss of pressure in the duct.

5. Mixing

Water shall be added to the mixer first, then the cement. When these are thoroughly mixed, the admixture, if any, shall be added. Mixing shall continue until a uniform consistency is obtained. Mixing shall not be by hand.

6. Injecting Grout

Grouting shall be carried out as soon as is practicable after the tendons in them have been stressed and anchors trimmed and the Engineer's permission to commence has been obtained. Injection shall be continuous, and it shall be slow enough to avoid producing segregation of the grout. The method of injecting grout shall ensure complete filling of the ducts and complete surrounding of the steel. Grout shall be allowed to flow from the free end of the duct until its consistency is equivalent to that of the grout injected. The opening shall then be firmly closed. Any vents shall be closed in a similar manner one after another in the direction of the flow. After an appropriate time, further injections shall be carried out to fill any possible cavities.

The injection tubes shall then be sealed off under pressure until the grout has set.

The filled ducts shall not be subjected to shock or vibration within 1 day of grouting.

Not less than 2 days after grouting, the level of grout in the injection and vent tubes shall be inspected and made good as necessary.

The Contractor shall keep full records of grouting including the date each duct was grouted, the proportion of the grout and any admixtures used, the pressure, details of any interruptions and topping up required. Copies of these records shall be supplied to the Engineer within 3 days of grouting.

Where required by the Engineer, the Contractor shall provide facilities and attendance for the radiographic testing of duct.

7. Strength of Grout

The compressive strength of 100 mm cubes made of the grout shall exceed 17 N/mm² at 7 days. Cubes shall be cured in a moist atmosphere for the first 24h, and subsequently in water.

6.18 Ducts for Unbonded Tendons

Unless shown otherwise on the Drawings, ducts and injection tubes in the superstructure and substructure shall be formed from high density polyethylene (HDPE) which shall incorporate a stabilizing agent to prevent Ultra Violet Light (UVL) degradation.

The minimum wall thickness of the ducts shall be such that the ducts are capable of resisting the pressures developed during installation of the protection compound. The ducts shall be smooth bore.

Ducts with external diameters greater than 70 mm shall be transported and stored in straight lengths. The distance between supports shall be limited to 3m and the height of storage to 1.5 m. Alternatively, ducts may be transported and stored in coils provided that they are fixed to the tolerances required by the Designer.

Damaged ducts shall not be used in the Works.

No boring of any No boring holes in the ducts shall be permitted once the tendons are installed.

U-bend anchorages shall be formed from smooth-bore unwelded steel tubes and shall comply with the requirements of BS 4360.

Joints between ducts, ducts and anchorages and ducts and U-bend anchorages shall be formed by a coupling device using thermo-fusion techniques which shall provide a watertight seal to the ducts and shall be capable of resisting the pressure developed during installation of the tendon protection compound. The inner surfaces of the joints shall form a smooth transition between ducts and U-bend anchorages to allow satisfactory installation of the tendons. All coupling devices shall be approved by the Engineer.

Injection tubes shall be provided at the U-bend anchorages, the stressing anchorages and at any other positions on the length of the ducts which are required to achieve satisfactory installation of the tendon protection compound. The injection tubes at the U-bend anchorages shall also be used as drainage points for the U-bend. The connection between the ducts and the injection tubes shall be watertight and capable of resisting the pressure developed during installation of the tendon protection compound.

All injection tubes shall be sealed after use to prevent the ingress of water to the satisfaction of the Engineer.

After completion of all duct joints and before completion of the insitu joints between precast segments and before installation of the tendons, all ducts shall be air tested to an equivalent 100 mm water gauge unless otherwise directed by the Engineer. The test shall be performed in accordance with BS 8301 Section 5.

Any ducts which do not contain tendons shall remain empty and shall be sealed at each end to prevent the ingress of water.

6.19 Prestressing Tendons - Trial Construction-Unbonded Tendons

Before commencing construction of the precast segments a trial shall be carried out which shall demonstrate the satisfactory installation, removal and replacement of a prestressing strand together with the proposed techniques for duct jointing, duct testing and installation of the tendon protection compound.

- i. The tendons shall be stressed in accordance with this Specification.
- ii. The ducts shall be filled with a tendon protection compound in accordance with the specification as detailed in relevant subsections and the tendon extension and anchorage shall be protected as if they were to be included in the permanent works.
- iii. The trial shall demonstrate that any one strand may be destressed, removed, inspected, replaced and re-stressed and that no voids are created within the tendon protection compound, all to the satisfaction of the Engineer.
- iv. The trial shall also demonstrate that all of the strands in a duct may be removed and that the tendon protection compound can be removed from the ducts and U-bend anchorage to the satisfaction of the Engineer.
- v. The trial shall be undertaken using the prestressing system to be used in the permanent works and shall be approved by the Engineer.

Prestressing Tendons - Temporary Tendons

Temporary tendons may be re-used as temporary tendons elsewhere provided special precautions are incorporated at the anchorages to ensure tendons are not damaged. These precautions shall be approved by the Engineer.

The tendons shall be enclosed within a duct throughout their length.

The tendons shall be pre-treated in accordance with the specifications as detailed in relevant subsections and the protection compound shall be applied to the outer surfaces of the tendon after each use.

The maximum jacking force for the re-usable temporary tendons shall not exceed 70 percent of their guaranteed minimum breaking load.

After removal of the tendons the ducts shall be sealed at each end to prevent the ingress of water.

6.20 Preparation for Casting

- a) The Contractor shall submit for approval, in accordance with the provisions of the Employer's Requirements, working drawings of the prestressing system proposed for use. For initial review, 3 sets of such drawings shall be submitted.

- b) After review, between 6 and 12 sets, as requested by the Engineer, shall be submitted for final approval and for use during construction.
- c) The working drawings of the prestressing system shall show complete details and be accompanied by substantiating calculations of the method and materials the Contractor proposes to use in the prestressing operations, including any additions or rearrangement of reinforcing steel from that shown on the Drawings. Such details shall outline the method and sequence of stressing and shall include complete specifications and details of the prestressing steel and anchoring devices, working stresses, anchoring stresses, type of ducts, and all other data pertaining to the prestressing operation, including the proposed arrangement of the prestressing steel in the members.
- d) Working drawings shall be A1 size and each drawing and calculation sheet shall include the job site, name of the structure as shown on the Contract Drawings and Contract name.
- e) Working drawings shall be submitted sufficiently in advance of the start of the affected work to allow time for review by the Engineer and correction by the Contractor of the drawings without delaying the work. Such time shall be proportional to the complexity of the work but in no case shall such time be less than eight (8) weeks.
- f) At the completion of each structure, one set of reproducible mylars of the corrected original tracing of all working drawings for said structure shall be furnished to the Engineer. Drawings which are common to more than one structure shall be provided for each structure. An index prepared specifically for the drawings for each structure containing sheet numbers and titles shall be included.
- g) Reinforcing steel shall be fabricated and placed in accordance with the Drawings. and as required herein. No reinforcing steel shall be cut and removed to permit proper alignment of stressing ducts. Any bar that cannot be fabricated to clear the conduits shall be replaced by additional bars with adequate lap lengths and shall be submitted to the Engineer for approval. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 12 mm or one-tenth (1/10) of the spacing between bars, whichever is less.
- h) All prestressing steel shall be protected against physical damage and rust or other results of corrosion at all times from manufacture to grouting or encasing in concrete. Prestressing steel that has sustained physical damage at any time shall be rejected. The development of visible rust or other results of corrosion shall be cause for rejection, when ordered by the Engineer.
- i) Prestressing steel shall be packaged in containers or shipping forms for the protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor which prevents rust or other results of corrosion shall be placed in the package or form, or shall be incorporated in a corrosion inhibitor carrier type packaging material, or when

permitted by the Engineer, may be applied directly to the steel. The corrosion inhibitor shall have no deleterious effect on the steel or concrete or bond strength of steel to concrete. packaging or forms damaged from any cause shall be immediately replaced or restored to original condition.

- j) The shipping package or form shall be clearly marked with a statement that the package contains high-strength prestressing steel, and the care to be used in handling; and the type, kind and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use.
- k) Prestressing steel for post-tensioning which is installed in members prior to placing and curing of the concrete, shall be continuously protected against rust or other corrosion, until grouted, by means of a corrosion inhibitor placed in the ducts or applied to the steel in the duct. The corrosion inhibitor shall conform to the requirements specified herein.
- l) When steam curing is used, prestressing steel for post-tensioning shall not be installed until the steam curing is completed.
- m) All water used for flushing ducts shall contain either quick lime (calcium oxide) or slaked lime (calcium hydroxide) in the amount of 13g. per litre. All compressed air used to blow out ducts shall be oil free.
- n) When acceptable prestressing steel for post-tensioning is installed in the ducts after completion of concrete curing, and if stressing and grouting are completed within 10 calendar days after the installation of the prestressing steel, rust which may form during said 10 days will not be cause for rejection of the steel. Prestressing steel installed, tensioned and grouted in this manner, all within 10 calendar days, will not require the use of a corrosion inhibitor in the duct following installation of the prestressing steel. Prestressing steel installed as above but not grouted within 10 calendar days shall be subject to all the requirements in this section pertaining to corrosion protection and rejection because of rust.
- o) Any time acceptable prestressing steel for pretensioning is placed in the stressing bed and is exposed to the elements for more than 36 hours prior to encasement in concrete, adequate measures shall be taken by the Contractor, as approved by the Engineer, to protect said steel from contamination or corrosion.
- p) All ducts shall be located within 5 mm of the locations given on approved fabrication plans. Method and spacing of supports for ducts shall be shown on the working drawings. After installation in the forms, the end of the ducts shall at all times be sealed to prevent entry of water and debris. Following each pour of concrete, the Contractor will be required to demonstrate that all empty ducts are free of water and are unobstructed and undamaged. Immediately prior to installation of the prestressing steel, the Contractor shall again demonstrate to the satisfaction of the Engineer that all ducts are unobstructed and that they are free of water and debris.

Where tendons are described in the Contract as debonded from the concrete they shall be covered with sleeves approved by the Engineer. The ends of the sleeves shall be taped to the tendon to prevent the ingress of grout.

- q) Concrete shall not be deposited into forms until the entire set-up of the forms, reinforcement, ducts, and anchorage has been thoroughly inspected and checked. The placing of concrete will not be permitted until the Engineer is satisfied that the rate of producing and placing concrete will be sufficient to complete the proposed pour and finishing operations within the scheduled time, that experienced concrete finishers are available where required for finish work and all necessary finishing tools and equipment are on hand at the site of the work and are in satisfactory condition for use.
- r) Conveying equipment shall be of a size and design that will permit the placing of concrete within the time limits specified. Conveying equipment shall be cleaned at the end of each operation or work day and just prior to reuse shall again be checked and cleaned of hardened concrete and foreign materials. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An approved arrangement shall be used at the discharge end to prevent aggregate segregation. Mortar shall not be allowed to adhere to the return length of the belt. Concrete shall be discharged into a hopper or through a baffle.
- s) The concrete shall be first placed in the web forms followed by placement at the bottom slab and then in the top form. Any alternate sequence shall be submitted to the Engineer for approval.
- t) All concrete shall be consolidated by means of approved vibrators together with any other equipment necessary to perform the work as specified. Internal vibrators shall have a minimum frequency of 8,000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. At least two (2) standby vibrators in working condition shall be provided for emergency use in case of malfunction. The use of external vibrators for consolidating concrete will be permitted and may be required when the concrete is inaccessible for adequate consolidation. When external vibration is used, the forms shall be constructed sufficiently rigid to resist displacement or damage. Vibrating of concrete shall be done with care and in such a manner as to avoid displacement of reinforcing, conduits, and other items to be fixed in place.

6.21 Safety Precautions During Tensioning

Care shall be taken during tensioning to ensure the safety of all persons in the vicinity.

Jacks shall be secured in such a manner that they will be held in position, should they lose their grip on the tendons.

No person shall be allowed to stand behind the jacks or close to the line of the tendons while tensioning is in progress.

The operations of the jacks and the measurement of the elongation associated operations shall be carried out in such a manner and such a position that the safety of all concerned is ensured.

A safety barrier shall be provided at both ends to prevent any tendon, which might become loose from recoiling unchecked.

During actual tensioning operation, warning sign shall be displayed at both ends of the tendon.

After prestressing, concrete shall neither be drilled nor any portion cut nor chipped away nor disturbed, without express approval of the Engineer.

No welding shall be permitted on or near tendons nor shall any heat be applied to tendons. Any tendon which has been affected by welding, weld spatter or heat shall be rejected.

6.22 Tolerances

Permissible tolerances for positional deviation of Prestressing tendons in cast-in-situ construction shall be limited to the following

- a) Variation from the specified horizontal profile : 5 mm
- b) Variation from the specified vertical profile : 5 mm
- c) Variation from the specified position in member : 5 mm

6.23 Transportation and Storage of Unit:

Precast members shall be transported in an upright position. Points of support and the direction of reactions with respect to the girder shall approximately be the same during transportation, and storage as when the girder is placed in final position.

When members are to be stacked, they shall be firmly supported at such bearing positions as will ensure that the stresses induced in them are always less than the permissible design stresses. Further, inclined side supports shall be provided at the ends and along the length of a precast girder to prevent lateral movements or instability.

Care shall be taken during storage, hoisting and handling of the precast units to prevent their cracking or being damaged. Units damaged by improper storing or handling shall be replaced by the Contractor at his expense

6.24 Tests and Standards of Acceptance

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

Shop drawings and design calculations for construction procedure needs to be submitted by the contractor

6.25 Measurement

The prestressing steel rates are included in the quoted lumpsum price of price schedule. The Lumpsum Price for high tensile steel work shall include formation of cables in position including cost of spacers, transporting, anchorages, sheathing, grouting, stressing and all other relevant work including extra length of wires and staging etc.

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SECTION-7
STRUCTURAL STEELWORKS

SECTION- S.07**7. (A) STRUCTURAL STEEL WORKS****7.1 STRUCTURAL STEELWORK SPECIFICATIONS- GENERAL
(Station Roof and Viaduct Hand rails works only)**

This section covers the scope of work of structural steel works, submittals by the Contractor, applicable codes of practice for structural steel work and the specifications for the materials to be used, including steel, bolts & nuts, washers etc and the storage thereof. These specifications shall be read in conjunction with the CPWD specifications 1996 / 2002, MORTH Specifications and other relevant reference specifications.

7.2 Scope of Specification

The scope of work for the contractor in respect of structural steel work shall cover, but shall not be limited to the following:

- (a) Preparation of complete detailed fabrication drawings and erection marking drawing based on the design drawings, required for all the permanent and temporary structures.
- (b) Submittal of revised design, with calculations and detailed fabrication drawings, in case any substitution of the designed sections is required.
- (c) Submittal of design calculations for joints and connections to be developed by the contractor along with detailed fabrication drawings.
- (d) Supply of all raw steel materials for fabrication, taking into account wastage margin, including storage and upkeep of the materials.
- (e) Furnishing of all materials, labour, tools and plant and all consumable required for fabrication and supply of all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections, with necessary wastage margins.
- (f) Fabrication of the steel works in accordance with the approved fabrication drawings, including all shop assembling, matching and marking. Design, manufacture / fabrication and provision of all jigs, fixings, manipulators etc. required for the fabrication.
- (g) Provision of shop painting and requisite site painting to all fabricated steelwork, as per requirements of the related specification of the painting.
- (h) Suitability marking, bundling and packing for transport of all fabricated materials.

- (i) Preparing and furnishing detailed bill of materials, drawing Office dispatch lists, Bolts Lists and any other lists of bought out items required in connection with the fabrication and erection of the structural steelwork.
- (j) Loading, Transportation and unloading of all fabricated structural steel materials from site storage yard to erection site , handling, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location, according to approved erection drawings and/or as directed by the Engineer.
- (k) The contractor shall submit, for examination by the Engineer, detailed particulars of his proposed methods of erection of the superstructure steelwork, together with complete calculations relating to strength and deflection. If the erection scheme necessitates the attachment of strength steelwork to the permanent steel work, the contractor shall submit, for approval of the Engineer, the methods he proposes for making good the permanent steelwork after removing the temporary work. The contractor shall also submit the design and fabrication drawings of all temporary support, staging, braces etc. required for safe erection, for approval of the Engineer.
- (l) The contractor shall provide all construction and transport equipment, tools, tackle, and consumables, materials, labour and supervision required for the erection of the structural steelwork.
- (m) Receiving, unloading, checking and moving to storage yard, storage, guarding and upkeep of fabricated steelwork and other consumable materials and fasteners at site.
- (n) Transportation of all fabricated structural steel materials from site storage yard, handling, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location, according to approved erection drawings and/or as directed by the Engineer.
- (o) Setting out, aligning, plumbing, leveling, bolting, welding and securely fixing the fabricated steel structures in accordance with the erection scheme, or as directed by the Engineer.
- (p) Provision of requisite site painting to all fabricated steelwork, as per requirements of related specifications of the painting.
- (q) Providing protective treatment to the erected steel structures, as per Specification.
- (r) All major modifications of the fabricated steel structures, as directed by the Engineer, including but not limited to the following:
 - i. Removal of bends, kinks, twists etc. for parts damaged during transport and handling.
 - ii. Cutting, chipping, filling, grinding etc. if required or preparation and finishing of site connections.

- iii. Reaming of holes for use of higher size bolt if required.
 - iv. Re-fabrication of parts damaged beyond repair during transport and handling or refabrication of parts which are incorrectly fabricated.
 - v. Fabrication of parts omitted during fabrications by error, or subsequently found necessary.
 - vi. Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.
 - vii) Carry out tests in accordance with the related Specification.
- (s) Preparing and furnishing detailed bill of materials of fabricated parts received from concerned organization or its authorized fabricator.
- (t) The Contractor shall observe all safety requirements for erection of structural steelwork as covered in IS: 7205

The coated finish for flashing and roofing sheet shall have the following properties:

- a) Humidity Residence Blistering tested accordance to ASTM D 2247 (3000 Hours) with no Blistering.
- b) Acid salt spray tested accordance to ASTM B117 (3000 Hours) with no creepage sighted.
- c) Formability of OT to 2T, tested accordance to ASTM D4145.
- d) Pencil hardness conforming to ASTM D2794, with no loss of adhesion.
- e) Flame test tested to ASTM E84. Class A Coating.
- f) Specular gloss of 20-35%, measure at 60° and tested in accordance to ASTM D523.

7.3 Submittals

On commencement of the Project, the Contractor shall submit the following:

(a) On commencement of the Project, the Contractor shall submit the following:

- i) Prior to the technical submittals, the contractor shall submit the proposed overall schedule for documentation such as calculations, shop/ working drawings, plan/ procedures and records. Submission of samples, process of fabrication / delivery / erection for the approval of the Engineer.
- ii) Complete fabrication drawings, materials lists, cutting lists, bolt lists, welding schedules and QC schedules, based on the design drawing furnished to him and in accordance with the approved schedule. It is highlighted that structural steel members dimensions indicated in tender drawings are tentative only, and may be modified during final design stage.
- iii) Results of any tests, as and when conducted and as required by the Engineer.
- iv) Manufacturers mill test reports in respect of steel materials, bolts, nuts and electrodes, as may be applicable.

- v) A detailed list of all constructional Plant & Equipment, such as cranes, derricks, winches, welding sets, erection tools etc. their make, model, present condition and location, available to the contractor and the ones he will employ on the job to maintain the progress of work in accordance with the contract.
 - vi) The total number of experienced personnel of each category, like fitters, welders, riggers etc., which he intends to deploy on the project.
- (b) The contractor shall submit a detailed erection programme for completion of the work in time and in accordance with contract. This will show, in a performa approved by the Engineer, the target programme, with details of erection proposed to be carried out in each week, details of major equipment required and an assessment of required strength of various categories of workers.
- (c) The contractor shall submit complete design calculations for any alternative sections proposed by him, for approval of the Engineer. Use of any alternative section shall be subject to approval of the Engineer. However, no escalation in unit rates of work shall be allowed for such cases

7.4 Drawings:

- 7.4.1 The Engineer will supply to the Contractor profile drawings showing sizes of all structural members and typical connection details.
- 7.4.2 Should there be any discrepancy in the drawings the Contractor is to refer the matter to the Engineer. The Contractor shall further provide a drawing showing the accurate setting out to line and level of all the anchor bolts intended for the work in sufficient time for their inclusion in the work so as to maintain the building program.
- 7.4.3 The Contractor is to prepare all the necessary fabrication shop drawings and these shall be submitted to the Engineer in duplicate and be approved by him before fabrication is commenced. All such drawings shall show the dimensions of all parts, method of construction, welding and bolting. A further set of all approved fabrication drawings shall be supplied by the Contractor for use of the Engineer as required.
- 7.4.4 Approval by the Engineer of drawings or any other particulars submitted by the Contractor shall not relieve the Contractor of full responsibility for any discrepancies, errors or omissions therein. The Contractor shall at his own expense supply such additional copies of his working drawings as are required for the use of the interested parties.

7.5 Furnishing of Information

- A. Design drawings shall be furnished to the contractor and all such drawings shall form part of these Specifications.
- B. The Engineer reserves the right to make changes in the design drawings even after release for preparation of shop drawings to reflect addition, omission & modifications in data/details and requirements. Contractor shall consider such changes as part of these Specifications and the contract, and no extra claims shall be entertained on this account.
- C. Design drawings, approved by the Engineer, will show as appropriate the salient dimensions, design loads, sizes of members, location of openings at various levels and other necessary information required for the preparation of fabrication drawings, designs and erection details.
- D. It shall be clearly understood that the drawings of the Engineer are design drawings. The typical details of connection, cuts, notches, bends, etc. where shown in the design drawings are only for general guidance of the contractor. The contractor shall design and develop all such details based on the design forces and functional requirements.
- E. In case of variations in design drawings and specifications, the decision of the Engineer shall be final. Should the contractor, find any discrepancy in the information furnished by the Engineer, same shall be immediately brought to the notice of Engineer for resolution. The contractor shall obtain clarifications on discrepancies from Engineer before proceeding with the work.
- F. No detailed shop drawings will be accepted for examination by the Engineer unless the same, have first been completely checked by the contractor's qualified structural engineer (independent agency to be appointed by contractor) and are accompanied by an erection plan showing the location of all pieces detailed. The contractor shall check and ensure that detailing of connections is carefully planned to obtain ease in erection of structures, including field-welded connections and/or bolting.
- G. No fabrication work shall be started by the contractor without having obtained approval of Engineer on the relevant drawings. Approval by the Engineer of any of the drawings shall not relieve the contractor of his responsibility to provide correct design of connections, workmanship, fit of parts, details, materials and errors or omissions of all work shown thereon. The approval of Engineer shall constitute approval of the size of members, dimensions and general arrangement, but shall not constitute approval of the connections between members and other details.
- H. Drawings, for approval, shall be submitted by the contractor in an orderly manner commensurate with erection sequence and approved construction programme.
- I. The contractor shall furnish ten prints of all approved final drawings for field use and record purpose.

- J. The drawings prepared by the Contractor, and all subsequent revisions thereof shall be at the cost of the Contractor, and no separate payments shall be made for the same. Revisions shall incorporate all modifications, field changes, substitutions etc. effected. The Lumpsum Price quoted for fabrication work shall be deemed to include the cost of such drawing work.
- K. The Contractor shall give due consideration to the need of trial assemblage at shop, weight and size limitation of elements for transportation from shop to construction site, temperature variation of 25 degree centigrade between the fabrication shop and site, site measurements of the as-built dimensions and avoidance of site welding except for fixtures. All the drawings shall be prepared in metric units. The drawings should preferably be of A-1 standard size, and the details shown therein shall be clear and legible. These drawings shall include but shall not be limited to the following:
- i. Assembly drawings, giving exact sizes of the sections to be used and identification marks of the various sections.
 - ii. Dimensional drawings of base plans, anchorages details in foundation, foundation bolts location etc.
 - iii. Complete Bills of Materials and detailed drawings of all sections including their billing weights.
 - iv. Shop details of temporary structures together with detailed calculations.
 - v. Detailed shop drawings for proper co-ordination with the concrete components to which the steel members shall be connected, as required.
 - vi. Any other drawings or calculations that may be required for proper completion of the works and clarification of the works or substituted parts thereof.
 - vii. All 'as-built' drawings.

Applicable Codes of Practice

- A. All materials to be supplied by the Contractor shall conform to relevant Indian Standards or equivalent, as approved by the Engineer.
- B. Steel materials required for the work shall be free from imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair strength, durability and appearance. All materials shall be of tested quality only. If desired by the Engineer test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are permitted for procurement from identified stocks, a random sample shall be tested at an approved laboratory, as directed by the Engineer.

The following specifications, standards and codes are included as part of this Specification. All Standards, specifications, codes of practice current on the date of signing of agreement and referred to herein shall be applicable

1. IS: 800 (1984) Code of Practice for General Construction in Steel.
2. IS: 808 (1989) Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections.
3. IS: 814 (1991) Covered Electrodes for Manual Metal Arc Welding of Carbon & Carbon Manganese Steel.
4. IS: 816 (1969) Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.
5. IS: 817 (1969) Code of Practice for Training and Testing of Metal Arc Welders.
6. IS: 919 (1993) ISO System of Limits & Fits (Part 1 & Part 2)
7. IS: 1148 (1982) Hot Rolled Rivet Bars (upto 40mm) for Structural Purposes.
8. IS: 1182 (1983) Recommended Practice for Radio Graphic Examination of Fusion Welded Butt Joints in Steel Plates.
9. IS: 1363 (1992) Hexagon Head Bolts, Screws and Nuts of Product grade C. (Part 1 to Part 3)
10. IS: 1364 (1992) Hexagon Head Bolts, Screws and Nuts of Product Grades A & B (Part 1 to 5)
11. IS: 1367 (1991) Technical Supply Conditions for Threaded Steel Fasteners.
12. IS: 1821 (1987) Dimensions for Clearance Holes for Bolts and Screws.
13. IS: 4206 (1987) Dimensions for Nominal Lengths and Thread Lengths for Bolts, Screws and Studs.
14. IS: 1852 (1985) Rolling & Cutting Tolerances for Hot-Rolled Steel Product.
15. IS: 1977 (1975) Structural Steel (Ordinary Quality).
16. IS: 2016 (1967) Plain Washers.
17. IS: 2062 (1992) Steel for General Structural Purposes.
18. IS: 2595 (1978) Code of Practice for Radio Graphic Testing.
19. IS: 3600 (1985) Methods of Testing Fusion Welding Joints. (Part 1 to Part 9)
20. IS: 3613 (1974) Acceptance Tests for Wire Flux Combinations for Submerged Arc Welding.
21. IS: 3658 (1981) Code of Practice for Liquid Penetrant Flow, Detection.
22. IS: 3757 (1985) High Strength Structural Bolts.
23. IS:4000 (1992) High Strength Bolts In Steel Structures-Code of Practice
24. IS: 4353 (1967) Recommendations for Submerged Arc Welding of Mild Steel and Low Alloy Steel.
25. IS: 4943 (1968) Assessment of Butt and Fillet Fusion Welds in Steel Sheet, Plate and Pipe.
26. IS: 5334 (1981) Code of Practice for Magnetic Particle Flow Detection of Welds

27. IS: 5369 (1975) General Requirements for Plain Washers and Lock Washers.
28. IS: 5372 (1975) Taper Washers for Channels
29. IS: 5374 (1975) Taper Washers for I Beams.
30. IS: 6623 (1985) Specification for High Strength Structural nuts
31. IS:6649 (1985) Specifications for hardening and tempering washers for high strength structural nuts
32. IS: 6755 (1980) Double Coil Helical Spring Washers.
33. IS: 7215 (1974) Tolerances for Fabrication of Steel Structure.
34. IS: 7318 (1974) (Part I) Approval Tests for Welders When Welding Procedure Approval is not required -fusion Welding of Steel.
35. IS:8500 (1991) Structural steel -Micro alloyed (Medium and High Strength Qualities) .
36. IS:8910 (1978) General requirements of Supply of Weldable Structural Steel.
37. IS: 9595 (1980) Recommendations for Metal Arc Welding of Carbon & Carbon- Magnese Steels.

7.6 Products

7.6.1 Material:

- A. All materials to be supplied by the Contractor shall conform to relevant Indian Standards or equivalent, as approved by the Engineer.
- B. Steel materials required for the work shall be free from imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair strength, durability and appearance. All materials shall be of tested quality only. If desired by the Engineer test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are permitted for procurement from identified stocks, a random sample shall be tested at an approved laboratory, as directed by the Engineer.

Structural Steel

All structural steel shall be of tested quality and shall conform to one of the following standards

IS:226 Structural steel (Standard Quality)

IS:2062 Structural steel (Fusion welding quality)

IS:961 High Tensile Structural Steel (Ordinary)

IS:1161 Steel Tubes for Structural purposes

IS:4923 Hollow Steel Sections for Structural use

IS 3757& IS 4000 for high strength bolts in steel structures.

IS 816for use of metal arc welding for general construction in mild steel

IS 9595 for Metal arc welding of carbon and carbon manganese steels

IS 811 for Cold Formed Light Gauge Structural Steel Sections -

The Contractor shall supply to the Engineer copies of the manufacturer certificate that the steel brought to the site for incorporation in the works is of a quality fully complying with the specification. If required by the Engineer, the Contractor shall arrange for testing of the steel samples as per IS:1608 - 1599.

Welding electrode shall conform to IS:814

7.6.2 **Bolts and Nuts:**

For splicing of any structural member wherever required HSFG bolts and nuts of property class-8.8 conforming to IS:3757 and IS:6623 (1985) respectively shall be used. Unless specified otherwise, the bolts shall be hexagonal.

All anchor bolts shall be of property class of 8.8 and nuts shall conform to IS:1363 (1992), IS:1364 (1992) and IS:1367, as applicable, and unless specified otherwise, shall be hexagonal. All nuts shall conform to property class compatible with the property class of the bolt used..

7.6.3 **Washers**

For HSFG bolts , washer shall be conforming to IS:6649 (1985). Plain washers shall be conforming to IS:5369 (1975), unless otherwise specified. One washer shall be supplied with each bolt and, in case of special types of bolts, more than one washer as needed for the purpose shall be supplied. An additional double coil helical spring washer, conforming to IS:6755 (1980), shall be provided for bolts carrying dynamic or fluctuating loads and those in direct tension. Tapered washers, conforming to IS:5372 (1975) and IS:5374.

7.6.4 **Storage of Materials**

General

All materials shall be so stored as to prevent deterioration, and to ensure the preservation of their quality and fitness for the work. If required by the Engineer , the materials shall be stored under cover and suitably painted for the protection against weather. Any material, which has deteriorated or has been damaged shall be removed from site and replaced by new members, as directed by the Engineer at no extra cost and time.

- A. The steel to be used in fabrication shall be a stored in separate stack clear of the ground section wise and lengthwise.
- B. The storage area shall be kept clean and properly drained. Structural steel shall be so stored and handled in such a manner that members are not subjected to excessive

stresses and damage. Girders and beams shall be placed in upright position. Long members shall be supported on closely spaced skids to avoid unacceptable deflection.

7.6.5 Yard

- A. The Contractor shall be required to establish a suitable yard, in an approved location at site for storing the fabricated steel structures and other materials which will be delivered to site. The yard shall have proper facilities such as drainage and lighting including access for cranes, trailers and other heavy equipments.
- B. The Contractor shall have been deemed to have visited the site, prior to submission of his tender, to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc., all of which shall be carried out by the Contractor at his own cost and as directed by the Engineer.

Covered Store

All field connection materials, paints etc. shall be stored on racks and platforms, off the ground. in a properly covered building by the contractor .

7.7 STRUCTURAL STEELWORK SPECIFICATION -WELDED STRUCTURE

General

Scope of Specification

This Specification covers the supply, fabrication and delivery to Site of welded structural Steelwork, including the supply of all consumables, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the Specification.

Products

Ref. Specification 7.1 for Structural Steel-General

Execution

Workmanship

General

All workmanship shall be in accordance with the best practices in modern structural shops. Greatest accuracy shall be maintained in the manufacture of every part of the work and similar

parts shall be strictly interchangeable. The contractor shall not proceed with any welding until the Engineer has approved his welding plan, which shall include.

- All information's on welding procedures, equipment, additives and preheating during welding operation.
- Details of non destructive testing methods
- Precautions with regard to welding shrinkage
- Possible treatment of completed welds by grinding
- Procedure and programme of welding sequence

Templates

Templates used throughout the work shall be of steel In cases where actual materials have been used as templates for drilling similar pieces, the Engineer shall decide whether such materials are fit to be used as parts of the finished structure.

Straightening

All materials shall be straight and free from twists, and if necessary, before being worked, shall be straightened and/or flattened by pressure, unless required to be of curvilinear form.

Clearance

The clearance between fraying surface of bolted connections shall not be greater than 1mm at each end. If separation is between 1 to 3mm, the surface should be tapered to eliminate the separation. Over 3mm separation shall be filled with filler plates.

Shearing, Cutting and Planning

Cutting shall be done automatically. Cutting by shearing machine may be used for plates not exceeding 10 mm in thickness provided that the plate edges be fully enclosed in a weld. Oxygen cutting may be used provided a smooth and regular surface free from cracks and notches is secured.

1. Chipping of angle flanges and edges of plates, wherever necessary, shall be done without damaging the parent metal. Chipped edges shall be ground to a neat finish and sharp corners and hammered rough faces shall be rounded off.
2. The edges and ends of all cut/sheared plates members, flange plates, web plates of plate girders, and all cover plates, and the ends of all angles, tees, channels and other sections forming the flanges of plate girders, shall be planed/ground. Edge preparation for welding may be done by machine controlled flame cutting, with edges free from burrs should be clean and straight.

3. The butting surfaces at all joints of girders shall be planed so as to butt in close contact throughout the finished joint.
4. All flame cut surfaces shall be ground to remove the burned/ hardened portion of the material for flame cut surfaces

Assembly

1. All parts assembled for welding shall be in as close contact as practicable over the whole surface.
2. The component parts shall be so assembled that they are neither twisted nor otherwise damaged. Specified cambers, if any, shall be provided.
3. All parts of bolted and welded members shall be held firmly in position by means of jigs or clamps while bolting or welding. No drifting of holes shall be permitted, except to draw the parts together and no drift used shall be larger than the nominal diameter of the bolt. Drifting done during assembling shall not distort the metal or enlarge the holes.
4. Trial assemblies shall be carried out at the fabrication stage to ensure accuracy of workmanship. These checks shall be witnessed by the Engineer-in-Charge and such trial assemblies shall be at the cost of the Contractor.

Welding

General

The welding and the welded work shall conform to welded bridge code, IS:816 (1969) and IS:9595 (1980), unless otherwise specified. As much work as possible shall be welded in shops and the layout and sequence of operations shall be so arranged as to eliminate distortion and shrinkage stresses.

Electrodes

All electrodes shall be kept under dry conditions. Any electrode damaged by moisture shall not be used unless it is guaranteed by the manufacturer that, when it is properly dried, there will be no detrimental effect. Any electrode, which has part of its flux coating broken away or is otherwise damaged, shall be rejected. Any electrode older than six (6) months from the date of manufacture shall not be used. Batch certificates for electrodes shall be submitted by the Contractor.

Manual Metal Arc Welding electrodes shall be adopted as per following details :

Serial	Classification	Brand Name	Manufacturer	Remarks
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1	E-6013	Over Steelon Standard Excel-123 S Ferrospeed Plus	M/s .Advani Orelikon (P) Ltd. Modi Arc Electrodes Co. Weld Excel India Ltd. (Modi Group Co) EsAB Indai Ltd	For structural steel having thickness upto 15mm
2	E-7018	Super Cito Modi-7018 Excel-18 S ESAB 36H	Advani Orelicon Modu Arc Electrodes. Weld Excel Indai Ltd . (Modi Gropu Co) Esab India Ltd	For structural steel having thickness more 15mm

For MIG and SAW welding the suitable product/brand of above mentioned manufacturer shall be used.

Preparation of Joints

1. The edges shall be prepared, with an automatically controlled flame cutting torch, correctly to the shape, size and dimensions of the groove, prescribed in the design and fabrication drawings. In case of U-groove joints, the edges shall be prepared with an automatic false cutting torch in two phases, following a bevel out with a gouging pass, or by machining.
2. The welding surfaces shall be smooth, uniform and free from fins, tears, notches or any other defects, which may adversely affect welding, and shall be free of loose scale, slag, rust, grease, paint, moisture or any other foreign material.

Welding Procedure

1. All welding procedures shall be submitted to the Engineer for approval, well before starting fabrication.
2. The welding procedures shall be arranged by the Contractor to suit the details of the joints, as indicated in the drawings and the position at which welding has to be carried out. Welding procedure shall cover the following
 - a. Type and size of electrodes
 - b. Current and (for automatic welding) arc voltage
 - c. Length of run per electrode; or (for automatic welding) speed of travel

- d. Number and arrangement of runs in multirun welds
 - e. Position of welding
 - f. Preparation and set-up of parts
 - g. Welding sequence
 - h. Pre or post heating
 - i. Any other relevant information.
3. The welding procedures shall be so arranged that distortion and shrinkage stresses are reduced to the minimum, and that the welds meet the requirement of quality specified.
 4. Any weld found defective shall be removed, by using either chipping hammer or gouging torch, in such a manner that parent material is not injured in any way.

Fusion Faces and Surrounding Surfaces

1. Fusion faces and the surrounding surfaces within 50mm of the welds shall be free from all mill scale and free from oil, paint or any substance which might affect the quality of the welds or impede the quality/progress of welding. These shall be free from irregularities, which would interfere with the deposition of the specified size of weld or be the cause of defects.
2. All mill scale within 50mm of welds shall be removed prior to welding, either by pickling followed by thorough power wire brushing, or by other approved methods.
3. If preparation or cutting of the fusion faces is necessary, the same shall be carried out by shearing, chipping, gas cutting or flame gouging.
4. Where hand gas cutting or hand gouging is employed, the blowpipe or gouging blowpipe shall be properly guided.

Assembly for Welding

Parts to be welded shall be properly assembled and held firmly in position by means of jigs and clamps prior to and during welding.

Welded Girders and Other Plate Construction

Automatic submerged arc welding shall be employed for fabrication of welded girders and other plate construction, wherever specified. Metal inert gas welding (CO₂) may be done for short length where access to the location of the weld does not permit submerged arc welding subject to approval of Engineer.

Accuracy of Fit-Up

Parts to be fillet welded shall be brought into as close contact as practicable, and the gap due to faulty workmanship or incorrect fit-up shall not exceed 1.5mm. If greater separation occurs at any position, the size of fillet weld shall be increased at such positions by the amount of the gap.

Jigs and Manipulators

Jigs and manipulators shall be used, where practicable, and shall be designed to facilitate welding and to ensure that all welds are easily accessible to the operators.

Ends of Butt Welded Joints

The ends of butt joints shall be welded so as to provide full throat thickness. This may be done by the use of extension pieces, cross-runs or other approved means.

Weld Face and Reinforcement of Butt welds

The weld face shall, at all places, be deposited projecting the surface of the parent metal. Where a flush surface is required, the surplus metal shall be dressed off.

Testing of Butt Welds

Butt-welded joints are to be 25% radiographically tested by the Contractor at his own cost. If such tests indicate the joints to be defective, the cost of rectification of defective welds shall also be borne by the Contractor .

Minimum Leg Length & Throat Thickness in Fillet Welds

The minimum leg length of a fillet weld as deposited shall be not less than the specific size. In no case shall a concave weld be deposited, unless specifically permitted. Where permitted, the leg length shall be increased above that specified length, so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat-faced weld of the specified leg length.

Dislodging

After making each run of welding, all slag shall be thoroughly removed and the surface cleaned.

Quality of Welds

The weld metal, as deposited (including tack welds), shall be free from-cracks, slag inclusions, porosity, cavities and other deposition faults. The weld metal shall be properly fused with the parent metal without under cutting or overlapping at the toes of the weld. The surface of the weld shall have a uniform consistent contour and regular appearance.

Weather Conditions

Welding shall not be done under weather conditions, which might adversely affect the efficiency of welding.

Qualification and Testing of Welders

The Contractor shall satisfy the department that the welders are suitable for the work for which they will be employed, and shall produce evidence to the effect that welders, have satisfactorily completed appropriate tests, as described in IS:817 Part I (1992). The Engineer may, at his own discretion, order periodic tests of the welders and/or of the welds produced by them. Such tests shall be at the expense of the Contractor.

Supervision

The Contractor shall employ competent welding supervisors to ensure that the standard of workmanship and the quality of the materials comply with the requirements laid down in this Specification.

Machining of Butts and Bases

Splices and butt joints of compression members, depending on contact for stress transmission, shall be accurately machined over the whole section. In column bases, the ends of shafts together with the attached gussets, angles, channels etc., after bolting and/or welding together as the case may be, shall be accurately machined so that the parts connected butt over the entire surface of contact. Care shall be taken that connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 0.8mm.

Requirement of Welded Joints

Apart from the requirements of welding specified under the above sub clauses, sections above, the Contractor shall ensure the following requirements in the welded joints.

- i. Strength-quality with parent metal.
- ii. Absence of defects
- iii. Corrosion resistance of the weld shall not be less than that of parent material in an aggressive environment.

Shop Assembly

1. The steelwork shall be temporarily shop assembled, as necessary, so that the accuracy of fit may be checked before dispatch. The parts shall be shop assembled with a sufficient number of parallel drifts to bring and keep the parts in place

2. Since parts drilled or punched, with templates having steel bushes shall be similar and, as such, interchangeable, such steelwork may be shop erected in part only, as agreed by the Engineer.

Erection Marking

1 Each fabricated member, whether assembled prior to dispatch or not so assembled, shall bear an erection mark, which will help to identify the member and its position in respect of the whole structure, to facilitate re-erection at site.

These erection marks shall be suitably incorporated in the shop detail and erection drawings.

STRUCTURAL STEELWORK SPECIFICATION BOLTED STRUCTURE

General

Scope of Specifications

This specifications cover the supply, fabrication and delivery to site of bolted structural steelwork, including the supply of all consumables and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the Specification.

Products

Ref. Specification 7.17.1.6 for Structural Steelwork –General

Execution

Workmanship

General

All workmanship shall be in accordance with the best practice in modern structural shops. Greatest accuracy shall be maintained in the manufacture of every part of the work and all similar parts shall be strictly interchangeable.

Templates

Templates used throughout the work shall be of steel. In cases where actual materials have been used as templates for drilling similar pieces, the Engineer shall decide whether such materials are fit to be used as parts of the finished structure.

Straightening

All materials shall be straight and free from twists, and if necessary, before being worked, shall be straightened and/or flattened by pressure, unless required to be of curvilinear form.

Clearance

The clearance between fraying surface of bolted connections shall not be greater than 1 mm at each end. If the separation is between 1 to 3 mm the surface should be tapered to eliminate the separation. Over 3mm separation shall be filled with filler plates.

Shearing, Cutting and planning

1. Cutting shall be done automatically. Cutting by sheathing machine may be used for plates not exceeding 10mm in thickness provided that the plate edges be fully enclosed in a weld. Oxygen cutting may be used provided a smooth and regular surface free from cracks and notches is secured.
2. Chipping of angle flanges and edges of plates, wherever necessary, shall be done without damaging the parent metal. Chipped edges shall be ground to a neat finish and sharp and sharp corners and hammered rough faces shall be rounded off.
3. The edges and ends of all cut/sheared flange plates, web plates of plate girders, and all cover plates, and the ends of all angles, tees, channels and other sections forming the flanges of plate girders, shall be planed/ground.
4. The butting surfaces at all joints of girders shall be planed so as to but in close contact throughout the finished joint.
5. The ends of all build up girders and of all columns shall be faced in an end-milling machine after the members have been completely assembled. Bearing edges for girder bearing stiffeners and column bases shall be machined.
6. Unless clean, square and true to sharp, all flame-cut edges shall be planed. Cold sawn ends, if reasonably clean and flame-cut ends of sections not inferior to sawn ends in appearance need not be planned, except for butting ends.

Drilling

1. Holes for bolts shall be drilled to conform to Clause 10 of IS:7215-1974. Punching of holes shall not be permitted. All holes, except as stated hereunder, shall be drilled to the required size, 3mm less in diameter and reamed thereafter to the required size. All matching holes for bolts shall register with each other so that a gauge of 0.8mm less in diameter than the hole can pass freely through the members assembled for bolting, in the direction at right angle to such members.

2. All drilling shall be free burrs.
3. No holes shall be made by gas cutting process.

Assembly

1. All parts assembled for bolting shall be in close contact over the whole surface
2. The component parts shall be so assembled that they are neither twisted nor otherwise damaged. Specified cambers, if any, shall be provided.
3. All parts of bolted and welded members shall be held firmly in position by means of jigs or clamps while bolting or welding. No drifting of holes shall be permitted, except to draw the parts together and no drift used shall be larger than the nominal diameter of the bolt. Drifting done during assembling shall not distort the metal or enlarge the holes.
4. Trial assemblies shall be carried out at the fabrication stage to ensure accuracy of workmanship, and these checks shall be witnessed by the Engineer. Such trial assemblies shall be at the cost of the contractor.

Field Bolts

1. Requirements stipulated under bolting shall apply for field bolts. Field bolts nuts and washers shall be furnished by the Contractor in excess of the nominal numbers required. He shall supply the full number of bolts, nuts and washers and other necessary fittings required completing the work, together with the additional bolts, nuts and washers totaling to 10% of the requirement subject to minimum of 10 Nos. Only HSFSG bolts of class 8.8 shall be used.
2. At the time of assembly, the surfaces in contact shall be free of paint or any other applied finish, oil, dirt, loose rust, loose scale, burrs and other defects which would prevent solid seating of the parts or would interfere with the development of friction between them.
3. If any other surface condition, including a machined surface, is specified, it shall be the responsibility of the Contractor to work within the slip factor specified for the particular case.
4. Each bolt and nut shall be assembled with washers of appropriate shape, quality and number in cases where plane parallel surfaces are involved. Such washers shall be placed under the bolt head or the nut, whichever is to be rotated during the tightening operation. The rotated nut or bolt head shall be tightened against a surface normal to the bolt axis, and the appropriate tapered washer shall be, used when the surfaces are not parallel. The angle between the bolt axis and the surface under the nonrotating component (i.e. the bolt head or the nut) shall be $90 + 3$ degree. For angles outside these limits, a tapered washer shall be placed under the non-rotating component. Tapered washers shall be correctly positioned.

5. No gasket or other flexible material shall be placed between the holes. The holes in parts to be joined shall be sufficiently well aligned to permit bolts to be freely placed in position. Driving of bolts is not permitted. The nuts shall be placed so that the identification marks are clearly visible after tightening. Nut and bolts shall always be tightened in a staggered pattern and where there are more than four bolts in any one joint, they shall be tightened from the centre of the joint outwards.
6. If, after final tightening, a nut or bolt is slackened off for any reason, the bolt, nut and washer or washers shall be discarded and not used again.

Shop Assembly

1. The steelwork shall be temporarily shop assembled, as necessary, so that the accuracy of fit may be checked before dispatch. The parts shall be shop assembled with a sufficient number of parallel drifts to bring and keep the parts in place.

Erection Marking

Each fabricated member, whether assembled prior to dispatch or not so assembled, shall bear an erection mark, which will help to identify the member and its position in respect of the whole structure, to facilitate re-erection at site.

This erection mark shall be suitably incorporated in the shop detail and erection drawings.

7 (B) STRUCTURAL STEEL SPECIFICATIONS -PAINTING WORKS

7.8 General

Scope of Specification

This Specification covers the scope of painting, methods for the surface preparation, application of paints and precautions to be taken for the painting of structural steel work. It covers the supply and delivery of all necessary materials, labour, scaffolding, tools, equipment and everything that is necessary for the job completion on schedule.

Applicable Codes

The following Specifications, Standards and Codes are included as part of this Specification. All standards and codes of practice referred to herein shall be the current editions during the **currency** of project including all applicable official amendments and revisions.

In case of discrepancy between this Specification and those referred to herein, this specification shall govern. In case of discrepancy between Contract drawings and this specification, the Contract drawings shall govern.

- a). IS: 102 (1962) : Ready Mixed Paint, Brushing, Red lead, Non Setting, Priming.

- b). IS: 159 (1981): Ready Mixed Paint, Brushing, Acid Resisting for Protection against Acid Fumes, Colour as Required.
- c). IS: 384 (1979) : Brushes, Paints and Varnishes, Flat.
- d). IS: 487 (1985) : Brush, Paint and Varnish i) Oval Ferrule Bound
ii) Round Ferrule Bound.
- e). IS: 958 (1975) : Temporary Corrosion Preventive Grease, Soft Film, Cold Application.
- f). IS: 1153(1975): Temporary Corrosion Preventive, Fluid, Hard Film, Solvent Deposited
- g). IS: 1477(1971) : Code of Practice for Painting of Ferrous Metals in Building.
Part I –Pretreatment
Part II –Painting
- h). IS: 1674(1960) : Temporary Corrosion Preventive Fluid, Soft Film, Solvent Deposited.
- i). IS: 2074(1992) : Ready Mixed Paints, Red Oxide -Zinc Chromate.
- j). IS-5666: Etch (Pretreatment) Primer
- k). IS-104: Ready mixed paint, brushing, zinc chrome, priming
- l). IS-2339: ALUMINIUM PAINTS FOR GENERAL PURPOSES OF SPECIFICATION

Products & Materials:

Paint:

All paint delivered to the fabrication shop shall be ready mixed, in original sealed containers, as packed by the paint manufacturers, and no thinners shall be permitted.

Paint shall be stirred frequently to keep the pigment in suspension

Storage of Paints:

All paints shall be stored strictly in accordance with the requirements laid down by the paint manufacturers. The storage area shall be well ventilated and protected from sparks, flame, direct exposure to sun or excessive heat, preferably located in an isolated room or in a separate building.

All paint containers shall be clearly labeled to show paint identification, date of manufacture, batch number, order number and special instructions in legible form. The containers shall be opened only at the time of use. Paints which have liveried, gelled or otherwise deteriorated during storage shall not be used. Paints for which the shelf life specified by the supplier has expired shall not be used without inspection and approval by the Engineer-in-charge.

Execution:

Paint System (High Performance Polysiloxane System)

Sand blasting shall be carried out in accordance with IS: 1477.

Painting work shall be carried out as follows:

Description	Surface	
Fabrication Shop	External Surfaces	Internal Surfaces
Surface Treatment	Abrasive Blast to SA 2.5(ISO 8501-1:1988). If oxidation occurs between blasting and application of paint, the surface shall be re blasted to the specified standard.	Abrasive Blast to cleaning to minimum SA 2.5 (Swedish Standard SIS 055900), Near-White blast cleaning.
primer	Providing & applying two components high build Zinc Rich Epoxy Primer Poly amide cured with minimum volume Solids of approximately 60% and a product weight of 2.50 kg/liter, minimum recoat interval of not more three hours at 25 deg C. The primer can be like Interzinc 52 of International Paints or approved equivalents. DFT-75 microns The primer shall be applied by Conventional/Airless Spray only in Shop.	Surface Tolerant Epoxy with minimum Volume Solids of 80%, minimum overcoat interval of not more than 24 hours at 25 deg C and a product weight of 1.6kg/liter. The primer can be like Interseal 670 HS of international paints or approved equivalent DFT-150 microns
1st Coat	Providing and applying two components Hi Build Epoxy Intermediate Coat pigmented with Micaceous Iron oxide with approximate Volume Solids of 80%, minimum re-coat interval of 6 hours at 25 deg C and a product weight of approximately 2 kg/liter- like Intergard 475 HS of international paint or approved equivalent. DFT-150 microns The coat shall be applied by Conventional/Airless Spray only in Shop	
Erection Site		
Touch up Primer	Power Tool Cleaning to ST 2 standards followed by Surface Tolerant Epoxy with minimum Volume Solids of 80%,minimum overcoat interval of not more than 24 hours at 25 deg C and a product weight of approximately 1.6kg/liter like Interseal 670 HS of International Paints or approved equivalent. This primer shall be applied as touch up wherever damages have occurred on account of welding or Transportation &Erection.(Stripe Coat)-The DFT shall not	

	be included in the Total DFT of System DFT-75 microns The primer shall be applied by Conventional/Airless Spray only at site	
2 nd coat(Finish Paint)	Providing and applying two components Hi Gloss Acrylic Polysiloxane Finish Paint with approximate Volume solids of 70%, The product shall hard dry in not more than 5 hours at 25 deg C and 50% R.H. like Interfine 878 of International Paints or approved equivalent. This product should exhibit Gloss Retention following 3000 hours to U.V-A florescent lamp when checked as per ASTM-523 DFT-75 microns The paint shall be applied by Conventional/Airless Spray only at site.	

The total Average DFT of External Surface is 375 microns

The total Average DFT of Internal Surface is 150 microns

DFT measurements should be done in accordance with Specifications SSPC PA 2.

INTERNAL SURFACE =Internal surface are those which will become inaccessible after fabrication and are not prone to humidity and moisture from the atmosphere.

EXTERNAL SURFACE = All other surfaces which are prone to humidity and moisture from the atmosphere.

The following precautions must be taken:

After abrasive blast cleaning, the first undercoat (primer coat) should be applied well before surface deterioration.

Over coating intervals, application parameters shall conform to manufacturer's instruction manual.

The DFT (Dry film thickness) shall be measured after completion of each coat.

Surface Preparation (sandblasting)

All surfaces shall be cleaned of loose substances and foreign materials. e.g. dirt, rust, scale, oil, grease, welding flux etc so that the primer coat adheres to the original metal surface. The work shall be carried out in accordance with IS: 1477 (1971) (Part I). Any oil, grease, dust or foreign matter deposited on the surface after preparation shall be removed and care shall be taken to ensure that the surface is not contaminated with acids, alkalis or other corrosive chemicals. The primer coat shall be applied immediately after the surface preparation is completed.

Before the application of any paint the surfaces to be treated shall be thoroughly cleaned freed from all scale, loose paint, rust and other deleterious matters. Oil and grease shall be removed from the surface by washing with solvents or with a detergent solution before blast cleaning operation of metal

polish with metal pellets. If any traces of oil or grease remain after blasting they shall be removed by solvent cleaning and the area will be re-blasted thereafter.

All welding areas shall be given special attention for removal of weld flux slag, weld metal splatter weld head oxides; weld flux fumes silvers and other foreign objects before blasting. If deemed necessary by the Engineer in Charge, acid washing and subsequent washing with clean water shall be used.

Any rough seams will have to be ground and must be inspected and approved by the Engineer-in-charge before application of the coatings.

All structural steel to be painted shall be cleaned using blast cleaning in accordance with SA 2 1/2 Near- White Blast cleaning (equivalent Swedish Standard SIS 055900). For SA 2 1/2 the profile should be in the range of 40-70 microns and shall be measured with comparator. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are light stains in the form of spots or stripes. Finally, the surface shall be cleaned with a vacuum cleaner or clean dry compressed air.

The blast cleaning shall produce a surface roughness complying with the one specified by the paint manufacturer for the primer concerned. If, cleaned surfaces are rusted or are contaminated with foreign material before painting is accomplished they shall be re-cleaned by the Contractor at his own expenses. Nothing extra shall be paid on this account.

Mixing of paint

All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments, before use and during application, to maintain homogeneity. All pigmented paints shall be strained after mixing to remove skins and other undesirable matters.

1. Dry pigments, pastes, tinting pastes and colours shall be mixed and/or made into paint so that all dry powders get wetted by vehicles and lumps and particles are uniformly dispersed.
2. Additives that are received separate such as curing agents, catalysts, hardeners etc. shall be added to the paint as per the manufacturers' instructions. These shall be promptly used within the pot life specified by the manufacturers and unused paint thereafter shall be discarded.
3. Thinners shall not be used unless essential for proper application of the paint. Where thinners are used, they shall be added during the mixing process and the type and quantity of thinner shall be in accordance with the instructions of paint manufacturer.

Paint Application

General

- Paint shall be applied in accordance with the manufacturer recommendations, as supplemented by these Specifications. The work shall generally follow IS 1477 (1971) Part II. Prior approval of the Engineer-in-charge shall be taken in respect of all primers and/or paints, before their use in the works.
- Paint shall generally be applied by brushing except that spraying may be used for finish coats only when brushing may damage the prime coats. Roller coat or other method of paint application shall not be used unless specifically authorized.
- Paint shall not be applied when the ambient temperature is 10°C and below. For paints, which dry by chemical reaction the temperature, requirements specified by the manufacturer shall be met with. Also, paint shall not be applied in rain, wind, fog or at relative humidity of 80% and above or when the surface temperature is below dew point, resulting in condensation of moisture. Any wet paint exposed to damaging weather conditions shall be inspected after drying and the damaged area repainted after removal of the paint.
- Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots. The film thickness shall not be so great as to detrimentally affect either the appearance or the service life of the paint.
- Each coat of paint shall be allowed to dry sufficiently before application of the next coat, to avoid damages such as lifting or loss of adhesion. Undercoats having glossy surface shall be roughened by mild sand papering to improve adhesion of subsequent coats. Successive coats of same color shall be tinted. Whenever practical, to produce contrasts and helps in identifying the progress of the work.

Brush Application

Proper brushes shall be selected for a specific work piece. Round or oval brushes which conform to IS: 487(1985) are better suited for irregular surfaces, whereas flat brushes which conform to IS: 384(1979) are convenient for large flat areas. The width of flat brushes shall not generally exceed 1.25mm.

Paint shall be applied in short strokes depositing a uniform amount of paint in each stroke followed by brushing the paint into all surface irregularities, crevices and corners and finally smoothening or leveling the paint film with long and light strokes at about right angles to the first short strokes. All runs and sags shall be brushed out. The brush marks left in the applied paint shall be as few as practicable.

Spray Application

1. The spraying equipment shall be compatible with the paint material and provided with necessary gauges and controls. The equipment shall be cleaned of dirt, dried paint, foreign matter and solvent before use.
2. The paint shall be applied by holding the gun perpendicular to the surface at a suitable distance and moved in a pattern so as to ensure deposition of a uniform wet layer of paint. All runs and sags shall be brushed out immediately. Areas not accessible to spray shall be painted by brush or dauber.
3. Water trap acceptable to Engineer-in-charge shall be furnished and installed on all equipment used in spray painting.

Shop Painting

The painting system specified in Table shall be followed. Surfaces, which will be inaccessible after field assembly, shall receive the full-specified protective treatment before assembly.

Surfaces in contact during shop assembly shall not be painted. Surfaces which cannot be painted but require protection shall be given a rust inhibitive grease conforming to IS:958-1975 or solvent deposited compound conforming to IS: 1153 (1975) or IS: 1674 (1960) or treated as specified in the drawing.

The shop coats shall be continuous over all edges, including ends meant for jointing at site by bolting, except where the paint could be detrimental to bolting. In such cases, no paint shall be applied within 50mm, and the unprotected surface shall be given a coat of corrosion inhibitive compound.

The unpainted area shall be cleaned prior to welding. The welded joint shall be cleaned and deslagged, and immediately after covered by the same paint as has been used for the remaining surface.

Painting at Site

Surfaces which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly. Surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while the paint is still wet.

Damaged or deteriorated paint surfaces shall be first made good with the same type of coat as the shop coat. Where steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds, bolts and site rivets. Specified protective treatment shall be completed after erection.

Protection of Paint work

The Contractor shall provide measures as necessary to prevent damage to the work and to other property or persons from all cleaning and painting operations. Paint or paint stains, which result in other unsightly appearance on surfaces not designated to be painted, shall be removed or obliterated by the contractor at his cost.

All painted surfaces that in the opinion of the Engineer-in-charge are damaged in anyway, shall be repaired by the contractor at his cost with materials and to a condition equal to that of the requirements specified in these specifications.

Upon painted surfaces that in the opinion of any other work that would cause dust, grease or foreign materials to be deposited upon the painted surfaces, the painted surfaces shall be thoroughly cleaned.

The areas for high-strength bolts shall be protected by masking tape against undercoat application at the fabrication shop. Immediately prior to erection any rust in the paint area shall be removed by power wire brushing to a standard equivalent to SA3.

Site Painting

1. After the erection of structures at the site, the contractor shall provide the necessary treatment as specified in Table "PAINTING SPECIFICATIONS".
2. Surface which have not been shop coated, but require surface treatment shall be given necessary surface preparation and coats at site as specified in Table.

7.9 STRUCTURAL STEEL WORK -QUALITY CONTROL & TESTING REQUIREMENTS

General

Scope of Specification

The scope of work of these specifications is to establish the norms for ensuring the required Quality Control through established testing norms of the welded structural steelwork

Codes / Standards

Relevant IS codes for tolerance and tests of welding procedures as specified in the specification for Structural Steelwork -General.

Submittals

The Contractor shall submit the following : Proposed overall schedule for documentation of calculations, shop drawings, plan/procedures and records, submission of procedure of fabrication. The contractor shall himself inspect all materials, shop work and field work to satisfy

the specified tolerance limits and Quality norms before the same are inspected by Engineer or his authorized representative.

Products

Make of approved manufacturer

Execution

Tolerances

The contractor shall through appropriate planning and continuous measurements in the workshop and the erection at site, ensure that the tolerance specified below are strictly adhered to.

Dimensional & Weight Tolerance

The dimensional and weight tolerance for rolled shapes shall be in accordance with IS: 1852. The acceptable limits of straightness for rolled or fabricated members as per IS: 7215 are

Struts and columns: $1/1000$ or 10 mm whichever is smaller where L is the length of finished member A limit for distortion in transverse direction δ from the true axis of plate and box girder shall not be more than $L/1000$ where L is the length of diagonal of profile.

Tolerance in specified camber of members shall be 3mm in 12m length

Tolerance in specified lengths shall be as follows:

- Column finished for contact bearing + 1 mm
- Other members (cols.) upto and over 10 m + 5 mm
- Including 10 m $L/2000$ sub to max of + 8 mm
- Other members (beams) upto 12 m + 3 mm
- Over 12m $L/4000$ sub max. of + 5 mm

End of Members

Beam to beam and beam to column connection -Where the abutting parts are to be jointed by butt welds, permissible deviation from the squareness of the end is :

Beam upto 600 mm in depth : 1.5 mm

Beam over 600 mm in depth: 1.5 mm for increase in depth of every 600 mm subjected to max of 3 mm.

Where abutting parts are to be jointed by bolting through cleats or end plates, the connections require closer tolerance, permissible deviation from the squareness of the end is:

Beams upto 600 mm in depth 1mm per 600mm of depth subject to a max of 1.5 mm.

For full bearing, two abutting ends of columns shall first be aligned to within 1 in 1000 of their combined length and then the following conditions shall be met :

- a) Over atleast 80% of the bearing surface the clearance between the surfaces does not exceed 0.1mm.
- b) Over the remainder of the surfaces the clearance between the surfaces does not exceed 0.3 mm.

Where web stiffeners are designed for full bearing on either the top flange or the bottom flange or both, atleast half the stiffener shall be in positive contact with the flange. The remainder of the contact face could have a max. gap of 0.25 mm

Depth of Members

Acceptable deviation from the specified overall depth as per IS:7215 (1974) is:

Upto and including 1000mm : 1.0 mm

Over 1000 mm : 2.0mm

Web Plates

An acceptable deviation from flatness in girder webs in the length between the stiffeners or in a length equal to the girder depth shall be:

Upto 500 mm depth : 0.5 mm

Over 500 mm & including 1000 mm : 1.0 mm

Over 1000 mm : 2.0 mm

Flange Plates

A reasonable limit for combined warpage and tilt on the flanges of a built-up member is 1/200 of the total width of flange or 2 mm whichever is smaller measured with respect to centerline of flange.

Lateral deviation between centreline of web plate and centreline of flange plate at contact surfaces measured as the difference δ between diagonals of nominal length L shall not be greater than L/1000.

End Milling

Column ends bearing on each other or resting on base plates and compression joints designed for bearing shall be milled true and square to ensure proper bearing and alignment. Base plates shall also have their surfaces milled true and square.

Quality Control

In order to exercise proper control of the quality of the welding, Contractor shall enforce methods of control as tabulated below:

	Purpose	Control Subjects	Method of control
	1	2	3
1.	Control of welding and basic metal quality	Quality control; of electrodes, welding wire, flux and protective gases Checking of quality and weldability of the basic metal and welded members	Welding test to determine the technological properties of materials Mechanical test of weld metal Metallographical investigations of welds macro- structure and microstructure Checking of weld metal resistance for intercrystalline corrosion. Study if weld metal solidity by physical control methods.
2.	Checking of welders qualifications	Welding of specimens for quality determination	Mechanical tests, metallographical investigation & checking of welded joints by physical control methods Checking of assembly quality & centering of welded members
3.	Control of welded joint quality	Control of assembly accuracy and technological welding process	Checking of welding equipment conditions. Checking correctness of welding procedure. Visual examination of welds

Tests & Testing Procedures

Agency for testing of weld shall be approved by the Engineer prior to testing

Visual Examination

The contractor shall conduct visual examination and measurement of the external dimensions of the weld for all joints. Before examining the welded joints, areas close to it on both sides of the weld for a width not less than 20 mm shall be cleaned of slag and other impurities. Examination shall be done by a magnifying glass which has a magnification power of ten (10) and measuring instrument which

has an accuracy of + 0.1 mm or by weld gauges. Welded joints shall be examined from both sides. The contractor shall examine the following during the visual checks.

- i) Correctness and shape of the welded joints
- ii) Incomplete penetration of weld metal.
- iii) Influx
- iv) Burns
- v) Unwelded craters
- vi) Undercuts
- vii) Cracks in welded spots and heat affected zones
- viii) Porosity in welds and spot welds
- ix) Compression in welded joints as a result of electrode impact while carrying out contact welding
- x) Displacement of welded element

The contractor shall, document all data as per sound practices.

Mechanical Test

The Contractor shall carry out various mechanical tests to determine weldability, metal alloyability, nature of break, correct size and type of electrodes, degree of pre-heat and post-heat treatment. The type, scope and sample of various mechanical tests shall be determined in agreement with the purchaser. The number of tests conducted shall depend on the result obtained to satisfy the Engineer that the correct type and size of electrode, degree of pre-heating and post-heating and weldability of metal are being followed.

Dye Penetration Test

All welds shall be tested by "Dye Penetration test" as per current practices.

Before conducting the examination the welded joints shall be cleaned of slag and scales and visually examined. The welds shall be marked into separate portions depending on the length of photograph. The length of photograph shall be such as to ensure that there are no distortions and shall reveal the defect correctly. The length shall not be more than 0.75 of the focal distance and the width of the photograph would depend on the width of the welded joint plus 20 mm on either side of the weld. The cassette with film shall be protected by sheet of lead or equivalent of proper thickness against incidental, diffused and secondary radiation.

The direction of the ray with relation to the film shall be as specified hereunder.

Welds of butt joints without edge slopes with edge processing shall be examined by central ray directed at right angles to the weld.

In special cases examination of welds with inclined rays directed along edge slopes may be permitted by the Engineer.

Lap joints shall be examined by directing rays at 45 degree to the bottom plate. Welds in

T-joints without any edge preparation shall be examined by rays directed at 45 degree to the weld. Angle welds in lap and tee-joints shall be examined by the rays in opposite direction i.e. the film will be on the side of the weld. Weld in angle joints shall be checked by directing ray along the bisector of the angle between the welded elements. Opposite direction of the ray and location of the film may also be permitted by the Employer.

Ultrasonic Test

Ultrasonic test shall be conducted by the contractor to detect gas inclusion (pores), slag inclusion, shallow welds, cracks, lamination and friability etc. Prior to starting of ultrasonic test the welded joint shall be thoroughly cleaned of slag and other material. Surface of the basic metal adjacent to welded joint on both sides shall be mechanically cleaned by the grinder or a metal brush to provide the contact of the whole ultrasonic probe surface with surface of basic metal. The width of the clean surface shall be as directed by the Engineer. The welded joint then shall be covered with a thin coat of transformer oil, turbine or machine oil to ensure acoustic contact. The joints so treated shall be marked and the marks shall be entered into the documentation, subsequent to this, ultrasonic test shall be carried out as directed by the Engineer. At least 50% of weld shall be tested by ultrasonic testing

Radiography Test

Radiography test shall be conducted by the contractor to determine gas inclusion (blow holes, hollows) slag inclusion, shallow welds and cracks for 25% lengths all butt joints.

Testing of welds

Butt Welds- Radiography test-5% IS:1182.

Fillet welds- Ultrasonic Test

All welded connections shall be inspected as per

All welds shall be tested by

7.9.1 STRUCTURAL STEEL WORK ERECTION:

i) Scope of Specifications

This Specification covers the delivery to site, storage and erection of structural steelwork at site. This includes plant and equipment requirements, installation of fabricated steel work in position and grouting all complete as per drawings, specifications and other provisions of the Contract.

ii) Submittals

A. Ref. Specification for Structural Steelwork Erection –General

- B. The contractor shall submit for approval a full description of his proposed erection method including sequence of erection, use of temporary supports, connection details and erection camber diagram and design calculations covering various stages of erection process.

iii) Execution

Delivery, Storage & Handling

- A. Before the shop assembly is dismantled, all members and sections shall be appropriately marked with paint or grooved with their identification numbers as detailed in shop drawings. The Contractor's representative shall be present during all the shop assemblies (wherever fabrication will be done), its dismantling and marking operations.
- B. The Contractor shall deliver the fabricated structural steel materials to site, with all necessary field connection materials, in such sequence as will permit the MoRT&H efficient and economical performance of the erection work. As per scheduled programme, the Engineer may, at his discretion prescribe or control the sequence of delivery of materials.
- C. Fabricated parts shall be handled and stacked in such a way-that no damage is caused to the components. Measures shall be taken to minimize damage to the protective treatment on the steelwork. All work shall be protected from damage in transit. Particular care shall be taken to stiffen free ends, prevent permanent distortion and adequately protect all machined surfaces. All bolts, nuts, washers, screws, small plates and articles shall be suitably packed and identified.

iv) Plant and Equipment

All erection tools and plant & equipment proposed to be used shall be efficient, dependable duly certified by independent third party and in good working condition, and the suitability and adequacy of such shall be determined by the Engineer. The Contractor shall, in his technical proposal submittal, specify the plant and equipment proposed by him for erection of structural steelwork at Site.

v) Storage

Materials to be stored shall be placed on skids above the ground and shall be kept clean and properly drained.

vi) Method and Sequence of Erection

The method and sequence of erection shall have the prior approval of the Engineer. The contractor shall arrange for the MoRT&H economic method and sequence consistent with the drawings and Specifications and such information as may be furnished to him prior to the execution of the Contract. The erection of steelwork shall be planned so as to ensure safe-

working conditions at all times. The Contractor shall be solely responsible for enhancing the safety of his construction activities at Site.

vii) Assembly & Erection

- A. During erection, the members and sections shall be accurately assembled as shown in the approved shop drawings and by following the match marks. The material shall be carefully handled so that no section will be bent, broken or otherwise damaged. Hammering which will damage or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Splices and field connections shall have 50% of the holes filled with bolts and balance 50% with cylindrical erection pins before bolting with high-strength bolts. Filling-up bolts shall be of the same nominal diameter as the high-strength bolts, whereas the cylindrical erection pins shall be 1 mm or larger in diameter.
- B. The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Engineer and his approval of the method of correction obtained. The contractor shall be responsible for all misfits, errors and injuries and shall make the necessary corrections and replacements.
- C. The straightening of plates, angles, other shapes and built-up members, when permitted by the Engineer, shall be done by methods that will not produce fracture or other damages. Distorted members shall be straightened by mechanical means or, if approved by the Engineer, by the carefully planned and well supervised application of a limited amount of localized heat. Each application will be subject to the approval of the Engineer.
- D. The responsibility in respect of temporary bracing and guys shall rest with the Contractor until the structural steel is located, kept in plumb, leveled, aligned and grouted within the tolerances permitted under the Specifications, and the permanent bracing/framing system has been installed.
- E. The temporary guys, braces, false work and cribbing shall not be the property of the Engineer/Employer and will be removed by the Contractor, with the approval of the Engineer, without any charge, once the permanent framing system has been installed to the satisfaction of the Engineer and when the temporary bracing, guys etc. can be removed without any potential danger/damage to the erected structure.

viii) Setting Out

- A. Positioning and leveling of all steelwork, keeping in plumb and placing of every part of the structure, with accuracy, shall be in accordance with the approved drawings and to the satisfaction of the Engineer. The Contractor shall check the positions and levels of the anchor bolts etc. before concreting and ensure that they are properly secured against disturbance during pouring operations. The Contractor shall remain responsible for correct positioning and shall set proper screed bars to maintain proper level. No extra payment shall be made on this account.
- B. No permanent field connections by bolting shall be carried out until proper alignment and guides for keeping in plumb have been attached.

ix) Field Bolting

- A. Bolts shall be inserted in such a way that they remain in position under gravity, even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled all joint surfaces including those adjacent to the washers shall be free of scales. They shall be free of dirt, loose scales, burns and other defects that would prevent solid seating of the parts.
- B. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications.
- C. All high tensile bolts shall be tightened to provide the required minimum bolt tension as per relevant Indian Standards / Specifications when all fasteners in the joint are tight,
- D. The manufacture and use of high strength friction grip bolts shall comply with the requirements of IS:3757 (1985).
- E. Load indicating bolts or washers may be used, subject to the approval of the Engineer.

x) Holes, Cutting and Fitting

- A. No cutting of sections, flanges, webs, and cleats, rivets, bolts, welds etc. shall be done unless specifically approved and / or instructed by the Engineer.
- B. The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contract, or directed by the Engineer. Wherever such work is specified, the Contractor shall obtain complete information as to size, location and number of alterations, prior to carrying out any work.

xi) Drifting

- A. Correction of minor misfits will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes, as necessary, to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed.
- B. Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be brought to the attention of the Engineer, and approval of the method of correction obtained. The use of gas cutting torches at the erection site is prohibited.

xii) Grouting

- A. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water, and any accumulated water shall be removed. Grouting shall be carried out under expert supervision; taking care to avoid air locks. Edges shall be finished properly.
- B. Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally aligned and leveled. Immediately before grouting, the space under steel is thoroughly cleaned. Where packings are to be left in place, they shall be placed such that they are completely covered with grout.
- C. The grout to be used shall be Non-shrink grout Conbextra GP-2 of M/S Fosroc or equivalent.
- D. All steel in foundations shall be solidly encased in Portland Cement Concrete of minimum characteristic strength at 28 days as specified in the drawings, subject to a minimum of 35 N/mm². A minimum cover of 100mm shall be provided to all steelwork where surrounding concrete is in contact with soil.

xiii) Inserts and Embedment

Various steel inserts and embedment are required under the contract to be fabricated, positioned and secured firmly into place inside the formwork prior to concrete being poured. There are also requirements of jointing, threading, bolting and welding inserts and embedment of different concrete and structural steel elements in order to establish structural continuity and connection. Great care shall be exercised by the contractor in executing all aspects of the work related to inserts and embedment, including tolerances, so that the final assembly of the concrete elements can meet satisfactorily the continuity and contiguity requirements intended in the structure.

xiv) Painting after Erection

- A. The surfaces required to remain unpainted at shop, shall be given a protective coating after the structure is erected, leveled, kept in plumb, aligned in its final position, and accepted by the Engineer. However, touch up painting, making good any damaged shop painting and completion of any unfinished portion of the shop coat shall be progressively carried out by the Contractor.
- B. Painting shall not be done in frost or foggy weather, or when humidity is such as to cause condensation on the surfaces to be painted. Before, commencing painting of steel, which is delivered unpainted, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.
- C. Surfaces, which will be inaccessible after field assembly, shall receive the full-specified protective treatment before assembly. Bolts and fabricated steel members, which are galvanized or otherwise treated, shall not be painted.
- D. The contractor shall be responsible for any damage caused to other components of the structure including the substructure. In particular, he shall take all necessary precautions to minimize concrete splash onto completed steelwork or rust staining of concrete due to erected steel work and clean and/or repair all stains and other damages to completed work prior to tests on completion.

xv) Final Cleaning up

Upon completion of erection, and before final acceptance of the work by the Engineer, the Contractor shall remove, free of cost, all false work, rubbish and all temporary works, resulting from or in connection with the performance of his work.

SECTION- PILE FOUNDATIONS

SECTION- S.08**8. PILE FOUNDATIONS****8.1 General**

All piles shall be RCC bored cast in situ reinforced concrete piles.

8.1.1 Piling plant and Methods

Suggested method for piling is cast in situ-bored piles with hydraulic drilling rigs using 4.5m. Depth casing by oscillator or vibro hammer arrangement,

1. Not less than 2 weeks before any piling work is commenced the Contractor shall submit to the Engineer for approval full details of his proposed piling plant, polymer slurry mixing, handling, transporting and disposal scheme and detailed method statements for carrying out the Works.

Details of casings and concreting methods in respect of bored cast in place concrete piles are to be provided.

2. The Contractor shall not commence any piling until the plant and methods which he proposes to use including polymer slurry mixing, handling, transporting and disposal scheme have been approved by the Engineer but such approval shall not relieve the **Contractor** from any of his obligations and responsibilities under the Contract. If for any reason the Contractor wishes to make any change in the plant and methods of working which have been approved by the Engineer, he shall not make any such change without having first obtained the Engineer approval thereof.
3. List and nos. of equipments & accessories proposed to be used for the present job shall be submitted along with the bid.

8.1.2 Records

The Contractor shall keep complete records of all data required by the Engineer covering the fabrication; driving and installation of each pile and shall submit two signed copies of these records to the Engineer not later than noon of the next working day after installation of the piles.

8.1.3 Programme and Progress Report

1. The Contractor shall inform the Engineer each day of the programme of piling for the following day and shall give adequate notice of his intention to work outside normal hours and at weekends, where approved.

2. The Contractor shall submit to the Engineer on the first day of each week, or on such other date as the Engineer may decide, a progress report showing the rate of progress to that date and progress during the previous week or period of all main items of piling works, as required by the Engineer.

8.1.4 Setting Out

The Contractor shall establish and maintain permanent datum level points, base lines and grid lines to the satisfaction of the Engineer and shall set out, with a suitable identifiable pin or marker, the position of each pile. The setting out of each pile shall be agreed with the Engineer at least 8 working hours prior to commencing work on a pile and adequate notice for checking shall be given by the contractor.

Notwithstanding such checking and agreement, the Contractor shall be responsible for the correct and proper setting out of the piles and for the correctness of the positions, levels, dimensions, and alignment of the piles.

- #### 8.1.5
- After all piles are cast in a pile cap and weak concrete is chipped out, the Contractor shall submit the drawing showing the exact location of piles with respect to the column centre line.

8.1.6 Disturbances and Noise

1. The Contractor shall carry out the piling work in such a manner and at such times as to minimise noise, vibrations and disturbance. Noise limit as prescribed in "Building and other Construction Workers Act-Schedule-VI" shall be referred
2. The Contractor shall take precautions adequate enough to avoid damage to existing services and adjacent structures. Fig.1 of IS:2974 (Part 1) - 1969 may be used as a guide for studying qualitatively the effect of vibration on persons and structures. In case of deep excavation adjacent to buildings/structures, proper shoring or other suitable arrangement shall be done to guard against the lateral movement of soil stratum or releasing the confining soil stress. Any such damage if caused shall be repaired by the contractor at his own cost to the entire satisfaction of the Engineer.
3. The Contractor shall ensure that damage does not occur to completed piling works and shall submit to the Engineer for approval his proposed sequence and timing for driving or boring piles having regard to the avoidance of damage to adjacent piles.

8.1.7 Obstructions

If during the execution of the Works the Contractor encounters obstructions in the ground, he shall forthwith notify the Engineer accordingly, submit to him details of proposed methods for

overcoming the obstruction and proceed according to the Engineer's instructions at no cost to the employer.

8.2 Scope of Work

- 8.2.1** These specifications cover the works of providing pile foundations. Work included consists of all necessary services and furnishing of all labour material, tools, plant, equipment and related items for the full and satisfactory performance of the contract, conforming to these specifications and as shown in the Contract Drawings or reasonably implied therein or any authorised conditions or alterations thereof.
- 8.2.2** The tenderer is advised to visit the site and familiarise himself with the conditions at site. The Engineer shall not be held responsible for the accuracy of the soil data, furnished in good faith with the tender.
- 8.2.3** The construction of piles shall be in accordance with the following Indian Standard Codes of Practice for Design and Construction of Pile Foundations: IS:2911-1979 Part I Section 2 Bored Cast in-situ Concrete Piles Or IRC:78 Standard specifications and code of practice for road bridges Foundation And Substructure
- 8.2.4** With the tender, the Contractor shall submit the detailed method of construction to be adopted. For cast-in-situ concrete piles, the Contractor shall indicate the methods he proposes to concrete the piles in order to prevent necking of piles.
- 8.2.5** The items of work to be carried out in piling will generally be:
- (a) Boring/drilling including provision of temporary casing (including its withdrawal), empty boring, & polymer slurry,
 - (b) Supplying, fabrication, tying and placement of all reinforcement.
 - (c) Casting of concrete piles as per specifications.
 - (d) Integrity and Load testing of piles.

8.3 Materials

8.3.1 General

Unless otherwise specified in this section all materials shall conform to the requirements specified in separate sections for Concrete, Formwork and Reinforcement.

8.3.2 Cement

The cement to be used for piling and all foundation work shall be conforming to following Indian Standard Specifications:

IS: 455: Specification for Portland slag cement

However, if the soil and ground water conditions are found Ok on chemical testing in labs, Ordinary Portland Cement of 53grade may also be used as per codal provisions.

Cement shall be free from lumps and caking.

8.3.3 Concrete Mix Design

The concrete shall generally be of grade M35. The maximum size of coarse aggregate shall not exceed 20mm. For cast-in-situ piles concrete with a slump of 150 to 175mm (consistent with the method of concreting) will be required. Minimum cement content for design mix shall not be less than 400 kg/m³ of concrete in piling. For piling, qty of cement to be used shall be as per the design mix or the minimum cement content whichever is greater.

The contractor shall submit mix design calculations and get the same approved by the Engineer well before the starting of boring of piles and carry out adequate numbers of tests to ensure the minimum specified strength as indicated in drawings.

8.3.4 Concrete cube tests

Concrete cubes shall be cast, tested and evaluated as specified in Section 3.

8.3.5 Reinforcement

- (a) The reinforcement shall conform to the requirements specified in Section 5 extending for the full length of the pile and shall project 60 times bar diameters above the cut off level or as specified in the drawing. Only circular concrete cover blocks threaded on to the helix shall be used for ensuring the specified cover.
- (b) Joints in main longitudinal bars will be permitted only where, in the opinion of the Engineer, each bar cannot be supplied in one complete length. Where permitted, laps with full welding shall be provided as per the design/ drawings to develop the full strength of the bar across the joint, provided with adequate extra links or stirrups in position from those of adjacent longitudinal bars, all to the approval of the Engineer. No extra payment on account of providing laps shall be paid. The cost towards steel consumed in laps shall be considered in the Lumpsum Price Schedule.
- (c) All main longitudinal bars shall be welded at lapping and to the pile cap reinforcement. The last circle of helical stirrups at each end shall be welded to main longitudinal bars Nothing extra shall be payable on account of this. Any extra tack welding required for handling and lowering of cage in borehole shall also be done by the contractor at no extra cost.

8.3.6 Casings and Tremie Pipes

The casings and tremie pipes shall be in mild steel. The temporary casing plates of 4.5m. Length and permanent liners shall have adequate wall thickness and strength to withstand driving stresses, stresses due to soil pressure, etc. Without damage or distortion all joints shall be water tight. The internal diameter of the casing shall not be less than the nominal diameter of pile.

8.4 Cast In-Situ Bored Piles

8.4.1 General

- (a) Diameters of the piles shall be the concrete shaft diameters and shall not be less than the diameters specified in the drawing.
- (b) These shall be formed by boring to the founding strata specified on the drawings or as directed at site. The sides of the boring shall be prevented from collapsing by one of the following
 - Providing permanent mild steel liner (cased pile)
 - Providing removable mild steel casing (uncased pile)
- (c) Piles shall be constructed in a sequence approved by the Engineer. During boring, the Contractor shall, where required by the Engineer, take soil, rock or ground water samples and transport them to an approved testing laboratory or carry out soil tests as directed.
- (d) The method adopted shall be chosen giving due consideration to the subsoil data, ground water conditions and to the other relevant conditions at site as well as to the presence of adjacent structures.
- (e) The bottom of the steel lining shall be sufficiently in advance of the boring tool so as to prevent settlement of outside soil and formation of cavities.
- (f) Removable mild steel casings shall be used, only with extreme caution. Individual casings shall be joined together by screwing or any other approved method and not by direct butting with external lug connections. The inner surface of casings shall be smooth and free of all internal projections.

8.4.2 Boring

- (i) Boring shall be done using Rotary hydraulic drilling rigs with oscillator arrangement / equipments and methodology suitable for different kinds of strata encountered.
- (ii) As a general guideline, size of cutting tool shall in no case be less than the diameter of the pile minus 75mm. However, the size of cutting tool shall be chosen by contractor depending on the type of substrata and equipment employed by contractor so that executable pile shall not have

diameter less than nominal diameter of pile as specified in drawing. The contractor shall also ensure that there is no reduction in poured concrete quantities. These calculations shall be based on consumption of concrete poured in bore (as recorded in pour log) and actual concrete required in bore on theoretical basis i.e. based on nominal diameter of pile and actual bore hole length (based on actual sounding of founding level). More than 5% reduction in consumption of poured concrete quantities in pile may be rejected. In general, piling shall be done by using hydraulic rig with temporary liner. Use of liner for top 4.5 meters from ground level or upto depth having N. value (Minim) 10 (to protect loose soil falling in bore hole) as directed by Engineer, is essential. No extra payment shall be made to the contractor for using temporary liner, over the item of piling as in Price Schedule.

- (iii) Use of Polymer slurry in stabilizing sides of the pile borehole may also be necessary together with temporary or permanent casing wherever sub soil and ground water conditions are likely to cause mud flows or instability of pile bore or sand boiling. However, this will be permitted only when deemed necessary by the Engineer. In such situations the properties of Polymer used & quality control shall be as per requirement given below.

Fresh polymer slurry shall satisfy the following properties at all times:

Mud density shall not exceed 1.05 g/cc

PH Value to be 9 to 11.5

Marsh Cone viscosity 30-40 seconds

The sand content of Size > 0.075mm shall not be more than 1 Percent.

Liquid limit of bentonite shall not be less than 400 percent.

(Geo Polymer slurry specification to be added)

When using bentonite mud, flushing shall be done after lowering of inserting reinforcement cage and tremie before starting of concreting with fresh bentonite slurry.

When borehole is stabilised by casing and drilling mud or by maintaining water head using temporary/permanent casing, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning / flushing methodology shall be submitted and got approved by the engineer prior to commencement of piling.

The quantum of steel required in permanent liners from the cut off level downwards shall be measured as per drawing. Though the liner might have been provided right from the level of the working platform on practical considerations, the length of the permanent liner above the cut-off level has to be necessarily removed for facilitating chipping of the top portion of the pile and for interlacing its reinforcement bars into the capping slab. There is however, no objection if the surplus pieces (if cut and removed carefully and then found reusable) are joined and are re-welded to required length for reuse in the same contract on some of the other piles. No claim / compensation shall be entertained for such cut pieces if they cannot be reused by the Contractor in the aforesaid manner.

- (iv) Pumping from a bore hole shall not be permitted unless a casing has been driven into a stable stratum which prevents flow of external ground water from other strata in significant quantities.
- (v) In case of end bearing piles founded on rock, cutting of rock by hydraulic rig using diamond bits will be resorted to. Scheme adopted shall be such that noise and vibration parameters specified in tender document /Environment manual are not violated. Drilling in rock shall be carried out by hydraulic rig using diamond bits.
- (vi) On completion of boring, loose disturbed or remolded soil shall be removed from the base of bore.
- (vii) In case of dry bores inspection shall be carried out from the ground surface for bores having diameter less than 750mm. For larger diameter bores equipment shall be provided to enable the Contractor and the Engineer or their representatives to descend into the boring for the purpose of inspection

Penalty on mishandling of Polymer

Mishandling of Polymer (like splashing of Polymer outside specified width of barricading or non-cleaning of tyres of dumpers and transit mixers before leaving the piling site thereby making the road dirty etc.) is strictly prohibited. Noncompliance of same shall attract a penalty as follows:

- (i) On first observation –Rs. one lakhs
- (ii) On Second observation –Rs. two lakhs
- (iii) On third and each subsequent observation – Rs. three lakhs

8.4.3 Concreting

- (a) Prolonged delays in the commencement of concreting after the completion of the boring shall not be permitted. The time interval between the completion of boring and placing of concrete shall not exceed 6 hours.
- (b) The concrete shall have a minimum slump of 150 mm. Suitable precautions shall be taken for prevention of segregation. Internal vibrators shall not be used unless the Contractor is satisfied that segregation will not result because of vibration and unless the method of use has been approved by the Engineer.
- (c) The concrete for piles underwater or in drilling mud shall be placed with a tremie pipe. The tremie pipe shall not be less than 200mm diameter for 20mm aggregate. The joint between the hopper and tremie pipe as well as the joints in the tremie pipe shall be water tight and the tremie pipes shall be thoroughly cleaned after each use. .

It is essential that the water level within the pile bore be in equilibrium before commencement of concreting.

- (d) The Contractor shall ensure that heavily contaminated drilling mud has not accumulated at the base of boring since this could impair free flow of concrete from the tremie pipe.
- (e) If the specific gravity of the drilling mud at the base of the bore exceeds 1.20 the placing of concrete shall not proceed.
- (f) The first charge of concrete shall be placed in the hopper over a sliding plate of the bottom of the hopper. The charge should be adequate in volume to ensure flushing action to prevent mixing of water or drilling mud and concrete. Alternatively floating plugs of approved specification may be used before the first charge of concrete.
- (g) The tremie pipe shall at all times penetrate the previously placed concrete for minimum depth of 2 m as a precaution against accidental withdrawal. The tremie pipe shall not be withdrawn until the completion of concreting. At all times a sufficient quantity of concrete shall be maintained within the pipe to ensure that the pressure from it exceeds that from the seepage water.
- (h) Spot measurements shall be taken at suitable intervals to check that the tremie pipe has an adequate penetration into previously placed concrete.
- (i) Concreting of the pile shall be in one single and continuous operation. In case of long piles of large diameter, large size mixers or more number of mixers shall be used so that the entire concreting operation is completed in not more than two hours.
- (j) The top of concrete in a pile shall be brought above the cut-off level since the top concrete is loose and is weak because of contamination with water/drilling mud. This ensures good concrete at the cut-off level.
- (k) Cut off level (COL)

Cut off level of piles (50mm inside the pile cap) shall be as indicated in working drawings or as indicated by Engineer.

The top of concrete in pile shall be brought above the cut off level to remove all laitance & weak concrete and to ensure good concrete at cut-off level.

In case of concrete being placed by tremie method and pile cut off level being less than 1.0meter below the ground level, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 meter below working level then concrete shall be cast to a minimum of one meter above COL. Before concreting contractor shall obtain the approval of the Engineer of the height above COL up to which the concrete is to be cast.

In the circumstances where COL is below ground water level, the need to maintain a pressure should be observed & accordingly length of extra concrete above COL shall be determined by the Contractor and approval of Engineer obtained before concreting.

Any defective concrete in the head of the completed pile shall be cut away and made good with new concrete.

- (l) When a casing is being extracted, sufficient quantity of concrete shall be maintained within the bore to ensure the pressure from external ground water and soil is adequately exceeded by the pressure of concrete. Otherwise necking of the pile may result.
- (m) No concreting shall be placed in the bore once the bottom of the casing has been lifted above the top of concrete.
- (n) After each pile has been cast any empty bore shall be protected by putting steel cage/Jali over it and carefully backfilled as soon as possible with approved materials.
- (o) Complete boring and concreting records shall be submitted to the Engineer for each pile. The records shall include the duration of concreting, tremie lengths (individual and cumulative), tremie pipe lengths removed, theoretical sounding, actual sounding, actual lengths of pile concreted and the volume of concrete placed, cut off level, founding levels etc. For piles with temporary casings records of sequence of casing withdrawal and levels of concrete before and after withdrawal shall also be included in the reports.

Generally, the COL is 2.5 m below the existing ground level however, if any utility has to be placed on top of the pile cap, the COL may vary according to the requirement at that specific location.

8.5 Alignment of Piles

8.5.1 Piles shall be installed as accurately as possible according to the drawings either vertically or to the specified batter. All deviations will be measured at the cut off level of the piles. The deviation from the true axis shall not be more than 1.5% for vertical piles and 4% for raker piles. Piles should not deviate in location by more than 75mm when used in groups. For single or two piles used under piers / columns, deviation shall not be more than 50mm.

8.5.2 The Contractor shall maintain a record of actual pile locations in the form of a drawing and submit the information to the Engineer at suitable intervals.

8.6 Pile Cap

Pile caps shall be of reinforced concrete. A minimum offset of 200mm shall be provided beyond the outer faces of the outer MoRT&H piles in the group. If the pile cap is in contact with earth at the bottom, a levelling course of minimum 75 mm thickness of PCC of grade M20 shall be provided or as shown in the drawings.

The attachment of the pile head to the cap shall be adequate for the transmission of loads and forces. A portion of pile top may be stripped of concrete and the reinforcement anchored into the cap. Manual chipping may be permitted after three days of pile casting while pneumatic tools for chipping shall not be used before seven days after pile casting. The top of pile after stripping shall project at least 50mm into the pile cap. Concreting of the pile cap shall be carried out in dry conditions. Nothing extra will be paid for dewatering, etc. for carrying out pile cap excavation. Cost of all the operations and tools required for making the pile cap in dry condition is deemed to be included in the item.

The road surface after casting of pile cap should be repaired immediately. If the surface is not repaired immediately, penalty will be imposed as decided by the Engineer.

8.7 Testing of Piles

- 8.7.1** The load tests shall be in accordance with the Indian Standard Code of Practice for Design and Construction of Pile Foundations IS 2911 (Part IV) Load Tests on Piles. For initial load test, test load will be 2.5 times the theoretical designed capacity of pile. For initial load, test arrangement to be designed shall also cater for additional 25% above test load and nothing extra will be paid on this account. The payment shall be made based on relevant item included in Price Schedule on test load only. Permissible stresses in test arrangement (steel truss or plate girder) to cater for test load plus additional 25% load shall be within permissible stresses as per IS: 800 (as for permanent structure). For test frame, steel of Grade –B conforming to IS: 2062 shall be used.
- 8.7.2** Engineer will decide the locations and nos of initial load tests to be performed in different zones depending on variation in substrata but minimum two initial load tests are required to be done for different types of strata. The contractor shall undertake test piles required for initial pile load test in the initial stages of work using the same methodology and equipment's which will be subsequently used for working piles. These tests shall be undertaken well in advance of working pile. No working pile would be allowed to be undertaken till initial pile load tests have been satisfactorily completed.

Non-granting of permission for pile/ pile cap by Engineer in such respect will not be considered as reason for delay or any claim thereof. The test arrangement to be employed shall be of nature which is quick to install and remove and easily transferable. Sufficient nos of test arrangement and resources will be required to be mobilized by contractor so as to conduct required nos of initial load tests simultaneously. Vertical cyclic loading tests shall be carried out where specially needed and specified for separation of skin friction and point bearing components of the load carrying capacity of the piles. **At every one KM initial load tests both vertical and horizontal is to be performed by the contractor during the mobilisation period. GFC design and drawings will be made as per the initial load test results.**

- 8.7.3** Routine tests are performed as a check on the load carrying capacity and settlements of the pile foundations. At least one routine test shall be performed for every 100 piles unless otherwise specified by the Engineer.

- 8.7.4** The Contractor shall give the Engineer at least 48 hours notice of the commencement of construction of these piles which are to be subjected to Initial Tests.
- 8.7.5** The load tests shall not normally be conducted unless the concrete is at least 28 days old. However, in special circumstances, permission can be given by Engineer for prior testing.
- 8.7.6** All testing shall be done under the direction of experienced personnel conversant with the equipment and the testing procedure.
- 8.7.7** Before the commencement of the tests all the particulars regarding the test pile including boring data and concrete cube strengths shall be made available at site and shall form a part of the test report.
- 8.7.8** On completion of each load test the Contractor shall submit a report of the load test which shall include the following information.
- a. Description of soil conditions, ground water table, actual boring and installation records, concrete cube test results.
 - b. Method of load application
 - c. Load settlement readings during loading and unloading
 - d. Time load-settlement curve
 - e. All other observations relevant to the test being conducted.

8.7.9 Integrity test

Two types of pile integrity tests will be performed

- 8.7.10** This Dynamic Integrity test using pile driving analyser or approved equivalent for pile integrity shall be performed on the sample of piles selected by the Engineer. The top of the pile shall be made accessible, chipped off up to hard concrete, levelled by trimming it back as far as practicable. The reinforcing bars of the piles tested shall be bent sideways. The test shall be performed after removal of bad/ weak concrete at top so that the wave propagation is steady through hard concrete. The test shall be carried out at minimum 3 locations on each pile in such a way that the entire cross section of the pile is evenly covered. The test shall be conducted with a minimum age of concrete of 15 days. A specialist approved agency shall be employed for the test and the tests shall generally be as per recommendations of the agency unless otherwise directed by the Engineer. A complete report indicating the graphical display of wave propagation under each flow shall be submitted along with interpretation of results showing discontinuities, cross-sectional changes or material changes if any. The results are to be co-related with Site data.

8.7.11 Cross Sonic Logging Test

'Cross Sonic Logging' test should be conducted to verify the structural integrity of piles by means of the measurement of the time travel of a sound waveform an emitter to a receiver through the

concrete of a pile. The emitter and the receiver shall generally be at the same level. Cross-hole Sonic logging testing is compulsory for 25% of piles with 100% of piles installed with recess tubes and equipped for testing. The Engineer in Chief from client will randomly select and conduct tests of 25% of piles.

a. Sonic Logging Tubes

Material

Every pile must be provided with sonic logging tubes cast into it. The tubes shall be manufactured from steel of 50mm ID and 1mm thick. To form single tube the pipes to be connected with an enlarged end Bell Mouth – push fit arrangement provided with rubber gasket only. The bell mouth and rubber gasket should ensure a concrete-tight joint to maintain the tube integrity and prevent entry of foreign material. PVC or any kind of plastic material is strictly prohibited as it cannot resist great compression pressure. The expansion factor between PVC and concrete is not the same (unlike steel and concrete). When the concrete is setting, its temperature goes up and leads to the expansion of the PVC. Once the concrete has set and the temperature goes back to normal there will be a void between the tube and the concrete: this will lead to bad reading of the test and the rejection of the pile. One tube in each pile should be installed of internal diameter 100mm in order to allow for coring of the concrete at the base of the pile.

Tests to be conducted for Sonic Tubes assembly and desired results

The Sonic Tubes assembly should be tested for following tests –

1. External Pressure Test –

Description	Pressure in Mpa	Hold Time	Desired Results
Sonic Tubes Diameter 50 mm X 1.0 mm Thick	≥ 5 Mpa	≥ 60 Sec	No Leakages from Inner Surface of Tubes and No Distortion of Tubes

Minimum 3 test results should be obtained

2. Pull Out Test for Tubes-

Description	Tensile Force to be applied	Desired Results
Sonic Tubes Diameter 50 mm X 1.0 mm Thick	≥ 0.5 KN	No Distortion found and should withstand the test load of ≥ 0.5 KN

3. Pull Out Test for tubes ' Fixing Ears'

Description	Tensile Force to be applied	Desired Results
Sonic Tubes Diameter 50 mm x 1.0 mm Thick	≥ 0.5 KN	No Distortion found and should withstand the test load of ≥ 0.5 KN

4. Crush Test –

SI.No.	Descriptions	Test	Desired Results
	Direction	1500 mm	1. No Cracks 2. After test 30 mm Steel ball can go through the tubes.
	Drop Weight	4000 + 150/0g	
4	Diameter of Drop	50.03 mm	

Installation

The agency supplying sonic tubes should submit a detailed installation methodology and conduct a demo for one pile before being implemented for all piles.

Frequency

Four tubes shall be required for each pile, any other configuration is not allowed.

b. Sonic Coring

At least 7 days after the pile has been cast, but before carrying out any sonic logging test, a core of concrete and soil or rock from the founding material shall be taken. The core shall be taken from the base of the 100mm diameter sonic logging tube. The core shall be kept in a suitable wooden box with depths clearly recorded on rigid markers, shall be photographed along with a scale and colour chart. Thereafter, these shall be delivered to a core store designated by the Engineer. The scanning of the pile toe for its integrity by measuring the propagation time of transmitted waves between the vertical tubes and the pile toe/ founding strata shall also be carried out.

c. Sonic Logging Equipment

The equipment shall be properly maintained and calibrated. Where necessary, means shall be provided to centralise the probes within the tubes, so that variation in the separation of the emitter and receiver resulting from clearance between the probes and the tubes does not occur.

d. Test Procedure

The tubes shall be filled with water. The tests shall be repeated for each pair of tubes, i.e. three runs for a pile with three tubes and six runs for a pile with four tubes.

e. Analysis of Test Results

A report shall be prepared for each pile tested. The photographic record of the oscilloscope displays shall be analysed in detail. Any deviation from the record to be expected from a pile constructed entirely of sound concrete and without defect shall be reported. The report shall indicate the nature,

location and severity of the defect and recommendations shall be made for further testing. The implication of the existence of the defect on the performance of the pile shall be evaluated.

f. Submission of Results

Immediately after testing, a signed copy of all the raw test data of a pile shall be given to the Engineer. A test report shall be submitted to the Engineer within 7 days after testing.

g. Anomalous Sonic Logging Test Results

The piles with anomalous sonic logging results shall be rejected at the Engineer discretion unless the Contractor is able to demonstrate that the pile integrity is acceptable through proof coring.

h. Grouting of Pile after Testing

Upon completion of sonic logging test, the access tubes and sonic coring holes, if any, shall be grouted up.

Defective piles

The engineer reserves the right to reject any pile which is in his opinion has not been constructed in accordance with the specifications.

The contractor will not be paid for rejected pile.

Mode of measurement

Piles with casing pipe / Temporary Liners

1. The length of each pile is measured from the theoretical founding level (as per drawing) or as per actual whichever is less to the point of the vertical cut-off level. The Contractor's rate shall include all items of work including all temporary/permanent arrangements for boring including usage of Polymer, chiseling as specified / required, concreting, handling, form-work and grouting for precast piles, including chipping of top weak concrete, cutting off the MS liner / casing as necessary, removal of excavated earth, chipped concrete, casing / liners and Polymer slurry away from site including its treatment & final disposal, and all other items of work for the satisfactory completion of the pile foundations. The quoted price is also inclusive for permanent liners, temporary liners, socketing in weathered rock, soft rock and hard rock for all depths.
2. Pile load tests initial and routine load test.
3. Each pile integrity test and cross hole sonic test..
4. The quoted lumpsum price in price schedule is inclusive of all above items and the rates are including the costs of tools and plants, cutting, welding MS liner, cutting shoe etc. complete. Attention is also drawn to Para 8.4 2 (c) above.

Piles with Permanent Liners: Deleted.

As built drawings

On completion of the work, the Contractor will submit a plan showing the exact location and length of each pile as constructed at site, as well as dates of concreting, cube test results etc. The original tracings of these drawings along with soft copies shall be submitted to the Engineer.

K-RIDE

SECTION-9
OTHER WORKS

SECTION- S.09**9. OTHER WORKS****9.1 Bearings****9.1.1 General**

This work shall consist of design supply and fixing in position of bearings for bridge / viaduct girders in accordance with details shown on drawings and to the requirements of these Specifications, Codes and Standards quoted therein and as directed by Engineer.

Bearing plates, assemblies and other expansion or fixed devices shall be constructed in accordance with details shown on drawings.

When bearing assemblies or plates are shown on drawings to be placed (not embedded) directly on concrete, the concrete bearing area shall be constructed slightly above grade and shall be finished by grinding.

It shall be ensured that the bearings are set truly level and in exact position as indicated on drawings so as to have full and even bearing on the seats. This shall be checked with spirit level in both directions. Thin epoxy mortar pads (not exceeding 5 mm) may be made to meet with this requirement.

It shall be ensured that the bottoms of girders to be received on the bearings are plane at the location of these bearings and care shall be taken that the bearings are not displaced while placing the girders.

When elastomeric bearing pads or preformed fabric pads are to be provided, the concrete surfaces on which pads are to be placed shall be wood float finished to a level plane, which shall not vary by more than 1.5 mm from a straight edge placed in any direction across the area.

Scope of work

Rendering necessary assistance/coordinate with the manufacturer with regard to placement/fixing of said bearings. The contractor shall ensure that these bearings are installed in accordance with the specification of the manufacturers so that the bearings perform in the desired manner, in accordance with the forces/ displacements/ rotations for which these bearings have been designed.

The contractor shall liaise with the agency and will be responsible for design etc. The contractor shall furnish adequate and proper installation details for these bearings while submitting his design and detailed Engineering Drawings. The design criteria, specifications etc. as mentioned in tender documents are mandatory and no deviation to the same shall be permitted unless otherwise directed by the Engineer.

The contractor shall supply all the bearings in suitable packed condition (for its proper transportation and storage before placement in position) at project site to be identified by the Engineer. The price for such bearings (quoted in Schedule of Quantities) shall include all the accessories/holding down bolts/fixing arrangements (excepting reinforced concrete work in piers and girders, and finishing the surfaces of the pedestal) including grouting of holes with epoxy etc., as required.

SPHERICAL BEARINGS

Spherical bearings consisting of a metal piston supported by a disc , sealing rings, dust seals, steel mating surface, Complete as per IRC83-2014 Part (IV) and as per drawing and approved Technical Specifications. The design of the bearings shall be submitted by the manufacturers/ contractor and got approved from K-RIDE before fixing. Test report of the bearings should be got approved before the materials are lifted from the manufacturer premises.

A. ELASTOMERIC BEARINGS

The term "bearing" in this case refers to an elastomeric bearing consisting of one or more internal layers of elastomeric bonded to internal steel laminates by the process of vulcanization. The bearing shall cater for translation and/or rotation of the superstructure by elastic deformation.

A.1 Raw Material

Chloroprene (CR) only shall be used in the manufacture of bearing.

Grades of raw elastomer of proven use in elastomeric bearings, with low crystallization rates and adequate shelf life (e.g. Neoprene with low crystallization rates and adequate shelf life (e.g. Neoprene WRT, Bayprene 110 Skyprene B- and Denka S-40V) shall be used. No reclaimed rubber or vulcanized wastes or natural rubber shall be used. The raw elastomer content of the compound shall not be lower than 60 per cent by its weight. The ash content shall not exceed 5 percent (as per tests conducted in accordance with ASTM D-297, sub-section 10).

EPDM and other similar candidate elastomer for bridge bearing use shall not be permitted.

A.2 Properties

The elastomer shall conform to the properties specified in Clause 4.3.1 of the IRICEN publication titled "Bearings for Railway Bridges" and those specified in Table 2000-1 of the publication titled "Specifications for Road and Bridge Works", published by IRC on behalf of MORTH (Roads Wing).

A.3 Fabrication and Tolerances

Fabrication and Dimensional tolerances shall be governed by the specifications laid down in Clause 4.3.2 of the IRICEN publication & Clause 2005.2 of the MORTH specifications mentioned above.

A.4 Acceptance Specifications

For inspection and testing requirement Clause 4.4 of the above mentioned IRICEN publication shall be referred with modifications of lot size as mentioned below:-

Sampling testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria.

- (a) A lot shall not exceed a single contract or project quantity;
- (b) A lot shall not exceed 50 bearings;
- (c) A lot shall consist of bearings of the same type regardless of load capacity.

Accepting and testing requirements shall also conform to the specifications laid down in Clause 2005.3 of the referred MORTH specifications.

In addition to tests mentioned above, all bearings shall be also weight actually and compared with the theoretical weight.

All bearings shall carry a warrantee of not less than 15 years in an approved format. The contractor shall be responsible for immediate repair or replacement of the bearings in case of failure / distress to the satisfaction of the Owner at not extra cost to the Owner within the warrantee period.

Criteria for Selection of bearing manufacturer shall conform to requirement of MOST letter No-RW/NH-34057(1) / 95-(S & R) dated 2nd November,2000. It is necessary that all manufacturers of all elastomeric bearings shall have in house facilities for carrying out Infrared Spectro-Photometry as per ASTM D-3677.

A.5 Design

The design of elastomeric bearings shall be in accordance with EN1337 Part 1 and Part III.

The design, drawings and detailed method statements for installation and replaceability of the bearings shall be checked and certified by approved independent agency before submitting to the Engineer for approval.

A.6 Storage and Handling

Each elastomeric bearing shall be clearly labelled or marked. The bearing shall be wrapped in a cover. They shall be packed in timber crates with suitable arrangement to prevent movement and to protect corners and edges.

Care shall be taken to avoid mechanical damage, contamination with oil, grease and dirt, undue exposure to sunlight and weather to the bearings during transport and handling prior to and during installation.

A.7 Installation

Installation procedure shall conform to the guidelines listed in Clause 4.5 of the IRICEN publication and Clause 2005.6 of the MORTH specifications. Cost of Nonshrink grout above and below the bearing is included in the cost of bearing.

B. POT BEARINGS

B.1 Material specifications of Pot bearing

The material such as PTFE lubrication, Confined elastomer, stainless steel & internal seal shall conform to requirement of IRC: 83 Part-III. The Pot base, saddle & top plate shall be of Cast steel conforming to IS: 1030 Gr 280-520 W. The anchor bolts shall conform to IS: 1364. All welding shall conform to IS: 816 & IS: 9595 with electrode as per IS: 814. Painting on non-working surface of bearing shall be as per IRC: 83 Part-III. The mating surface of Piston and cylinder shall be hardened to 350BHN (Min).

Guides of sliding pot bearing shall be monolithic to parent component

Design of the bearing and all accessories shall be the responsibility of the Contractor and got approved from the Employer"s Representative.

B.2 Permissible stresses in steel component of POT bearing

All the design requirement for Pot bearing as specified in IRC: 83 Part-III has to be fulfilled with following modifications.

(a) No increase in permissible stresses in any material of bearing or bearing stress between concrete and bearing is permitted in seismic condition.

B.3 Permissible bearing stresses in concrete

The allowable bearing stresses in concrete as defined in IRC:83 Part-III has to be followed with following modifications.

No increase in permissible bearing stress between concrete and bearing is permitted in seismic condition.

B.4 Anchor sleeve

All the part of bearing such as anchor sleeves embedded in concrete shall be hot dip galvanized @ 300gm/ m². The anchor sleeves have to be designed taking account of difference in elasticity of steel of sleeve and concrete. The effect of shifting of center of rotation of sleeve should be also taken into account

B.5 The contractor shall furnish along with tender documents in technical bid, the name of the manufacturer of bearings, his qualifications with all details including proof of satisfactory performance, certification and testing facilities of the bearing he proposes to use. Products of reputed manufacturers shall only be used.

B.6 The Bearings shall be measured in numbers according to their capacities. For this purpose, Fixed type POT bearings, Free sliding type POT-cum-PTFE bearings, Guided sliding type POT-cum-PTFE bearings, Free or Guided PTFE Sliding Assembly, Pin Bearings or Metallic Guided bearings shall be counted separately. The rate shall include the cost of supplying, fixing, sampling and testing as required and confirming to the specifications

B.7 Testing of Pot Bearing

B.7.1 Proof Load Test

A test bearing shall be loaded to 150% of the bearing's rated design capacity and simultaneously subjected to a rotational range of 0.02 radians or design rotation, whichever is greater, for a period of one hour.

The bearing will be visually examined both during the test and upon disassembly after the test. Any resultant visual defects, such as extruded or deformed elastomer or PTFE, damaged seals, or cracked steel, shall be cause for rejection.

During the test, the steel bearing plate and steel piston shall maintain continuous and uniform contact for the duration of the test. Any observed lift-off will be cause for rejection.

All bearings will be applied with a vertical load perpendicular to the plan area of the bearings and on approved system duly approved by Engineer, to subject the bearings to rotation. The minimum load at which the required rotation is achieved is to be determined and this value should be less than the minimum design vertical load as tabulated in the drawing.

For guide-stopper bearing, test on specially molded test pieces shall be conducted as per clause 918.4.1.2. of IRC : 83 (Part – II) – 1987 which shall be compared with Test pieces from test bearings. The variation shall be within limits specified herein.

B.7.2 Sliding Coefficient of Friction

For all guided and non-guided expansion type bearing, the sliding coefficients of friction shall be measured at the bearing's design capacity.

The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's vertical design capacity.

The test result will be evaluated as follows: -

- (a) The measured sliding coefficients of friction shall not exceed 3%.
- (b) The bearing will be visually examined both during and after the test. Any resultant visual defects, such as bond failure, physical destruction, cold flow of PTFE to the point of debonding, or damaged components shall be cause for rejection.

B.8 Sampling and Testing

B.8.1 Lot Size

Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria.

A lot shall not exceed a single contract or project quantity;

A lot shall not exceed 25 bearings;

A lot shall consist of bearings of the same type regardless of load capacity. Bearing types shall be fixed or expansion bearings types. Guided and non-guided expansion bearing shall be considered a single type.

B.8.2 Sampling and testing requirements

The manufacture shall furnish the required number of samples to perform testing in accordance with Table Given below:-

Sampling and Testing Requirement

Test	Sample Required
Proof load	One production bearing per lot
Coefficient of Friction	One production bearing per lot
Physical Properties of elastomeric rotational elements	One elastomeric element per lot
Physical properties of PTFE sheet	One 10" x 15" sheet of PTFE material per project

A minimum of thirty (30) days shall be allowed for inspection, sampling and testing of production bearings and component materials.

All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

The manufacturer shall select, at random, the required sample bearing(s) from completed lots of bearings for testing by the manufacturer. He shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling, and acceptance consideration.

The Engineer shall select, at random, the required sample bearing(s) from completed lots of bearings.

Necessary test certificates for all raw material shall be furnished by manufacturer. Test specified in IS:1030 for cast steel shall be performed. Casting shall be ultrasonically got tested by approved testing agency.

(Spherical bearings to be added)

(Shear key devices)

B.9 Fabrication Details

The Contractor shall provide the Engineer with written notification thirty (30) days prior to the start of bearing fabrication. This notification shall include all the information shown on the shop drawings which are required as explained in subsequent section.

The finish of the mold used to produce the elastomeric rotational element shall conform to good machine shop practice.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded, shall be shop painted in accordance with the Contract Plans. Prior to painting, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if the time of exposure before

welding takes place is to exceed three months, the coating shall be removed at the time of welding. No painting will be done to these surfaces prior to the completion of welding.

Stainless steel sheet shall be attached to its steel substrate with an approved epoxy to ensure complete contact and then sealed with a continuous seal weld.

The steel piston and the steel pot shall each be machined from a solid piece of cast steel.

The outside diameter of the piston shall be no more than 1mm less than the inside diameter of the pot at the interface level of the piston and elastomeric rotational element. The sides of the piston shall be beveled to facilitate rotation. Except as noted all bearing surfaces of steel plates shall be finished or machined flat in accordance with tolerance given below:

Tolerances

Manufacture tolerance shall be as per IRC:83 Part-III

All the measurements will be taken using dial / height gauges, vernier calipers, surface finish measurement instrument etc has to be arranged by manufacturer at the workshop.

Every bearing shall have the Project Identification Number, Lot Number, and individual bearing number indelibly marked with ink on a side that will be visible after erection.

After assembly, bearing components shall be held together with steel strapping, or other means, to prevent disassembly until the time of installation. Packaging shall be adequate to prevent damage from impact as well as from dust and moisture contamination during transportation and storage.

B.10 Shop Drawings

Along with detailed design of different types of bearing, shop drawings shall be submitted. The shop drawings shall contain the following information, which is necessary for proper design and detailing of the bearings.

Quantity, type (fixed, guided expansion, non-guided expansion), and location of all bearing units.

A table containing maximum and minimum vertical and horizontal loads, design rotation requirements, and magnitudes and directions of movements.

Allowable contact stresses, maximum dimensions, and anchorage requirements at the bearing interfaces; grades, bevels, and slopes at all bearings; and allowable coefficients or friction of all sliding surfaces.

The painting system to be used on the steel components to guard against corrosion.

Any special consideration such as earthquake requirements, uplift details, or temporary attachments.

Installation scheme of pot bearing

The Contractor shall submit detailed shop drawings in conformance with the applicable requirements.

9.2 SHEAR KEY DEVICES

General Description of the system

General

The shear Key is made of concrete cast in place in second pour after concrete decks are assembled.

The shear keys shall take all horizontal loads (longitudinal and transverse) It is equipped with a system of fixation with high strength bars to one end of the deck, and with five vertical bearing taking the transverse horizontal loads and rotations.

Description of the proposed system

The system of fixation of the shear key to the deck is performed by high strength tensile bars installed on only one horizontal layer.

The system shall satisfy the following two main requirements.

- construction easiness
- maintenance easiness

The high strength tensile bars shall have good resilience and good resistance to fatigue as due to the rotation of the braking/acceleration loads, the bars are almost continuously loaded.

Material Characteristics

High tensile bars

Quality of steel: The quality of the raw material steel be according to the DIN EN 10083-1 equivalent.

The chemical composition shall be such as to guarantee the following mechanical characteristics:

- Yield stress $F_y > 1050$ MPa

- Tensile stress $F_u > 1200 \text{ MPa}$
- Elongation at breaking $>10\%$
- Resilience at $20\%C >50 \text{ Joules}$:

The threading of the bars shall be made by rolling method (cold plastic deformation of the metal between two dies). The threads shall have a triangular profile H7 according to ISO 262-NFE 03053.

The tolerance of the length of the bars is $\pm 5 \text{ mm}$.

Due to the repetitive loading that will be applied to the bars, tests shall be carried out to demonstrate the fatigue resistance of the bars. The test criteria shall be as follows: _

- mean stress: $0.57F_y$
- stress range: ± 0.03
- 4million cycles
- after 4 million cycles, no breaking at less than $0.80F_y$

Other materials

The repartition plates shall be of S355 JO steel quality or equivalent, and each shall include an injection pipe.

The ends of the bars shall be equipped with a protection cap filled up with grease and fixed on repartition plate by threading.

The nuts at the ends of the bars shall be spherical in order to ensure that the tensioning is axial. The sheaths shall be made of a 2mm-thick steel.

The injection product shall be wax in order to provide a good time –resistance and to provide flexibility under the deck rotations. The product shall be equivalent as for use for protecting stay cables or tension rods.

9.2 EXPANSION JOINTS

9.2.1 Scope of Work

The scope of work will include :

1. Preparation of detailed engineering and installation drawings, supply and supervision during fixing of strip seal/compression seal expansion joints conforming to specifications. The expected expansion/contraction of the superstructure at the location of expansion joints are shown in relevant drawings.
2. Design, manufacture, providing and seating of expansion joints by the specialized agency and approved by the Engineer.

3. Necessary technical supervision for installation of each and every expansion joint during different stages of installation including rectification of any deficiency or defect attributable to fixing and installation will be provided by the manufacturer/supplier.
4. The expansion joint shall be provided for the full width of viaduct including the railing.
5. Leak tightness of all joints shall be ensured which shall also carry a warranty of 10 years from the contractor.

The expansion joints provided over elevated structure decks should be so designed as to be compatible with the bearings wherever provided where the structure passes through stations, specially designed completely waterproof expansion joints should be provided.

The contractor shall submit design and drawing of expansion joints based on design criteria mentioned under "scope of Work" to the Engineer for approval. The design of expansion joint shall be done as per Revised Highways "Interim Specification for expansion joint" issued by MOST circular No. RW/NH – 34059/1/96 – S & R dated 30th

November 2000 and 20th february 2001, IRC Codes and MORTH Specification for Roads and Bridges and Sound Engineering practices.

Any modification to the design and drawings submitted by the Contractor, if suggested by the Engineer, shall be incorporated without any reservations. The design and drawings including changes approved by the Engineer shall form basis of execution and the Contractor shall undertake all necessary action for ensuring execution of work on that basis.

For design, manufacture, testing and supply of strip seal/modular strip seal expansion joints, following will be followed in order of preferences.

- a) Details in this chapter and elsewhere in tender documents.
- b) "Revised Interim Specifications for expansion joints" issued by MOST circular v No. RW/NH – 34059/1/96/ S & R dated. 30.11.2000 and 20th february 2001
- c) IRC Codes and MORTH specifications for Roads and bridges published by Indian Road Congress.
- d) Sound Engineering Practice (Decision of Engineer will be final in this case) which shall include specialized literature as decided by Engineer-in-Charge.

Building Expansion Joints

Specialised expansion joints consisting of extruded aluminum frame assemblies of suitable profile to receive free floating cover plate of required shape and profile / or elastomer suited to building applications shall be used. These will be provided for covering the structural gap at expansion joints along the horizontal faces of slabs and beams, vertical faces of retaining walls,

etc. Necessary block-outs as per the manufacturer's recommendations shall be provided in the structure which shall be filled in the approved manner after placing the expansion joints.

The base of the expansion joint assembly shall be fixed onto the concrete base using anchor fasteners (not exposed to top surface) as per manufacturer's specifications. The joint shall have and anti-skid serrated top plate with a free floating central plate. All aluminum in contact with concrete shall have zinc chromate finish. The joint assembly shall be capable of accommodating the specified movement without loss of cover and shall include all the necessary accessories ,sealant etc as per manufacture's drawings. The joint fixing shall be carried out either by the main contractor under the supervision of supplier/manufacturing agency of approved expansion joint . The expansion joint cover assemblies shall withstand a minimum 500lb point load without damage or permanent deformation. The joint should be water tight and test on same if required on direction of Engineer shall be conducted without any extra payment for same.

SPECIFICATION FOR STRIP SEAL EXPANSION JOINT

Expansion joint type described here-after is the "strip seal" type, but alternate designs can be proposed for concerned organisation approval.

1. Components:

Strip seal expansion joint shall comprise the following items:

(a) Edge beam:

This shall be either extruded or hot rolled steel section or cold rolled cellular steel section with suitable profile to mechanically lock the sealing element in place throughout the normal movement cycle. Further the configuration shall be such that the section has a minimum thickness of 10mm all along its cross section (flanges and web). The minimum height of the edge beam section shall be 80mm. The minimum cross sectional area of the edge beam shall be 1500mm ².

(b) Anchorage:

Edge beams shall be anchored to the deck by reinforcing bars or bolts or anchor plates cast in concrete or a combination of anchor plate and reinforcing bars. Anchor bars studs or bolts shall engage the main structural reinforcement of the deck and in case of anchor plates or loops, this shall be achieved by passing transverse bars through the loops or plates. The minimum thickness of anchor plate shall be 12mm. Total cross sectional area of bar on each side of the joint shall not be less than 1600mm Sq. per meter length of the joint and the center to center spacing shall not exceed 250mm. The ultimate resistance of anchoress shall not be less than 600 kN/m in any direction.

Material

- a) The steel for edge beams shall conform to any of the steel grade corresponding to RST 37-2 or 37-3 (DIN), ASTM A36 or A588, CAN/CSA Standard G40.21 Grade 300W or equivalent.
- b) Anchorage steel shall conform to IS:2062 or equivalent.
- c) All steel sections shall be protected against corrosion by hot dip galvanizing or any other approved anticorrosive coating with a minimum thickness of 100 micron.
- d) Chloroprene of strip seal element shall conform to Clause 915.1 of IRC:83 (Part-II).

The properties of chloroprene shall be as specified in Table-1.

Fabrication (Pre-installation)

- a) The strip seal joint system and all its component parts including anchorages shall be supplied by the manufacturer /system supplier.
- b) The width of the gap to cater for movement due to thermal effect, prestress shrinkage and creep, superstructure deformations (if any) and sub-structure deformations (if any) shall be determined and intimated to the manufacturer. Depending upon the temperature at which the joint is to be installed, the gap dimension shall be preset.
- c) Each strip seal expansion joint system shall be fabricated as a single entity unless stage construction or excessive length prohibits monolithic fabrication. It shall fit the full width of the structure as indicated on the approved drawing. The system shall be pre-set by the manufacturer prior to transportation. Presetting shall be done in accordance with the joint opening indicated on the drawing.

(Instead of expansion joint : strip seal , Compression seal expansion joint is to be used.)

Include vertical bearing including steel frame in Price Schedule. Also add in structural steel nomenclature and qty.

TABLE-1 STRIP SEAL ELEMENT SPECIFICATION

Sealing element is made of chloroprene and must be extruded section. The working movement range of the sealing element shall be at 70mm

Property	Specified Value
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Hardness*	63+ /-5 Shore A
DIN 53505	+/- 5 Shore A
ASTM D 2240 (Modified)	.
Tensile Strength*	Min 11 MPa Min 13 .8Mpa
DIN 53504	Min 350 per cent
ASTM D 412	Min 250 per cent
Elongation at fracture*	Min 10 N/mm
DIN 53504	Min 10 N/mm
ASTM D 412	Min 25 per cent
Tear Propagation Strength	Min 220 Cu.mm
Longitudinal	Max 28 per cent
Transverse	
Shock elasticity	
Abrasion	
Residual Compressive Strain (22h/70 deg C/30 per cent Strain)) Aging in hot air (14days/70 deg C) Change in hardness Change in tensile strength Change in elongation at fracture	Max + 7 Shore A Max -20 per cent
Ageing in Ozone	-20 per cent
(24 h/50 pphm/25 deg C/20 per cent elongation)	
Swelling behaviour in Oil (168h/25 deg. C)	No cracks
ASTM Oil No. 1	
Volume Change	Max + 5 per cent
Change in hardness	Max -10 Shore A
ASTM Oil No. 3	
Volume Change	Max + 25 per cent
Change in hardness	Max -20 Shore A
Cold Hardening Point	Max -35 deg C

Only one set of specification viz. ASTM or DIN shall be followed depending on the source of supply.

- d) Each strip seal expansion joint system shall be fabricated as a single entity unless stage construction or excessive length prohibits monolithic fabrication. It shall fit the full width of the structure as indicated on the approved drawing. The system shall be pre-set by the manufacturer prior to transportation. Presetting shall be done in accordance with the joint opening indicated on the drawing.
- e) The finally assembled joint shall then be clamped and transported to the work site.
- f) The finally assembled joint shall then be clamped and transported to the work site

Handling and Storage

- (a) For transportation and storage, auxiliary brackets shall be provided to hold the joint assembly together.
- (b) The manufacturer/supplier shall supply either directly to the Engineer or to the Bridge Contractor all the materials of strip seal joints including sealants and all other accessories for the effective installation of the jointing.
- (c) Expansion joint material shall be handled with care. It shall be stored under cover on suitable lumber padding.

Supply/Installation

Components of expansion joint such as edge beam and strip seal shall be imported from the specified foreign manufacturer / collaborator to ensure quality and performance. The joint shall be supplied and installed only by the MOST approved manufacturer . Contractor shall furnish a warranty of trouble free performance for at least ten years and free rectification of defects / replacement, if any, during this period.

The joints shall be installed by the manufacturer/supplier (only MOST Approved) or their authorised representative who will ensure compliance to the manufacture"s instructions for installation.

Taking the width of gap for movement of the joint into account, the dimensions of the recess in the decking shall be established in accordance with the drawings or design data of the manufacturer. The surfaces of the recess shall be thoroughly cleaned and all dirt and debris removed. The exposed reinforcement shall be suitably adjusted to permit unobstructed lowering of the joint into the recess.

The recess shall be shuttered in such a way that dimensions in the joint drawing are maintained. The formwork shall be rigid and firm.

Immediately prior to placing the joint, the presetting shall be inspected. Should the actual temperature of the structure be different from the temperature provided for presetting,

correction of the presetting shall be done. After adjustment, the brackets shall be tightened again.

The joint shall be lowered in a pre-determined position. Following placement of the joint in the prepared recess, the joint shall be levelled and finally aligned and the anchorage steel on one side of the joint welded to the exposed reinforcement bars of the structure. Upon completion, the same procedure shall be followed for the other side of the joint. With the expansion joint finally held at both sides, the auxiliary brackets shall be released, allowing the joint to take up the movement of the structure.

High quality concrete shall then be filled into the recess. The packing concrete must feature low shrinkage and have the same strength as that of the superstructure, but in any case not less than M40 grade. Good compaction and careful curing of concrete is particularly important. After the concrete has cured, the movable installation brackets and shuttering still in place shall be removed.

The neoprene seal shall be field installed in continuous length spanning the entire roadway width. To ensure proper fit of seal and enhance the ease of installation dirt, spatter or standing water shall be removed from the steel cavity using a brush, scrapper or compressed air. The seal shall be installed without any damage to the seal by suitable hand method or machine tools.

The deck surfacing shall be finished flush with the top of the steel sections. The horizontal leg of the edge beam shall be cleaned beforehand. It is particularly important to ensure thorough and careful compaction of the surfacing in order to prevent any premature depression forming in it.

Acceptance Criteria:

- (i) All steel elements shall be finished with corrosion protection system
- (ii) For neoprene seal, the acceptance test shall conform to the requirements stipulated in Table-1. The manufacturer/supplier shall produce a test certificate accordingly, conducted in a recognized laboratory, in India or abroad.
- (iii) The manufacturer shall produce test certificates indicating that anchorage system had been tested in recognized laboratory to determine optimum configuration of anchorage assembly under dynamic loading.
- (iv) Prior to acceptance 25 percent of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25mm above the highest point of deck. The width of ponding shall be at least 50mm beyond the anchorage block of the joint on either side. The depth of water shall

not fall below 25mm anytime during the test. A close inspection of the underside of the joint shall not reveal any leakage.

- (v) As strip seal type of joint is specialized in nature, generally of the proprietary type, the manufacturer shall be required to produce evidence of satisfactory performance of this type of joint

Test and Standards of Acceptance:

The materials shall be tested in accordance with these specifications and shall meet the prescribed criteria. The manufacturer/supplier shall furnish the requisite certificates from the recognized testing laboratory of India or abroad.

9.3 WATER BARS / WATERSTOPS

Where water bars/ waterstops are shown on the drawings, the joints shall incorporate PVC waterbar/ waterstop such as "Fixostop" or approved equivalent (conforming to IS:12200). The waterbars/ waterstops shall be complete with all the necessary moulded or prefabricated intersection pieces assembled with bends and butt joints in running lengths made by welding in an electrically heated jig. The fabrication drawing made by the manufacturer shall be submitted by the Contractor for approval of the Engineer

Jointing and fixing of waterbars / waterstops shall be carried out strictly in accordance with the manufacturer's instructions which should be enumerated in a detailed method statement and submitted for approval / comments of the Engineer. The following types of water bars / waterstops are proposed to be used in the Work.

Water bars / water stops shall be of approved and appropriate type obtained from approved manufacturers.

The water bars / water stops shall be installed so that they are securely held in their correct position during the placing and compacting of the concrete. Necessary supporting devices to prevent sagging of the water bars / water stops shall be provided.

Where reinforcement is present adjacent to water bars / water stops, adequate clearance shall be left between the reinforcement and water bars / water stops to facilitate compaction of the concrete.

Double headed nails maybe used in the edge of the water bar / water stop outside the line of the external grooves for fixing purposes, but no other holes shall be permitted through the water bar / water stop.

A representative of the manufacturer shall be present at site during the operations of installing, jointing and embedment of water bar / water stop. He shall monitor and certify that the work is being carried out strictly as per specifications and recommended practices.

SPECIFICATION FOR OMEGA TYPE EXPANSION JOINT

Expansion joint type described here-after is the **“OMEGA TYPE EXPANSION JOINT” as per IRC 83 Part-II**

Material.

1.1 Anchorage: The steel plate shall conform to IS: 2062 or equivalent. The bolt and nut shall be anchored to the deck by welding to the main reinforcement. Steel plate used for shall be 8 mm thick hot dip galvanized. The center-to-center spacing of bolts shall not exceed 400 mm.

G.1.2 Corrosion Protection: All steel section shall be protected against corrosion by hot dip galvanising or any other approved anticorrosive coating with a minimum thickness of 100micron.

Joint Seal:

The sealing element shall be a preformed continuous chloroprene or closed cell foam seal with high tear strength, insensitive to soil, gasoline and ozone. It shall have high resistance to ageing and ensure water tightness. The seal should be vulcanised in a single operation for the full length of the joint required for carriageway, kerbs and footpaths, if any. The seal shall cater for a horizontal movement up to 40mm and vertical movement of 3mm.

The physical properties of chloroprene/closed cell foam sealing element shall conform to the following:

Elastomeric Seal:

It shall be preformed extruded Omega type section of Elastomeric Seal of such a shape as to promote self removal of foreign material during normal service operations. Elastomer of joint seal shall conform to clause 915.1 of IRC:83 (Part-II) and satisfy the properties stipulated in Table 2 strip seal element specifications of these specifications given in MORTH Circular no. RW/NH-34059/96-5 & R dated 30 Nov 02 on the subject except in respect of the working movement range of the sealing element which shall be as specified.

Handling and Storage:

- (i) The expansion joint material shall be handled with care and stored under cover.

- (ii) All joint material and assemblies shall be protected from damage and assemblies shall be supported to maintain true shape and alignment during transportation and storage.

Installation

The expansion joint shall be installed by the manufacturer/supplier or their authorities representative, who will ensure compliance of installation procedure and instructions.

The dimension of the joint recess **edge beam above deck slab** and the width of the gap shall conform to the approved drawing.

Bolts shall be welded to the main reinforcement in the edge beam deck maintaining the level and alignment of the joint.

Concreting of pocket/recess **edge** shall be done with great care using proper mix conforming to same grade as that of the deck concrete but no less than M30 grade in any case. The water-cement ratio shall not be more than 0.40. If needed, suitable admixtures may be used to achieve the workability.

The width of pocket shall not be less than 300mm on either side of the joint. Care shall also be taken to ensure efficient bonding between already cast/existing deck concrete and the concrete in the joint recess **edge beam**.

At the time of installation, joint shall be clean and dry and free from spalls and irregularities, which might impair a proper joint seal.

Concrete or metal surfaces shall be clean, free of rust, laitance, oils, dirt, dust or other deleterious materials.

The joint seal shall be compressed to the specified thickness for the rated joint opening and ambient temperature at the time of installation, which shall be between +05 to +35 degree C.

The joint seal shall be installed without damage to the seal. Loose fitting or open joints shall not be permitted.

Acceptance Criteria:

All steel elements shall be furnished with corrosion protection system.

For the joint seal the acceptance test shall conform to the requirements as stipulated. The manufacturer/supplier of this type of joint shall produce a test certificate to this effect conducted in a recognized laboratory in India or abroad.

Prior to acceptance 25% of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25mm above the highest point of deck. The width of ponding shall be at-least 50mm beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25mm any time during the test. A close inspection of the underside of the joint shall not reveal any leakage.

Tests and Standards of Acceptance

The materials shall be tested in accordance with these specifications and shall meet the prescribed criteria.

The manufacturer/supplier shall furnish the requisite from the recognized testing laboratory of India or abroad.

The work shall conform to these specifications and shall meet the prescribed standards of acceptance.

Lumpsum Price

The Lumpsum Price of Schedule shall include the cost of all materials, labour, equipments, cost of testing including cost of test samples and other incidental charges for fixing the joints complete in all respects as per specifications.

Specification for Compression Seal Expansion Joint

Expansion joint type described here-after is the "Compression seal" type, but alternate designs can be proposed for approval of the Engineer.

Compression seal joint shall consist of steel armoured nosing at two edges of the joint gap suitably anchored to the deck concrete and a preformed chloroprene elastomers or closed cell foam joint sealer compressed and fixed into the joint gap with special adhesive binder.

Material:

Steel Nosing:

The steel nosing shall be of angle section ISA 100 x 100 conforming to weldable structural steel as per IS:2062. The thickness of legs shall not be less than 12mm. The top face of the angle shall be provided with Bleeder holes of 12mm diameter spaced at maximum 100mm centre so as to ensure that there are no voids in the concrete beneath the angle.

Anchorage:

The anchorage steel shall conform to IS:2062 or equivalent. The steel nosing shall be anchored to the deck by reinforcing bars or anchor plates cast in concrete or a combination of anchor plates and reinforcing bars, anchor plates and anchor loops. This shall be achieved by passing transverse bars through the loops or plates.

The minimum thickness of anchor plates shall be 12mm. Total cross sectional area of bars on each side of the joint shall not be less than 1600sq mm per m length of the joint and the centre to centre spacing shall not exceed 250mm. The ultimate resistance of each anchorage shall not be less than 600 KN/m in any direction.

Corrosion Protection:

All steel section shall be protected against corrosion by hot dip galvanising or any other approved anticorrosive coating with a minimum thickness of 100 microns.

Joint Seal

The sealing element shall be a preformed continuous chloroprene or closed cell foam seal with high tear strength, insensitive to soil, gasoline and ozone. It shall have high resistance to ageing and ensure water tightness. The seal should be vulcanized in a single operation for the full length of the joint required for carriageway, kerbs and footpaths, if any. The seal shall cater for a horizontal movement up to 40mm and vertical movement of 3mm.

The physical properties of chloroprene/closed cell foam sealing element shall conform to the following

(a) Chloroprene Seal

It shall be performed extruded multi-web cellular section of chloroprene of such a shape as to promote self-removal of foreign material during normal service operations. Chloroprene of joint seal shall conform to IRC:83 (Part-II) and satisfy the properties stipulated in Table 1 herein above strip seal element specifications of these specifications except in respect of the working movement range of the sealing element which shall be as specified above.

(b) Closed Cell Foam seal:

It shall be of preformed non-extruded non cellular section made from low density closed cell, cross linked ethylene vinyl acetate, polyethylene copolymer that is physically brown using nitrogen. The material shall possess properties as indicated in the Table 2 below.

Table-2
Properties of Closed Cell Foam Seal

Property	Special Value
(I) Density	41.7 – 51.3 kg/cum
(ii) Compression set on 25mm	50% compression samples (ASTM D 3575) for 22 hours at 23 ^o C, 2 hour recovery; 13% set.
(iii) Working temperature	-70 to +70 ^o C.
(iv) Water Temperature absorptions (total Immersion for 3 months) (ASTM3575)	0.09766 kg/sqm
(vi) Tensile strength	0.8 Mpa
(vii) elongation at break (ASTM D 3575)	195 +/-20%

Lubricant cum Adhesive: The type and application of material used in bonding the preformed joint seal to the steel nosing and concrete shall be as recommended by the manufacturer / supplier of the seal system.

Handling and Storage

The expansion joint material shall be handled with care and stored under cover.

All joint materials and assemblies shall be protected from damage and assemblies shall be supported to maintain true shape and alignment during transportation and storage.

Installation

- a. The expansion joint shall be installed by the manufacturer / supplier or their authorised representative, who will ensure compliance of specified installation procedure and instructions.
- b. The dimension of the joint recess and the width of the gap shall conform to the approved drawing.
- c. Anchoring steel shall be welded to the main reinforcement in the deck maintaining the level and alignment of the joint.
- d. Concreting of pocket/recess shall be done with great care using proper mix conforming to same grade as that of the deck concrete but no less than M30 grade in any case. The water-cement ratio shall not be more than 0.40. If needed, suitable admixtures may be used to achieve the workability. The width of pocket shall not be less than 300mm on either side of the joint. Care shall also be taken to ensure efficient bonding between already cast/existing deck concrete and the concrete in the joint recess.

- e. At the time of installation, joint shall be clean and dry and free from spalls and irregularities, which might impair a proper joint seal.
- f. Concrete or metal surfaces shall be clean, free of rust, laitance, oils, dirt, dust or other deleterious materials.
- g. The lubricant cum adhesive shall be applied to both faces of the joint and joint seal prior to installation in accordance with the manufacturer's instructions.
- h. The joint seal shall be compressed to the specified thickness for the rated joint opening and ambient temperature at the time of installation, which shall be between +05 to +35-degree C.
- i. The joint seal shall be installed without damage to the seal. Loose fitting or open joints shall not be permitted.

Acceptance Criteria

- (i) All steel elements shall be furnished with corrosion protection system.
- (ii) For the joint seal the acceptance test shall conform to the requirements stipulated in para above. The manufacturer/supplier of this type of joint shall produce a test certificate to this effect conducted in a recognized laboratory in India having NABL certification or abroad.
- (iii) Prior to acceptance 25% of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25mm above the highest point of deck. The width of ponding shall be at-least 50mm beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25mm any time during the test. A close inspection of the underside of the joint shall not reveal any leakage.

Tests and Standards of Acceptance:

The materials shall be tested in accordance with these specifications and shall meet the prescribed criteria. The manufacturer/supplier shall furnish the requisite certificates from the recognised testing laboratory of India having NABL certification or abroad.

The work shall conform to these specifications and shall meet the prescribed standards of acceptance.

Mode of Measurement

The measurement for expansion joints as a finished work shall be in running meters nearest to a centimetre.

Lumpsum Price

The quoted Lumpsum Price shall include the cost of all materials (including cast-in-situ concrete), labour, equipments, cost of transportation (overseas as well as within country), cost of testing including cost of test samples and other incidental charges for fixing the joints, covering plates over shear keys etc., complete in all respects as per specifications.

9.4 WEARING COAT

9.4.1 ASPHALTIC WEARING COAT

Wearing coat shall be provided as indicated on drawings. It shall consist of the following:

A coat of mastic asphalt 6mm thick with prime coat over the top of deck before the wearing coat is laid. The prime coat of mastic asphalt shall be 30% straight run 30/40 penetration grade bitumen and 50% light solvent (benzol) to be laid over the deck slab. The insulation layer of 6 mm thick mastic asphalt with 75% limestone dust filler and 25% of 30/40 penetration grade bitumen shall be laid at 375 degree F with broom over the prime coat.

A layer of asphaltic concrete wearing coat of thickness varying from 25 mm to 60 mm to be laid in single layer.

9.4.2 CONCRETE WEARING COAT

Scope

The work shall consist of laying cement concrete layer of required thickness as indicated on the drawings, It shall not be laid monolithic with the slab

Materials

Materials shall conform to ISI and / or IRC specifications.

Construction Operation

- i. For Weather and seasonal limitations shall be as per IRC Standards.
- ii. All carriageway and footpath surfaces shall have non-skid characteristics
- iii. The surface shall be thoroughly swept and scraped clean and made free of dust and other foreign matter. It shall be conditioned to the specified levels, grade and cross fall (camber) as directed by Engineer.
- iv. Construction operations such as preparation of mix, laying of concrete, steel reinforcement shall conform to respective specifications in the relevant Chapters.
- v. Curing of wearing coat earlier than what is generally specified may be resorted to, so as

vi. to avoid formation of shrinkage cracks in hot weather.

9.5 Railings

9.5.1 General

Railing are not contemplated for the project but these specifications are provisional in case railings are finally provided for the full length of viaduct or for small parts.

Prefabricated railing as per approved details shall be erected at site Fixing arrangements with deck shall be carefully designed and incorporated.

Railing on bridge shall not be constructed until the centering or form work for the span has been released and the span is self supporting. For concrete and steel, specifications of the items of controlled concrete and reinforcement mentioned under relevant specifications shall be applicable.

Railing shall be carefully erected true to line and grade. Posts shall be vertical with a tolerance not exceeding 6 mm in 3 m. The pockets left for posts shall be filled up with non-shrinkable mortar

All edges and corners shall be straight and finished to true line and level. Forms shall either be of single width boards / plates or shall be lined with suitable materials duly approved by Engineer. Form joints in plain surface will not be permitted. All mouldings, panel work and level strips shall be constructed according to the details shown in the drawings.

9.5.2 Metal Railings

9.5.2.1 General

All complete steel / aluminium railing elements, terminal sections, posts, and other fittings shall be of shape, size and designation of approved material and make as given in the item of work or as directed by Engineer. In case of steel railing all these elements shall be galvanised or painted with an approved paint. If galvanised, all elements of the railings shall be free from abrasions, rough or sharp edges, and shall not be kinked, twisted or bent. If straightening is necessary, it shall be done by methods approved by Engineer.

Aluminium sections shall be of approved quality and make and free from scratches, stains and discoloration.

The Contractor shall take every precaution against damage of the components during fixing in position.

Damaged galvanized surfaces shall be cleaned and re galvanised. Special care shall be taken to prevent staining of all products, rust, mortar, etc. before it is put into use.

Prefabricated railing as per approved details shall be erected at site Fixing arrangements with deck shall be carefully designed and incorporated.

9.5.2.2 Fixing

The railing shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints, correct alignment and camber throughout their length.

Fixing shall be strictly as per fixing details shown in the drawings or as directed by Engineer.

If sections are not galvanised, railing shall be given one shop coat of paint, and three coats of paint after erection.

All necessary holes, chases, etc., required in fixing shall be made by the contractor and made good after installation, without any extra charge.

9.6 DRAINAGE SPOUTS AND DRAINAGE PIPE

GENERAL

This work shall consist of supply and fixing in position of drainage spouts and drainage pipes for bridge decks and piers true to lines, levels and position in accordance with details shown on drawings and to the requirements of these specifications and drainage plan for structure. Where details are not given on drawings, contractor should prepare and submit his own drawings for approval of Engineer before commencement of work. Underground / Surface drainage works are to be designed by Contractor and carried as per CPWD specifications and paid for separately under DSR items.

All drainage pipe to be embedded in superstructure diaphragm and pier shall be HDPE corrugated double wall.

FABRICATION

Drainage assembly shall be fabricated to dimensions shown in drawings. All materials shall be corrosion resistant; steel components shall be of mild steel conforming to IS:226. The drainage assembly shall be seam welded for water tightness and then hot dip galvanised.

PLACEMENT

The galvanised assembly shall be given two coats of bituminous paint before placement. The whole assembly shall be placed in true position, lines and level as shown in drawing with necessary cut-out in the shuttering for deck slab and held in position firmly. Where reinforcement of the deck is required to be cut, equivalent reinforcement shall be placed at the corners of the assembly.

FINISHING

After setting of deck slab concrete, shrinkage cracks around the assembly shall be totally sealed with polysulphide sealant or bituminous sealant as per IS:1834 and excess sealant trimmed to receive the wearing coat. After the wearing coat is completed, similar sealant, finished to cover the wearing coat surface all-around the drainage assembly, shall be provided at least 50 mm.

9.7 CINDER

General

Cinder to be used for filling in floors shall be obtained from furnace of steam boilers using coal fuel only. It shall be clean and free from clay dirt, wood ashes or other deleterious matter. It shall pass through IS Sieve designation 3.35 mm with at least 50% of it passing through IS Sieve designation 1.70 mm. Cinder obtained from brick kilns shall not be used. At site of work, the cinder shall be protected from dirt collecting on it and could be used for filling in drops only.

9.8 SEALANTS

General

Joint sealing compounds shall seal joints in concrete against the passage of water, prevent the ingress of grit or other foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete surfaces and shall be resistant to flow and weathering.

Approved Sealant where specified on the drawings shall be provided strictly in accordance with the manufacturer's written instructions, such joints shall be formed to the correct dimensions, thoroughly cleaned and treated with recommended primer strictly in accordance with the manufacturer's written instructions prior to sealing. Wherever width of gap to be sealed is wide enough to necessitate the use of backer rod, the same shall be provided at no extra cost. The contractor shall use only competent personnel experienced in the application of sealant for such work.

Where specified in the drawings, silicon/polyurethane/ polysulphide based sealants shall be of an approved manufacture. The treatment of the joint and the use of sealing compound shall be strictly in accordance with the manufacturer's written instructions. The entire work shall be carried out as per IS:3414, IS:6509, IS:11433.

Sealants shall be as follows:

Silicon sealant shall be one part gungrade type with minimum movement capability of 25% and elongation at break of 450% conforming to BS 5889 or TTS 001543A. This Sealant shall be of approved color and shall be nonstaining to the parent concrete surface

Ancillary Materials

The Contractor shall provide all ancillary materials such as cleaning solutions, epoxy mortar, primer, tool cleaner, bond breaker type, filler boards, back up material, backing rods, polyethylene foam, masking tapes, sealant slot former etc.

Primer

Primer for sealants shall only be as recommended by the sealant manufacturer, Primer shall have been tested for compatibility and durability with the sealant to be used and on samples of the surfaces to be selected.

Backdrop Material

Backdrop material shall be an expanded polyethylene of nominal density 35 kg/cum as recommended by the sealant manufacturer. It shall be of non-absorbent and non-staining material compatible with the sealant used. Tube or rod stock shall be rolled into the joint cavity.

Bond-preventive Materials

Bond-preventive materials shall be pressure-sensitive adhesive polyethylene tape or aluminum foil.

Equipment

The Contractor shall inter alia provide the following plant and equipment for the work. T-paddle, follower plate, solid barrel gun, plastic nozzle, wire brush, heavy duty 500 rpm electric drill, palette knife, masking tape and paint brush for priming etc.

Working Life

Care shall be taken to ensure that material with adequate shelf life is provided. Material whose shelf life is over shall not be used in the works and shall be removed from the site forthwith. Depending on the storage, temperature and humidity, only one unit shall be drawn from the storage

Curing Period

No portion of the work where sealant has been applied shall be allowed to be submerged or be wetted by any liquid for a period of 7 days after application of the sealant. This period may be modified depending on the temperature and humidity prevalent at the time.

Environmental Requirements

The ambient temperature shall be within the limits as given by the manufacturer, when the sealants are applied. The work shall not be carried out in a dusty atmosphere or when it is raining or when the humidity is high.

Sealants shall not be applied when the ambient temperature is below 4 degree C. When the ambient temperature is below 10 degree C but greater than 4 degree C, the sealant containers shall be stored for some hours at 21 degree C, to ease mixing and application.

Delivery and Storage

Materials shall be delivered to the job site in the manufacturer's original unopened containers. The containers shall include the following information on the label.:

- (a) Name of supplier,
- (b) Name of material,
- (c) Formula,
- (d) Lot number,
- (e) Colour
- (f) Date of manufacture,
- (g) Mixing instructions
- (h) Shell life and
- (i) Curing time

Materials shall be carefully handled and stored to prevent contamination of foreign materials to exposure to temperatures exceeding 35 degree C.

Joints

The effective width to depth ratio shall be as per the table given below unless directed otherwise by the Engineer.

Table Surfaces	Joint Width	Joint Depth	
		Maximum	Minimum
For concrete masonry	6 mm	6 mm	6 mm
Over 6 mm upto 12 mm	6 mm	-	equal to width
Over 12 mm	½ of width	-	½ of width

Surface Preparation

General

The surface of joints to be sealed shall be clean, dry, sound and free of all release agents, water repellents, laitance, oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale and other foreign substances. Oil and grease shall be removed with solvent and the surfaces shall be wiped with clean clothes.

Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity. The surfaces/edges shall be repaired with epoxy mortar to give smooth and even surfaces to correct lines and levels with a uniform gap for the length to be sealed.

Application

Masking tape shall be placed on the finished surface on one or both sides of a joint cavity to protect adjacent finished surfaces from primer or compound smears. The masking tape shall be removed within 10 minutes after the joint shall be filled and tolled.

Bond-preventive materials

Bond-preventive materials shall be installed on the bottom of the joint cavity and other surfaces to prevent the sealant from adhering to the surfaces covered by the bond-preventive materials. The materials shall be carefully applied to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond-preventive materials.

Backstops

The back or bottom of joints constructed deeper than specified shall be packed tightly with an approved backstop material to provide a joint of the depth specified.

Primer

The primer shall be used in accordance with the manufacturer's instructions. The primer shall be applied to the joint surfaces to be sealed only and not spill over or be applied to surfaces adjacent to the joints.

Application of Sealant

The sealant shall be gun-applied with a nozzle of proper size to fit the width of the joint indicated and shall be forced into grooves with sufficient pressure to expel air and fill the groove solidly. The sealant shall be uniformly smooth and free of wrinkles.

The plastic nozzles shall be inserted on the gun and cut to appropriate size. The sealant shall be gunned into joints using an even trigger pressure. The nozzle shall be cleaned occasionally.

The sealant shall be pressed into joints with a wet spatula and tooled within five minutes of application. The joint shall be tooled slightly concave after the sealant is installed. The tooled joint shall present a smooth and professional joint giving the desired finish and shape. The masking tape shall be removed immediately after tooling.

Application equipment shall be cleaned with a tool cleaner, recommended by the manufacturer, after wearing PVC or rubber gloves and whilst the sealant is still in an uncured state.

Cleaning

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealing application as the work progresses. Sealant adhering to, porous surfaces shall be left until it is just cured and then removed by abrasion or other mechanical means.

FIRE PROOFING OF STEEL STRUCTURES

SCOPE

This specification covers the general requirements of materials and the method of application for internal protection of platform structural steel girder (in a limited length) and steel door where high voltage cables are crossing from track girder to off-road station building, against fire by vermiculite cementitious coating.

Materials

All materials to be used shall conform to the requirements of respective UL codes / IS codes. Sample and test results for all the materials shall be submitted to the Engineer and got approved by him in writing before execution of work. Acceptance criteria of commonly used materials is given below.

Vermiculite Cementitious Coating

Branded product with base as Vermiculite mixed with ordinary portland cement shall have a maximum loose dry density of 400kg/m³ while in moulded condition, density shall not exceed 800kg/m³. Sulphate content in the branded product shall not exceed 1%, when the sulphate content is expressed as sulphur trioxide.

Reinforcement

Welded wire fabric to be used as reinforcement shall conform to IS:1566 and shall be of approved type. Mesh size shall be 50mm x 50mm and thickness of wire shall be 3mm.

Attachments

(a) Tie wire

Tie wire shall be of mild steel not thinner than 16SWG.

(b) Nuts

Nuts shall be made of mild steel and shall conform to IS:1367 and IS:2585 of required size as recommended by manufacturer.

Surface Preparation

Surface cleaning, Welding nuts and application of primer

All steel surface to be in contact with the fire proofing coating materials shall be cleaned of all oil/grease, loose rust/scales/dust by using detergent and wire brushing. M-16 or of required size as recommended by manufacturer nuts shall be welded with all the steel members to be fire proofed. Maximum spacing of nuts shall be 400mm centre to centre in both directions. Nuts shall be welded to the steel surface in shop. Epoxy zinc phosphate primer polyamid as specified in table of painting specification or as recommended by manufacturer's shall be also applied to the MS nuts and effected surfaces of the members due to welding after cleaning.

Placement of reinforcement

Reinforcement shall be placed in the middle of coated material thickness. It shall be bent conforming with outlines of finished encasement and rigidly secured in place by tie wire with all the nuts. Minimum lap at ends and sides shall be 100mm and lapped wire fabric shall be tied firmly.

Application

Application of fire proofing material coating shall be carried out by skilled and experienced operators.

Before start of application, zone which is not to be fireproofed shall be covered with polythene/ tarpaulin to protect them against damage.

For vertical webs of steel girder, the coating materials shall be applied in horizontal bands working upwards from the bottom. All outside edges of the fire proofing shall be chamfered by 20mm.

Thickness of fire proof coating shall be established by measuring it with electrometer.

The fire proofing material, after application shall be cured by keeping it in moist condition for a period of at least 14 days or else the surface shall be coated with a membrane of approved curing compound. Brand name, name of manufacturers, test results and method of application shall be submitted to and got approved from the Engineer prior to procurement of curing compound.

Approach Working Platform & Scaffolding

The contractor shall arrange all approaches, scaffoldings, stairways, ladder, working platform etc. for carrying out the entire works safely. The working area shall be neatly maintained and all the facilities required by Engineer for proper supervision of the work shall be provided. In case, any special precaution is needed for the safety of the structure till the completion of application, the contractor shall make and provide all such arrangement to the complete satisfaction of the Engineer and shall remove the same after completion of works.

Specific Requirement

Vermiculite Cementitious Coating

Design Requirement

- (a) Vermiculite cementitious coating shall restrict the temperature of structure, below the maximum permissible temperature of 538 C for structural steel members, for a minimum time period of 2 hours and also it shall not fail till the end of the specified period.
- (b) The coating shall be non corrosive to the steel members & shall not be affected by environmental conditions. It shall also be asbestos free.
- (c) The coating materials shall be durable and easily repairable
- (d) Application procedure of the coating shall be easy, non hazardous and also shall not interfere with working of the adjoining areas.
- (e) The contractor shall submit coating thickness based on test results for structural steel sections to be fire proofed for review/approval of the Engineer for the offered branded product as per UL-1709 when tested on W10 x 49 steel I-beam.

Application

- (a) Vermiculite cementitious coating shall be mixed with water on a clean platform or in a clean mixing box or in a suitable mixer as per manufacturer's specifications. Water cement shall be adjusted so that vermiculite cementitious coating adheres properly to steel surface and does not sag or slide upon application.

- (b) Primer compatible with the vermiculite cement coating as recommended by the manufacturer's shall be applied over the steel surface after cleaning the shop primer if required as per the manufacturer's specifications.
- (c) Mixed vermiculite cementitious coating shall generally be applied, over the steel surface with the help of spray gun except for small area and inaccessible location, where application with conventional hand tools shall be permitted. Mixed vermiculite shall be used within the pot life specified by the manufacturer. Under no circumstances rebound material shall be used.
- (d) The full specified thickness shall be developed in three successive coats. rendering coat, floating coat, finishing coat and thickness of each coat shall be as manufacture's requirement.
- (e) Each successive layer shall only be applied after the preceding layer has developed its initial set and is also properly scratched with steel brush to developed proper bond. If the application is interrupted and does not satisfy successive layers criteria, the coating shall be cut back to the steel surface/preceding layer with a trowel at an inclined angle. Exposed surface of this coating shall be thoroughly wetted before resuming the work.
- (f) Application of mixed vermiculite shall not be carried out if the air temperature or the temperature of the surface to be fire proofed 4 C or less. Provision shall be made for adequate ventilation during and after application, until the coating is dry.

Finishing And Joint Sealing

Fire proof coating shall be finished with 2 coats of microporous exterior top coat as recommended by manufacturer, compatible to cement surfaces of approved make & colour conforming to IS: specifications.

Test

The contractor shall submit the certificate of test results for the vermiculite cementitious coating over structural member from a laboratory, approved by the Engineer. Test shall be performed as per the requirements laid down in UL-1709 for 2 hours duration when tested on W10 x 49 I-beam.

Measurement

Measurement for fire proofing coating of 2hrs shall be in Sqm based on the net surface of structural steel on which it is applied.

Approved Manufacturers/ Supplier

All materials and products shall conform to the relevant standard specification, IS codes and other relevant codes etc. and shall be of approved makes and design.

Polycarbonate Roof/Wall Panels

The multi-cell polycarbonate panel to be used for Roofing/Wall Panels should have the following specifications:

- Two side Co-extrusion for UV rays protection Panels have to be joined together by protected polycarbonate connector/aluminum connector/any other mechanism that makes joint perfectly water tight.
- year warranty
- Thermal Insulation $\geq 1.50 \text{ W/m}^2\cdot\text{K}$ Acoustic Insulation $\geq 20\text{dB}$
- Linear Thermal Expansion $= .065\text{mm/m degree C}$ Temperature Range (-20 degree to 120 degree C) Fire Reaction BS1d0 or better as per EN 13501:2002.

Epoxy

Epoxy bonding agents for match cast joints shall be thermosetting 100 percent compositions that do not contain solvent or any non-reactive organic ingredient or pigments required for coloring. Epoxy bonding agents shall be of two components i.e., a resin and a hardener. The two components shall be distinctly pigmented. So mixing produces a third color similar to the concrete in the segments to be joined, shall be packaged in proportioned, labeled, ready-to-use containers. Epoxy bonding agents shall be formulated to provide application temperature range that will permit erection of match cast segments at substrate temperature from 5°C to 40°C . depending upon the ambient temperature range, the following types of epoxy are recommended for use:

5° to 20°C : Fast reacting

15° to 30°C : Medium fast reacting

25° to 40°C : Slow reacting

If two surfaces to be bonded have different substrate temperatures, the adhesive applicable at the lower temperature shall be used.

Epoxy bonding agents shall be insensitive to damp conditions during application. After curing, shall exhibit high bonding strength to cured concrete, good water resistivity, low creep characteristics and tensile strength greater than concrete. In addition, the epoxy bonding agents shall function as a lubricant during the joining of match cast segments, as a filler to accurately match the surface of the segments and act as a durable water tight bond at the joint.

Epoxy bonding agents shall be tested to determine their workability get time, open time, bond and compressive strength and working temperature range. The frequency of the tests shall be as stated in the Special Specifications of the Contract.

The contractor shall furnish the Engineer with samples of the material for quality assurance testing and a certification from a reputed independent laboratory having NABL. Certification indicating that

the material has passes the required tests. Specific properties of epoxy and the test procedures to be used to measure these properties shall conform to FIP requirement.

Mixing and Installation of Epoxy

Instructions furnished by the supplier for the safe storage, mixing and handling of the epoxy bonding agent shall be followed. The epoxy shall be thoroughly mixed until it is of uniform color. Use of a proper sized mechanical mixer operating at no more than 600 RPM will be required. Contents of damaged or previously opened containers shall not be used. Surfaces to which the epoxy material is to be applied shall be at least at 40°F and shall be free from oil, laitance form, release agent or any other material that would prevent epoxy from bonding to the concrete surface. All laitance and other contaminants shall be preferably removed by water rinsing, or, alternatively, by light sand-blasting. Wet surfaces shall be dried before applying epoxy bonding agents. The surface shall be at least the equivalent of saturated surface dry (no visible water).

Mixing shall not start until the segment is prepared for installation. Application of the epoxy bonding agent shall be according to the manufacturer's instructions using trowel rubber glove or brush on one or both surfaces to be joined. The coating shall be smooth and uniform and shall cover the entire surface with a minimum thickness of 1.5 mm applied on both surfaces and 3 mm if applied on one surface. Epoxy should not be placed within 10 mm of prestressing ducts to minimize flow into ducts. A discernible bead line must be observed in all exposed contact areas after temporary post-tensioning. Erection operations shall be coordinated and conducted so as to complete the operations of applying the epoxy bonding agent to the segments, erection, assembling and temporary post-tensioning of the newly joined segment within 70% of the open time period of the bonding agent.

The epoxy material shall be applied to all surfaces to be joined within first half of the get time as shown on the containers. The segments shall be joined within 45 minutes after the application of the first epoxy material placed and a minimum required temporary prestress over the cross section should be applied within 70 percent of the open time of epoxy material. The joint shall be checked immediately after the erection to verify uniform joint width and proper fit. Excess epoxy from the joint shall be removed where accessible. All tendon ducts shall be swabbed immediately after stressing while the epoxy is still in the non-gelled condition to remove or smooth out any epoxy in the conduit and to seal any pockets or air bubble holes that have formed that joint. If jointing is not completed with 70 percent of the open time, the operation shall be terminated and the epoxy bonding agent shall be completely removed to the maximum possible extent from the surfaces. The surface must be prepared again and fresh epoxy shall be applied to the surface before resuming joining operations. As general instructions cannot cover all situations, specific recommendations and instructions shall be obtained in each case from the Engineer.

SECTION-10
**PRECAST U-GIRDER AND
RELATED ITEMS**

SECTION- S.10
PRECAST U-Girder and related items

10.1. Purpose

This Specification is Applicable for

- a. Precast Pier cap with cast-in-situ stitch concrete.
- b. U girder Type Superstructure.
- c. Precast Cross Arms at Platform Level / Concourse Level of Stations.
- d. Launching of I Girder for Silk Board Interchange.

The specifications for the same are being provided herewith

10.2. U-GIRDER AND PRECAST PIER CAP

10.2.1. Pre-cast Pier cap

Construction Methods

STAGE-1

- Fabrication of Pier Cap at Casting Yard.
- Recess hole is provided at center of pier cap along with in-situ connection with pier.
- Reinforcement bars are folded around recess hole for future connection with pier.

STAGE-2

- Transport of Precast pier cap to site.
- Lifting of pier cap to top of pier by means of lifting cranes.
- Adjustment devices may be required for correct adjustment of pier cap on pier head. These steel devices are fixed to pier head and pier cap shaft.
- Adjustment the Line, Level and Align the Pier cap as per Drawings.

STAGE-3

- Installation of PT duct through hole and U-Bars inside hole and through Rebar cage.
- Pouring of concrete in recess hole for integral connection between pier and pier cap.

STAGE-4

- Removal of adjustment device.
- After in-situ concrete has reached sufficient strength, stressing of first Stage PT and grouting.
- Plugging of lifting holes before installation of u-girder

STAGE-5

- Installation of superstructure by crane or launcher and then
- Second stage of PT will be done and grouted.
- Concreting of PT anchorage recesses

10.2.2. U - Girder

STAGE-1

- Fabrication of U Girder at Casting Yard.

STAGE-2

- Transport of U Girder to site.
- Lifting of U Girder to top of pier by means of lifting cranes / or by Launching Girder.
- Placing of U Girder on the temporary supports and adjust the Line and Level.

STAGE-3

- Cast the Shear Key.

STAGE-4

- Place the Bearings both Horizontal and Vertical.
- Lower the U Girder and secure it.

STAGE-5

- Install all the Drainage accessories and waterproof Expansion joint.
- Hand over to Track People.

10.2.3. Shop Drawings and Design Calculations for Construction Procedures

10.2.3.1 General

The Contractor shall submit according to a schedule, complete details and information concerning the method, materials, equipment and procedures he proposes to use. These shall be called "Method Statements". Method Statements shall be submitted sufficiently in advance of the start of superstructure field construction operations, so as to allow the Engineer adequate review period. The submittals shall invariably include step-by-step erection procedure. The Contractor's Method Statements shall also include all calculations, drawings and information as may be relevant.

10.2.3.2 Design Calculations and Construction Procedures

Design assumptions and calculations shall be submitted for temporary prestressing, false work, erection devices, formwork or other temporary construction which may be required to complete the work. Assumptions and Calculations shall also be submitted to substantiate the system and method of permanent and temporary prestressing proposed by the Contractor.

10.2.4. Casting, Stacking, Handling, Transportation and Erection Of Girder

➤ **General**

The Contractor shall submit detailed Method Statements for casting, handling, transportation and erection of girder. The superstructure shall be erected by the method indicated in the tender or by alternate method submitted by the Contractor, subject to the approval of the Engineer. The stressing system, cage of reinforcement and lifting details shall be successfully demonstrated on sample segment prior to casting any permanent segments.

All handling and erection plant and equipment shall be load tested prior to their use at site or when specifically asked for by the Engineer. Any additional material required to cater to any temporary condition including temporary prestressing shall be borne by contractor and nothing extra will be paid in this account.

➤ **Casting**

Casting bed and forms shall be structurally adequate to support the girders without settlement or distortion. The casting bed shall be designed for the hardware needed to adjust and maintain grade and alignment. Special consideration shall be given to those parts of the forms that have to change in dimensions. To facilitate alignment or adjustment, special equipment such as wedges, screws or hydraulic jacks shall be provided. Fittings shall not interfere with stripping of forms. External vibrators shall supplement the internal vibration if necessary and be attached at locations that will ensure maximum consolidation.

Details for casting bed and hardware for adjustment shall be submitted by the Contractor for the Engineer's approval. Casting of girders shall be done in a single pour. Construction joint is not permitted in girder.

Care shall be taken to ensure that deformations due to thermal gradients caused by the heat of hydration of the new cast concrete are negligible. These deformations shall be prevented by properly protecting with curing blankets and plastic sheeting. Reinforcing steel shall be fabricated in cages and placed according to the Execution Drawing issued by concerned organization. Any conflict or interference with the proper location of reinforcement or block-outs shall be promptly resolved and corrections made as directed by the Engineer/Engineer's Representative. All girders shall be marked on the inside with a unique identification at the time of form removal.

➤ **Stacking**

Stacking of Girders or Precast Units shall be done as per Approved Drawing and as per Available Layout in the Casting Yard.

➤ **Handling / Erection of Girders**

The Contractor shall be responsible for the proper handling, lifting, storing, transporting and erection of all girders so that they may be placed in the structure without damage. Only HTS bar shall be used for

lifting/handling of girder at any stage of construction, with due care for fatigue considerations (multiple re- use).

Girders shall always be maintained in an upright position and shall be stored, lifted and/or moved in a manner to prevent torsion and differential deformation other undue stress. Members shall be lifted, hoisted or stored with lifting devices approved on the shop drawings.

The Contractor shall furnish calculations to establish that the stresses induced during any stages of construction shall not exceed 50% of the cube strength achieved at that stage, nor 40% of the specified 28days cube strength. In addition, the following limitations shall be observed:

- The girder shall not be lifted from the casting bed till the concrete reaches a minimum cylindrical strength of 25 MPa (or 30MPa Cube strength).
- The age of the concrete shall not be less than 14 days at the time of its erection provided it has achieved its specified strength as per design requirements.

Girders shall be stacked with three-point support in curing tank / stacking yard as shown in tender drawing, or as approved by concerned organization Curing shall be done using sprinkler system (assisted by steam curing in the initial stages if adopted) and it has to be ensured that all parts of girder are water cured during water curing period. Curing compound as per relevant specifications may be applied after approval of Engineer-In-Charge

➤ **Cleaning of Girders**

Before transportation of girder, surface shall be cleaned by water rinsing or sand blasting as approved by the Engineer.

➤ **Miscellaneous**

The entire construction work shall be geared towards minimizing disruptions to road traffic. Also, the occupation of roads during all construction activities shall be reduced to a minimum and subject to the approval of the Engineer. Reinforcement shall be fabricated in cages in casting yard for piles, pile caps and piers before being brought into position for expediting the activities.

All elements of sub-structure below bearing pedestals viz piles, pile caps, piers and pier caps shall each be cast in single pour.

➤ **Load Testing of Standard Span of Superstructure**

The contractor shall conduct full scale load test for one Girder (simply supported span, erected in position, including arrangements for applications of serviceable vertical load for measuring deflections and rotations and submit the report).

The sequence of placement and position of loading on the girder shall be as directed by the engineer.

10.2.5. Overhead Gantry Specifications for U Girder

10.2.5.1. *Nomenclature*

The following terms and abbreviations are used in this report: LG Launching Gantry or Erection Gantry

MT	Main Truss	
UCB	Upper Cross Beam	
LB	Lifting Beam	
CB	Connection Beam	
(F/R)RS Beam LSF F/RSL	(Front/Rear) Roller Support (F/R)LCB Lower Support Frame Front/Rear Support Leg	(Front/Rear) Lower Cross
Stress bar Longitudinal Trans.	Threaded stress bar LSJ Transverse	Long Stroke Jack Long.
Ecc.	Eccentricity	
-NA-	Information Not Available	
EJ	Expansion Joint	
TBA	To Be Advised	

10.2.5.2. *Structural design codes & load factors*

The design of the gantry shall be based on a limit state design approach. The design codes used for the structural design of steelwork include the following:

- (a) IS800 or any other suitable international code of practice.
- (b) The load combinations, load factors and material resistance factors will be appropriate for each of the design code(s).

10.2.5.3. **Stability factors of safety**

For all possible scenarios of operation, the factor of safety for stability shall be established.

However, for certain controlled conditions, a reduction in the required factor of safety against instability can be considered, provided that the potential risks are assessed, and it is deemed sufficiently safe. However, the factor of safety against overturning should not be less than 1.2.

10.2.5.4. **Friction Factors**

The following friction factors shall be assumed:

- a) Crane wheels (adverse): 1.0%
- b) Lateral guide wheels and flanges of crane wheels (adverse): included above c) Crane wheels (beneficial): zero
- d) Lateral guide wheels (beneficial): zero e) Teflon/stainless steel (adverse): 5%
- f) Teflon/stainless steel (beneficial): zero
- g) Ecotex (Nylatron)/stainless steel (adverse): 10%
- h) Ecotex (Nylatron)/stainless steel (beneficial): 5% i) Brass (or bronze)/steel – greased (adverse): 20% j) Brass (or bronze)/steel - greased (beneficial): 5% k) Steel/steel – greased (adverse): 30
- l) Steel/steel – greased (beneficial): 5%

10.2.5.5. **Dynamic factors & launching forces**

a) Stationary MT

The following dynamic factors are to be used for consideration of moving loads when the MT is stationary:

- Vertical - 15% of moving loads
- Parallel to movement direction - 5% of moving load
- Perpendicular to movement direction - 3% of moving loads

b) Moving MT

i. Dynamic factors

The following dynamic factors are to be used for consideration of MT launching and movement:

- Vertical - 10% of moving loads
- Parallel to movement direction - 5% of moving loads
- Perpendicular to movement direction - 3% of moving loads

ii. Launching forces for equipment

For consideration of longitudinal forces on hydraulic jacks during launching of the MT, the force is derived considering longitudinal gradient and friction.

iii. Launching forces for structure

For consideration of longitudinal forces on the Roller support during launching of the MT, the force is derived considering longitudinal gradient and friction.

c) Moving UCB/FSL/RSL

i. Dynamic factors

The following dynamic factors are to be used for consideration of UCB/FSL/RSL movement:

- Vertical - 10% of moving loads
- Parallel to movement direction - 5% of moving loads
- Perpendicular to movement direction - 3% of moving loads

ii. Launching forces for equipment

For consideration of longitudinal forces on chain blocks or other moving devices during launching of the UCB/FSL/RSL, the force shall be calculated considering longitudinal gradient and friction.

iii. Launching forces for structure

For consideration of longitudinal forces on the MT/UCB/FSL/RSL during launching of the UCB/FSL/RSL, the force shall be calculated considering longitudinal gradient and friction.

iv. Longitudinal fixity

During span erection shall have a longitudinal fixity with Roller support and shall be considered in design and stability of system.

10.2.5.6. **Wind loading**

All wind speeds referred beneath are based on gust speed.

In service wind (with span erection) ≤ 20 m/s Gantry launching wind load ≤ 15 m/s Tropical storm wind (with span erection) ≤ 42 m/s

Tropical storm is normally with advance warning and hence it is deemed to be possible that span under erection shall be completed and load transfer onto span jack prior to arrival of storm. Effect of gantry stability under self- weight only should be evaluated without any segment suspended

and additional tie down system is to be provided if necessary. The Above Wind Speeds May be suitably modified for Site specific Winds.

Two types of wind loading shall be considered:

- In-service wind loading: wind while handling of span (lifting, lowering, etc)
- Out-of-service wind loading: Typhoon wind loading

10.2.5.7. **Height Restriction**

The gantry must cross few exiting structures. The height of top of main truss above pier cap top shall be limited to 6500mm.

10.2.5.8. **Minimum Horizontal Radius**

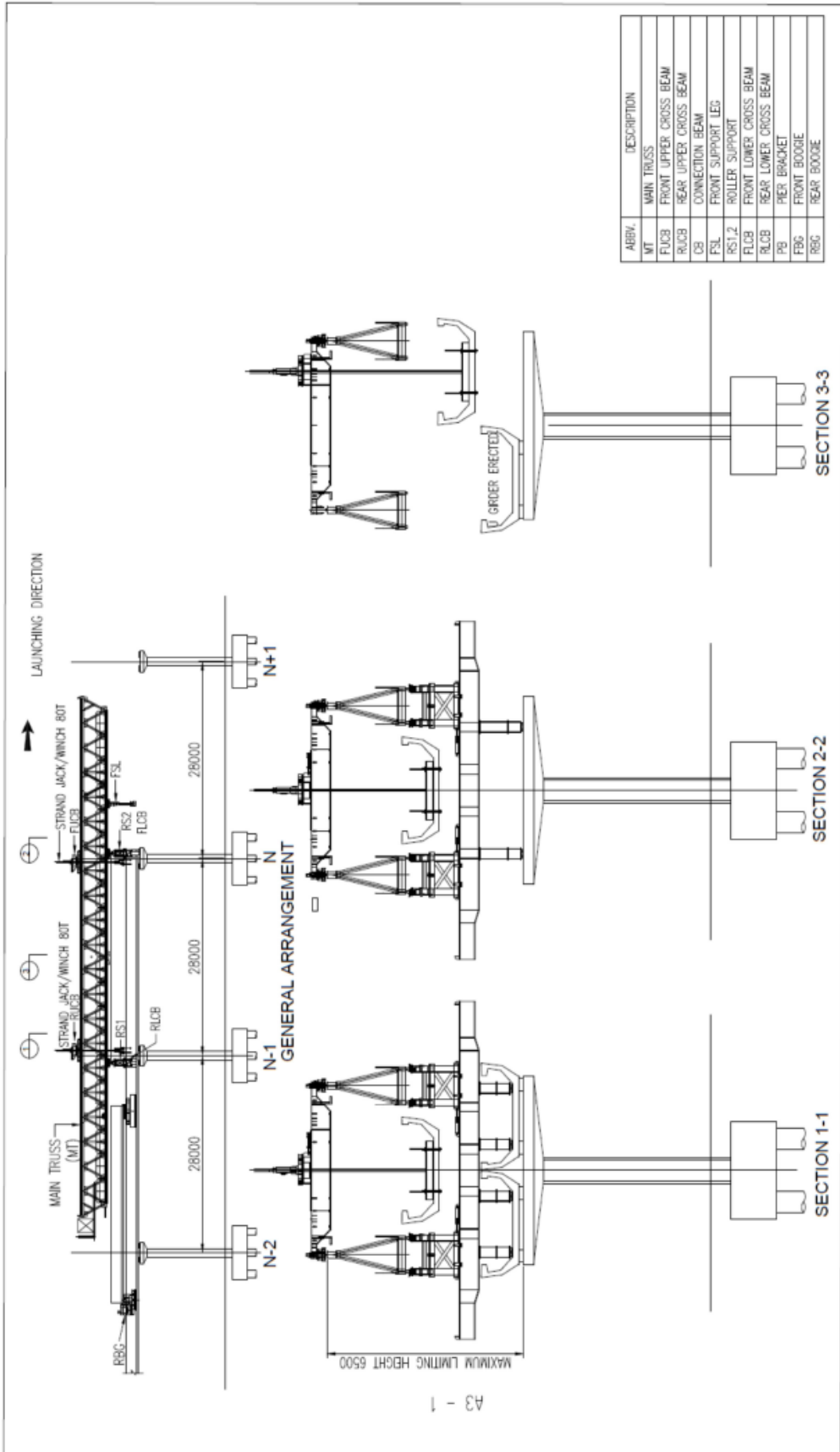
The gantry shall have adequate functional and structural provisions to launch over spans with 200m horizontal radius.

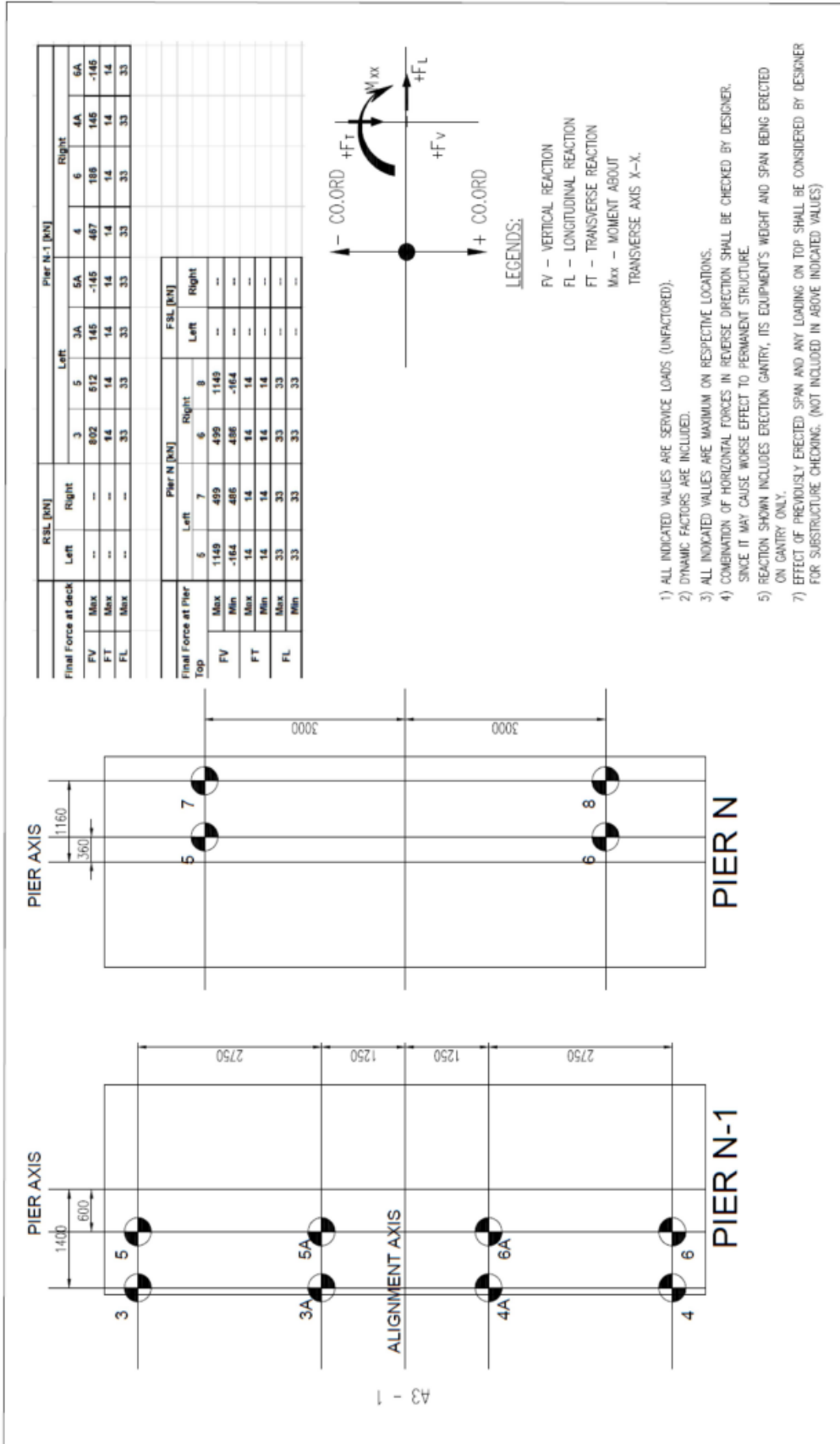
10.2.5.9. **Reaction on Piers**

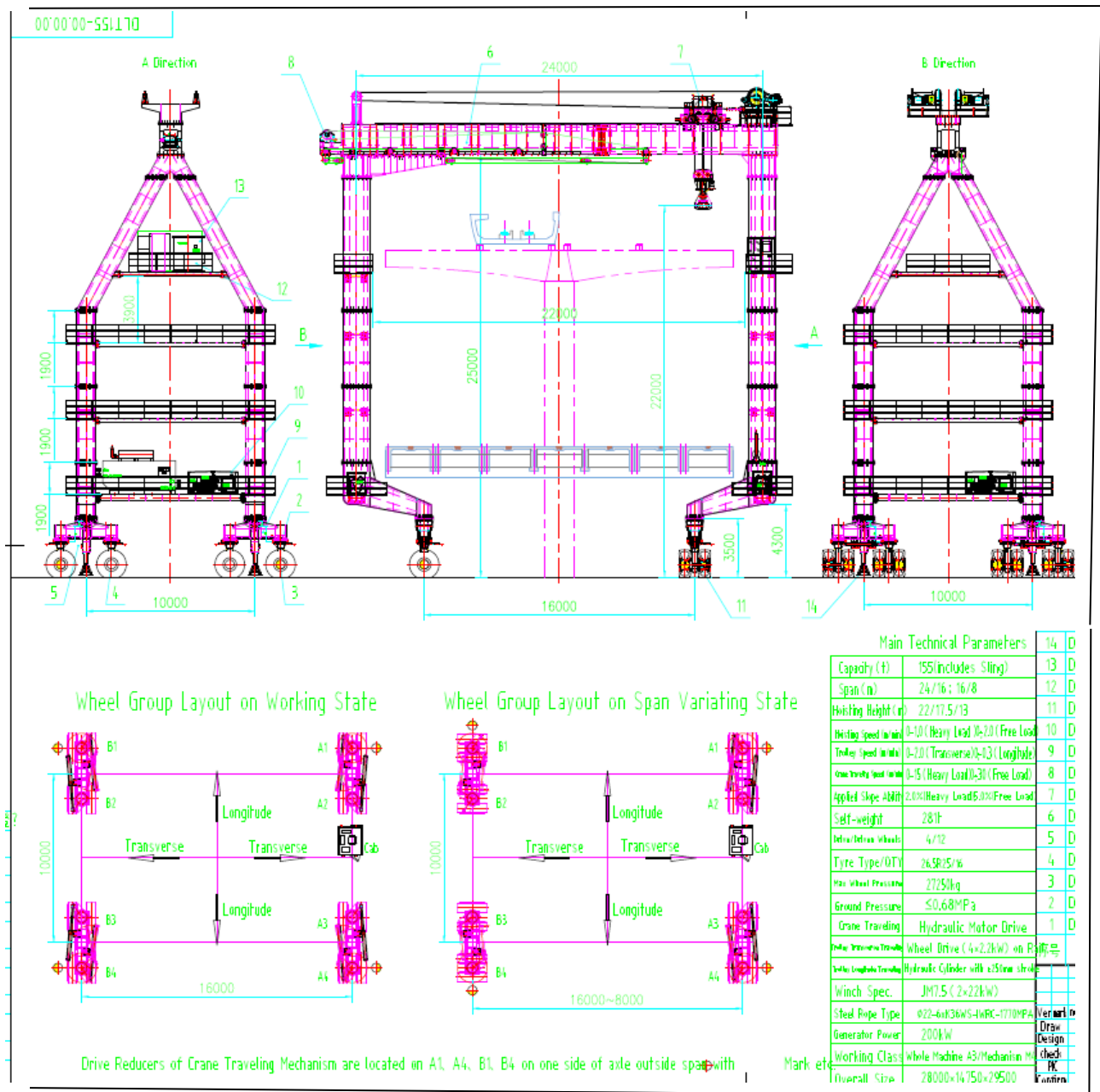
The reaction on pier top due to operation of erection gantry, shall be limited to followings: -

		RSL [kN]		Pier N-1 [kN]							
Final Force at deck		Left	Right	Left				Right			
				3	5	3A	5A	4	6	4A	6A
FV	Max	--	--	802	512	145	-145	467	186	145	-145
FT	Max	--	--	14	14	14	14	14	14	14	14
FL	Max	--	--	33	33	33	33	33	33	33	33
		Pier N [kN]				FSL [kN]					
Final Force at Pier Top		Left		Right		Left	Right				
		5	7	6	8						
FV	Max	1149	499	499	1149	--	--				
	Min	-164	486	486	-164	--	--				
FT	Max	14	14	14	14	--	--				
	Min	14	14	14	14	--	--				
FL	Max	33	33	33	33	--	--				
	Min	33	33	33	33	--	--				

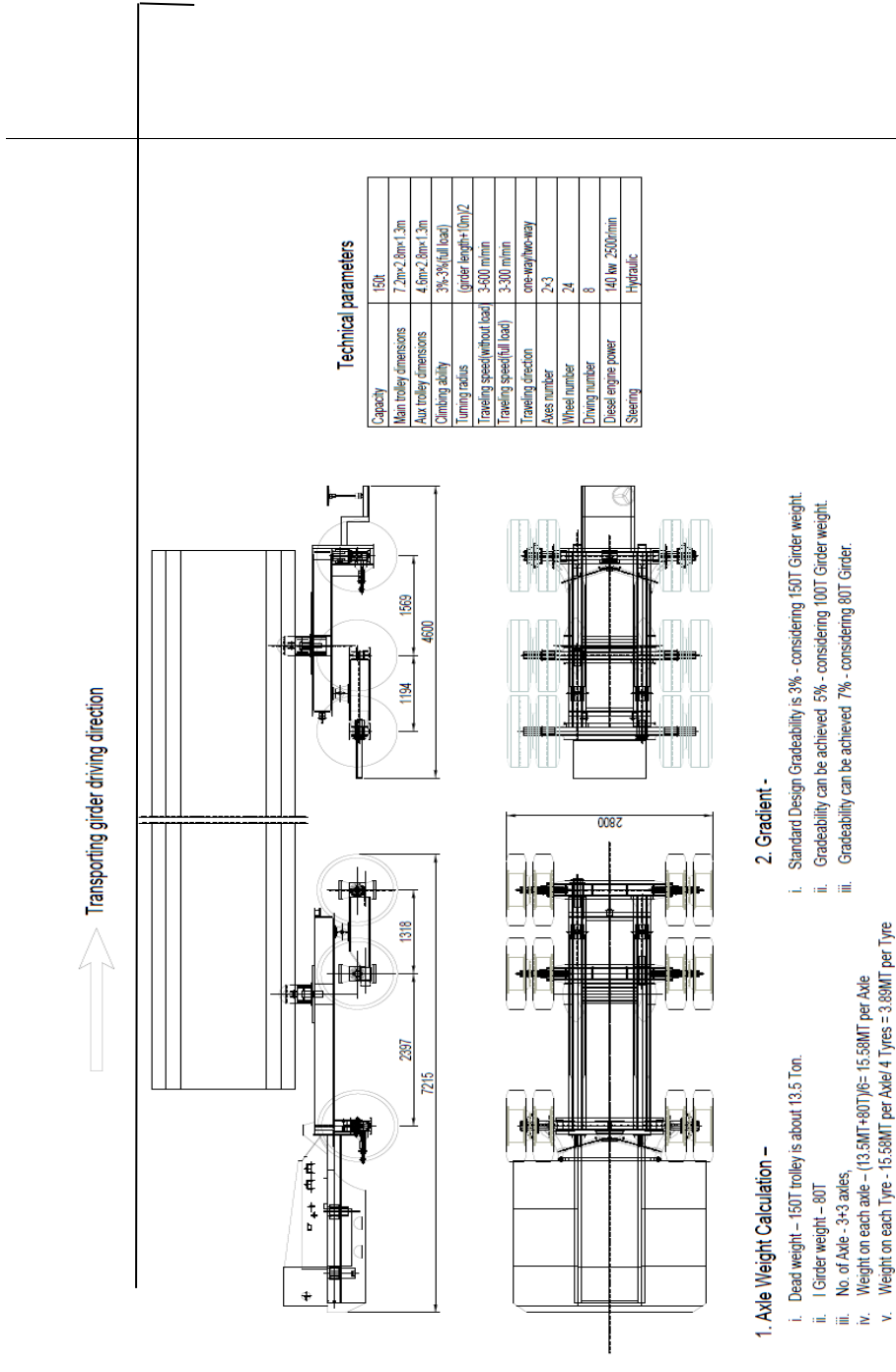
For nomenclature and location of reaction point definition refer to following drawings: -







SKETCH SHOWING DETAILS OF STRADLE CARRIER SUITABLE FOR STATION GIRDER LAUNCHING.



1. Axle Weight Calculation -

- i. Dead weight - 150T trolley is about 13.5 Ton.
- ii. I Girder weight - 80T
- iii. No. of Axle - 3+3 axles.
- iv. Weight on each axle - $(13.5MT + 80T) / 6 = 15.58MT$ per Axle
- v. Weight on each Tyre - $15.58MT$ per Axle / 4 Tyres = 3.89MT per Tyre

2. Gradient -

- i. Standard Design Gradeability is 3% - considering 150T Girder weight.
- ii. Gradeability can be achieved 5% - considering 100T Girder weight.
- iii. Gradeability can be achieved 7% - considering 80T Girder.

Indicative Sketch-2 for Launching Arrangements for 1 Girders , feeding of girder from back side

10.2.5.10. **Transfer Boogie**

The U Girder shall be transported with two numbers of motorized bogies.

The Weight of each bogey, inclusive of all equipment, shall be limited to 5.5 t.

S. Nr	Item	Specification
1	Max Weight of each boggy	5.5 t
2	Max Speed (Loaded condition)	2 Km/hr
3	Max Speed (Unloaded condition)	3 Km/hr
4	Maximum gradient	4%

10.2.5.11. **Specification on Safety**

a) **Illumination**

A lighting system for working area shall be provided to improve visibility in case of scarce daylight. Anyway, personnel responsible of safety must make sure that there is a good visibility of every point, not be create dangerous reflex and allow a clear reading of control boards and identification of emergency push buttons.

b) **Controls**

Operating any control that creates a sharp variation in drive direction, such as halting the winch by engaging the opposite movement, is forbidden. The stresses which may arise are uncontrollable and may seriously damage the equipment, causing personnel and material risk. Such controls may be operated in the event of an imminent danger to persons.

c) **Safety devices**

The GANTRY shall be provided with electrical and mechanical devices which reduce the danger that may occur during working phases. The safety devices are in various points of the launching machine and can be listed as follows:

➤ **Protected walkways, ladders and platforms**

Main walkways, placed inside the two trusses, allow safe access to working areas and all control units of supports, legs, winches, cranes. In order to reach walkways and platforms, protected ladders are mounted on both legs and supports.

➤ **Limit switches**

Electrical limit switches shall be installed on moving parts of the gantry. If actuated, they stop the related movement before mechanical stops are reached.

➤ **Over speed detection system**

A safety system that monitors operating speed and stops the machinery in case of over speed shall be installed on winch drums.

➤ **Inclination detectors**

Electrical inclination detectors shall be installed on the winch drums.

➤ **Load cells**

Gantry shall be equipped with load cells in order to constantly survey load conditions.

➤ **Emergency push buttons**

Emergency push buttons shall be installed in the gantry. If actuated by operators, they stop immediately all running movements.

➤ **Safety braking system**

Safety braking system shall be installed to stop the rope drum in case of failure of the control drive, motor, service brake or gearbox.

➤ **Encoders**

Lifting and lowering stroke shall be defined by an encoder mounted on each hoisting winch drum connected with a limit switch.

➤ **Digital speed gauges**

Speed gauge shall be mounted on each hoisting winch drum to continuously check for rope overspeed.

➤ **Max relief hydraulic valve**

Each hydraulic motor shall be equipped with a hydraulic valve to limit oil pressure in the circuits.

➤ **Hydraulic pressure switch**

Winches hydraulic circuit shall be equipped with a hydraulic switch to control lifting pressure.

10.3. Technical Specification for Steel Plates (Placed in between bearing and bottom of girder)

10.3.1. General

- This specification covers requirement for Carbon Steel Plates of Structural Quality as per IS:2062 Gr. E 250-B (as a minimum requirement) intended primarily for steel plates in contact with bearing and bottom of girder.
- Plates shall conform to IS: 2062 Grade E250-B-as a minimum requirement and to this technical specification. Reference shall be made to IS: 2062 wherever applicable.
- Steel Plates manufactured by steel makers only will be accepted. Plates rolled from slabs that are sourced from Third parties will not be accepted. Plates supplied to this specification shall conform to IS:2062 with additional requirement mentioned herein.
- The plate shall be free from surface flows, laminations and any other harmful defects.
- The tolerance for plate thickness, width and length shall be ZERO in negative side and the tolerance for plate thickness, width and length on the positive side shall be in line with the tolerance limit(s) specified in the latest issue of IS:2062 in accordance with IS 1852 - latest edition.
- The plates shall be free from injuries and defect and shall have workmanlike finish.
- Reconditioning/ repair of plates by welding is not permitted.

10.3.2. Plates shall comply with Chemical composition as per table 1 of IS:2062.

Plates shall have following Mechanical Properties:

Plates conforming to all the specifications of E-250-B quality as per

- | | |
|----------------------------|---|
| a) IS:2062. Yield Strength | : 250 MPa Minimum |
| b) Tensile Strength | : 410 MPa |
| c) Elongation | : 23% min. |
| d) Bend Test | : 2t for less than or equal to 25mm thick product.
: 3t for less than 25mm thick product. |
| e) Charpy Test | : applicable for E-250-B quality & thickness of
12mm & above. Table 2 of IS: 2062 may be referred
for full details. |

10.3.3. Supplementary Technical Requirements:

The contractor shall produce manufacture certificate of Chemical composition and Mechanical Properties in accordance with IS: 2062 Additionally, inspection reports for dimensional checks and surface conditions shall be furnished for confirmation that the plates are dimensionally acceptable and free from surface flows, laminations and any other harmful defects.

10.4. Measurement

Measurement shall be made for the finished volume of reinforced cement concrete (excluding lean concrete) only. All linear dimensions shall be measured correct to 1cm & restricted to design dimensions, and the volume calculation will be correct to two decimal places in cubic meters.

No deduction shall be made for volume of steel embedded in concrete or for voids not exceeding 0.03 cum in volume.

The measurement for prestressing steel wires shall be made on the actual length of wires from end to end of cut-face of anchorages for post tensioned concrete as per the profile drawing and shall not include the extra length of wires at both ends. For pretensioned concrete the measurements of high tensile steel wires shall be measured from end to end of concrete faces and shall not include extra length of wires at both ends. The quoted Lumpsum Price for high tensile steel work shall include formation of cables in position including cost of spacers, transporting, anchorages, sheathing, grouting, stressing and all other relevant work including staging etc.

SECTION-11

ADDITIONAL SPECIFICATIONS FOR
PRECAST SEGMENTAL CONSTRUCTION

SECTION- S.11**ADDITIONAL SPECIFICATIONS FOR PRECAST SEGMENTAL CONSTRUCTION****11. TYPE OF CONSTRUCTION**

The box girder superstructure for almost the entire length shall be constructed by precast segmental construction with epoxy bonded joints. The pre-stressing cables will be internal to the concrete. The methodology of construction will be "span by span". Only one end pre - stressing of permanent cables is contemplated, the other end of the cable being pre- blocked.

The standard spans c/c of piers have been envisaged as 31.0m, 28.0m, 25.0m, 22.0m. 28m, 25m & 22m. spans may have curved alignment in plan. Longer spans adopted under special conditions, viz. site constraints or any obligatory location.

The usual segments shall be 3.0m in length except the pier segments which shall be 1.975m and 3.745m each for Metro viaduct and NHA Flyover respectively. Standard spans shall be made to either add or subtract usual segments of 3.0m each. Where this is not possible or advisable for some reason, the segments will be of length between 1.5m and 3.0m. Hence the mould / casting bed shall be adaptable to cast non- standard length of segment.

The governing weight of the segments will be of the order of 55 t. The maximum span length contemplated for precast segmental construction will be of the order of 31.0m. Multiple Shear keys shall be provided at segmental joints at the webs as well as at top flange and soffit slab of the boxgirder.

Box girder segments shall be match cast at the casting yard and later transported to location and erected in position. Post-tensioned cables shall be threaded-in-situ and tensioned from one end. Box girder shall cater to two tracks.

11.1. MATERIAL SPECIFICATIONS**11.1.1. Cement**

Ordinary Portland Cement of 53 grade conforming to IS: 12269(2013) shall be used. For prestressed concrete, cement conforming to IRS T-40 specification or OPC-53 Grade shall be used. All other specification will remain same as indicated in section S.03.

11.1.2. Reinforcement

Only TMT bars shall be used. All other specification will remain same as indicated in section S.05

11.1.3. Pre-stressing Steel

Uncoated stress relieved Low Relaxation Steel conforming to IS: 14268 (1995), Class 2, shall be used. The nominal dia shall be 15.2mm with minimum breaking strength of 260.7 kN and minimum 0.2% proof load of 234.6kN.

The pre-stressing steel accessories shall be subjected to an acceptance test prior to their actual use on the works. (Guidance may be taken from BS: 4447). Only multi-strand jacks shall be used for tensioning of cables. Direct and indirect force measurement device like Pressure Gauge) shall be attached in consultation with system manufacturer.

11.1.4. Concrete

The 28-day concrete strengths measured on 150mm cubes to be adopted for various structural elements have been indicated in the Bill ofQuantities. The physical and chemical properties of the constituents of concrete and so also of the green and hardened concrete shall meet the requirements of MORTH Specifications for Road and Bridge Works, where relevant or where the standard specifications referred to in the Technical Specifications are silent.

11.1.5. Permanent Pre-stressing

The permanent pre-stressing cables shall generally be of the type 19K15 and 12K15, as suited to 19 nos. and 12nos. strands of 15.2mm nominal dia. intermediate numbers of strands may also be specified in the design, for which suitable anchorage heads shall be used. All aspects of pre-stressing including the system proper shall be subject to the approval of the Engineer. The corrugated sheathing shall be of HDPE. Maximum anchorage set- in shall be 6mm. Maximum friction ratios shall be 0.0020m-1 and 0.17rad-1.

11.1.6. Epoxy Bonded Joints

A minimum compressive stress of 3 kg / sq. cm shall be provided uniformly over the cross section for the closure stress on the epoxied joint until the epoxy hasset.

This temporary compressive stress can be applied by temporary pre-stressing bars.

The curing period for application of the compressive stress, method of mixing and application of epoxy and all related aspects including surface preparation shall be as per approved manufacturer's specifications.

The Epoxy shall be spread with the help of a stubby brush to a thickness of about 1 mm each on both the joining surfaces.

The purpose of the epoxy joint shall be to serve as lubricant during segment positioning, to provide water proofing of the joints for durability in service conditions and to provide a seal to avoid cross-over of grout during grouting cable into other ducts.

Prior to grouting, all cables shall be tested with water pressure of 0.3 MPa for approximately 3 minutes, to investigate leakages and connectivity of ducts. Since the epoxied joint is of paramount importance to ensure long-term durability of pre-stressing cables, this field test shall be taken as

indication of the Contractor's quality of work in general and effectiveness of the epoxy joint executed by him. All other aspects of grouting of cables shall be governed by MORTH Specifications.

The epoxy shall be special purpose proprietary material for the proposed usage with proven past record. Selection shall be subject to the approval of the Engineer. It shall meet the requirements of relevant provision of FIB (International Federation of Concrete, previously "FIP - International Federation of Pre-stressed Concrete"). For selection of epoxy, all tests which govern the properties of epoxy for its application and subsequently determine the durability of joint are required to be done in laboratory temperature controlled condition. Some tests for evaluating properties of epoxy are critical in the upper limit of specified application temperature range while other tests are critical for evaluating the properties in the lower limit of specified application temperature range. The tests shall be conducted in laboratories equipped to handle controlled temperature conditions. All tests shall conform to FIB requirements.

After receiving every batch, all tests (except shear modulus, instantaneous and deferred modulus in compression and water absorption, heat resistance, shear strength and solubility in water) are required to be done at the site laboratory at prevailing ambient temperature to conform to the uniformity of standard of supplied product. In case the received batch is kept at site for a period of more than three months all tests are required to be re-done. With every erection, tests for pot life and open time are required to be done at site at prevailing ambient temperature. Nothing extra shall be payable for providing epoxy and all related operations.

The uniform compressive stress during the curing period may be applied by approved external temporary bar pre-stressing (such as Macalloy or Dywidag bar systems). This shall be accomplished using short HTS bar connecting the adjoining segments. The bars shall be anchored on temporary steel frame, passing through dedicated holes within the girder through. No passing-through holes shall be used in soffit slab or web. Passing-through holes used in soffit slab should be filled with free flow, high strength, non-shrink cement-grout. In order to prevent intrusion of epoxy in sheathing, an O-ring with diameter compatible with the size of HDPE sheathing (10-20mm wide and 4mm thick) of polypropylene shall be provided on both mating surfaces. Nothing extra shall be payable for such temporary stress application including all related works.

11.2. SHOP DRAWINGS AND DESIGN CALCULATIONS FOR CONSTRUCTION PROCEDURES

11.2.1. General

The Contractor shall submit according to a schedule, complete details and information concerning the method, materials, equipment and procedures he proposes to use. These shall be called "Method Statements". Method Statements shall be submitted sufficiently in advance of the start of superstructure field construction operations, so as to allow the Engineer adequate review period, which shall not be less than 30 days. The submittals shall invariably include step-by-step erection procedure.

The Contractor's Method Statements shall also include all calculations, drawings and information as may be relevant.

11.2.2. Design Calculations for Construction Procedures

Design assumptions and calculations shall be submitted for temporary pre-stressing, false work, erection devices, formwork or other temporary construction which may be required to complete the work. Assumptions and Calculations shall also be submitted to substantiate the system and method of permanent and temporary pre-stressing proposed by the contractor. In the sections that follow, specific recommendations for precast segmental construction for superstructure are given apart from certain special aspects of construction.

11.2.3. Shop Drawings for Precast Segmental Construction

The Contractor shall submit detailed shop drawings for approval. The shop drawings shall be based on Execution Drawings issued by NMRCL to the Contractor and shall include:

- a. Fully and accurately dimensioned views showing the geometry of segments including all projections, recesses, notches, openings, block-outs, blister if any and where acceptable, as well as other pertinent details.
- b. Details of any special reinforcing required for handling of segments or for other purposes. Also all bar bending schedules shall be presented based on reinforcement schedules given in Execution Drawings issued by K-RIDE.
- c. Sheathing supports, grout tubes, vents and drains shall be shown including size, type and locations.
- d. Details and locations of all other items to be embedded in the segments such as inserts, lifting devices and post-tensioning hardware shall be shown.
- e. Pre-stressing system details shall include sizes and properties of tendons, anchorages, plates, assemblies and stressing procedure, and details and locations of additional reinforcement necessary to resist anchor block stresses.
- f. Graphs, charts or tables showing the theoretical location of each segment, as erected or placed shall be furnished to the Engineer for his use in checking the erection of the superstructure. Detailed procedures for making geometry corrections shall be described.
- g. Details of grouting equipment, grout mix design and method of mixing and placing grout shall be provided. h) Method of installing bearings and expansion joints shall be given including approved manufacturer's recommendations.

11.2.4. Forms for Precast Segmental Construction

Forms for precast segmental construction shall be metal form work only. Shop drawings shall be submitted for all formwork. The segments during storing /curing shall always be supported as shown in tender drawings or as approved by Engineer only. In addition to the requirements of the Standard Specifications, the forms used for pre-casting the concrete segments shall be capable of:

- Match casting for precast segmental construction.
- Producing the segments within the tolerance permitted in Annexure 11.2.
- Accommodating block-outs, opening sand protrusions. Protruding re-bars will be needed at least for diaphragm segments and for second-pour plinths. Anchorages, signaling equipment and cable routing supports shall also be included where needed in precast segments.
- Adjusting to changes in segment geometry as shown in Execution Drawings issued by NMRCL or for correcting previous minor casting errors to prevent accumulation.
- Adjusting the profile to take into account design camber values. → Stripping without damage to the concrete.
- The form design shall provide a tight leak-proof jointing to the previous segment. The bulk head must be capable of connecting the sheathing in a manner to hold their position and prevent intrusion of grout.

Joints in external formwork shall be avoided as far as possible. Where sections of forms are for some reason to be joined on the exterior face of the segment, an offset in excess of 0.5mm for flat surfaces and 1 mm for corners and bends will not be permitted.

Forms shall not be removed until the concrete has attained adequate strength. Care should be exercised in removing the forms to prevent spalling and chipping of the concrete. All side, bottom, inside and header forms for precast segmental construction shall be constructed of steel.

Forms shall be of sufficient thickness. With an adequate external bracing and stiffeners, and shall be sufficiently anchored to withstand the forces due to placement and vibration of concrete. Internal bracing and holding devices in forms shall be limited to stay bolts in webs. This can be removed from the concrete surface to permit patching following form removal. Joints in the forms shall be designed and maintained for mortar tightness. The grade and alignment of forms shall be checked each time they are set and shall be maintained during the casting of concrete.

Metal forms shall be reasonably free from rust, Grease or other foreign materials. All forms shall be cleaned thoroughly prior to each casting operation. End headers shall be maintained to provide a smooth casting surface.

All formed surfaces for casting members shall be constructed and maintained to provide segment tolerances in accordance with Annexure 11.2.

The faces of all forms, other, than end headers, shall be properly cleaned and treated with form oil or other bond breaking coating prior to placing concrete. Between adjacent match cast segment and headers bond breaking materials shall be provided as indicated elsewhere in these Additional Specifications. The oil or other materials used shall be of a consistency and composition to facilitate form removal. Materials which stain or react with concrete shall not be used. Care shall be exercised to facilitate formwork and segment removals without damage to the concrete.

11.3. CASTING, HANDLING, TRANSPORTATION AND ERECTION OF PRECAST SEGMENTS

11.3.1. General

The Contractor shall submit detailed Method Statements for casting, handling, transportation and erection of precast segments. The superstructure shall be erected by the method indicated in the tender or by alternate method submitted by the Contractor, subject to the approval of the Engineer. The stressing system, Cage of reinforcement and lifting details shall be successfully demonstrated on sample segment for prior to casting any permanent segments.

All handling and erection plant and equipment shall be load tested prior to their use at site or when specifically asked for by the Engineer. Any additional material required to cater to any temporary condition including temporary pre-stressing shall be borne by contractor and nothing extra will be paid in this account.

11.3.2. Casting of Segments

Casting bed and forms shall be structurally adequate to support the segment without settlement or distortion. The casting bed shall be designed for the hard ware needed to adjust and maintain grade and alignment. Special consideration shall be given to those parts of the forms that have to change in dimensions. To facilitate alignment or adjustment, special equipment such as wedges, screws, or hydraulic jacks shall be provided. Fittings shall not interfere with stripping of forms. Grading of the forms and the deck of each segment shall take into consideration the relative position of the member in the structure. External vibrators shall supplement the internal vibration if necessary and be attached at locations that will ensure maximum consolidation.

Details for casting bed and hardware for adjustment shall be submitted by the Contractor for the Engineer's approval. Casting of segments shall be done in a single pour. Construction joint is not permitted in segment.

After the first segment of each unit is cast, all succeeding segments shall be cast against previously cast segments to ensure complete bearing and proper alignment on all mating surfaces.

The anchorage system shall permit tendons to be inserted in the member after erection of segments and tensioned from one end only.

Care shall be taken to ensure that deformations of match cast segments due to thermal gradients caused by the heat of hydration of the new cast concrete are negligible. These deformations shall be prevented by properly protecting both the match cast and new cast segments with curing blankets and plastic sheeting. Both the previous segment and the new segment will be maintained at the same temperature.

Reinforcing steel shall be fabricated in cages and placed according to the Execution Drawing issued by K-RIDE. Any conflict or interference with the proper location of sheathing and / or

reinforcement or block-outs shall be promptly resolved and corrections made as directed by the Engineer.

Concrete down stands/Niches in pier segment –The segmental girders follows the longitudinal designed profile of the viaduct, so also the bottom of the girder. Since the pier segment (which is about 2.0m long) has to rest on the bearings over the whole area for the proper transmission of the load and as the segment bottom follows the gradient of the line, it becomes necessary to provide concrete 'down stands' (in the shape of trapezium like a wedge) integrally cast with the pier segment for normal transmission of load to the bearings. Alternatively 'niches' (again in the shape of the trapezium) can be provided in the pier segment to serve the same purpose. However the niches have the disadvantage that the bearings cannot be inspected thoroughly but by the jacking up the girder. However, if down stands are provided, then bearings are easily available for visual inspection. Hence down stands are the desirable alternatives. This applies in cases of all girders viz. Box girders, 'U' girders or 'I' girders.

All segments shall be marked on the inside with a unique identification at the time of form removal. This identification shall be used to identify each segment on shop plans, post tensioning details and calculations and any other document pertaining to the fabrication and erection of precast concrete segments.

Positive means of holding the sheathing in its correct position shall be provided in all cases and shall be indicated on the shop drawings submitted for approval. The sheathing shall be stiffened from the inside by rubber or plastic hoses or by inflatable rubber tubes.

11.3.2.1. **Casting Methods**

Match cast segments may be cast by the "long line" or "short line" method. The Contractor has to select the option carefully and provide appropriate type of formwork as well as casting and handling operations. The "short line" method requires much greater precision in the work as compared to the "long line" method.

11.3.2.2. **The "Long Line" Method**

The principle of the long line method is the casting of the segments, in their correct relative position, on a long line casting bed which exactly reproduces the profile of the structure. A long line is easy to set up, whilst the geometry of the segments is easily controlled. The segments shall be cast by long line method for spans curved in plan.

After stripping the forms it is not necessary to take away the segments immediately. Substantial space may be required for the long line. The theoretical length for casting alone is normally slightly more than the length of the longest span of the structure. It must be constructed on a firm foundation which will not settle or deflect under the weight of the segments. In case the structure is curved, the long line must be designed to accommodate horizontal and vertical curvature as

well as twists, if any, because the forms are mobile, equipment for casting, curing, etc., has to move from place to place.

11.3.2.3. The “Short Line” Method

The short line method is mentioned here as a possible alternate.

The segments are cast at the same place in stationary forms and against a neighboring element. After casting, the neighboring element is taken away and the last element is shifted to the place of the neighboring element, clearing the space to cast the next element.

The space needed for the short line method is small in comparison to the long line method, approximately three times the length of a segment for one short line. The entire process is centralized. Horizontal and vertical curves and twisting of the structure are obtained by adjusting the position of the neighboring segment and through specified formwork.

To obtain the desired structural configuration, the neighboring segments must be accurately positioned. Care must be taken that the formwork be sufficiently flexible to allow for adaptation at the joint with the accurately positioned matching segment.

If short line method is adopted, the deck segments should follow profile as given below:-

Suggested Deck Alignment on Vertical Curves

a) On Vertical Summit Curves

On vertical summit curves, deck will follow the path of straight line joining the two points on adjacent piers. These two points shall have the minimum offset from rail level to deck level as specified by Engineer at all points along the length of girder.

b) Vertical Valley Curves

On vertical valley curves, deck will follow the path of straight line joining the two points on adjacent piers. The minimum offset from rail level to deck level as specified by Engineer shall be ensured at all points along the length of girder.

c) Suggested Deck Alignment on Circular / Transition Horizontal Curves

On circular / transition horizontal curves, each segment of the deck will follow the profile of short chord line. The bottom and side form for segment to be cast are positioned to span between the stiff fixed end bulkhead and the previously match cast segment. The previously match cast segment shall be oriented w.r.t. segment to be cast and it should be ensured that fixed bulkhead always remain perpendicular to end face of formwork.

Due to orientation of match cast segment, the length of segment towards inner side of curve will be less and towards outer side of curve will be more than segment length along centerline. The formwork to be used should have flexibility to adjust the segment length on both sides by adjusting the position of the match cast segment without any additional pieces and it shall be ensured that offset of match cast segment and segment to be cast is limited to value so calculated.

11.3.3. Separation of Match-Cast Segments

The Contractor shall provide equipment to be used for uniform separation of match cast segments without damage. The method as well as details of the equipment to be used for separating match cast segments shall be included in the shop drawings. A bond breaking material shall be used in the form of wax only on the webs and soffit slab of the previously cast segment and a newly cast segment, as well as the end headers when required. The material shall not be injurious to the concrete and shall permit removal of a segment without adhesion of the concrete. Any breakage in segment end face during separation / handling shall not be repaired, unless specifically accepted by the Engineer, in which case repairing at end face of segment shall be done with epoxy at the time of epoxy application. Segments with excessive breakage shall be rejected. Decision of the Engineer shall be final binding in this regard.

11.3.4. Handling / Erection of Segments

The Contractor shall be responsible for the proper handling, lifting, storing, transporting and erection of all segments so that they may be placed in the structure without damage. Only HTS bar such as Macalloy or Dywidag shall be used for lifting/handling of segment at any stage of construction, with due care for fatigue considerations (multiple re-use).

Segments shall be maintained in an upright position at all times and shall be stored, lifted and/or moved in a manner to prevent torsion and differential deformation other undue stress. Members shall be lifted, hoisted or stored with lifting devices approved on the shop drawings.

The Contractor shall furnish calculations to establish that the stresses induced during any stages of construction shall not exceed 50% of the cube strength achieved at that stage, nor 40% of the specified 28 days cube strength. In addition, the following limitations shall be observed:

- (a) The segment shall not be lifted from the casting bed till the concrete reaches a minimum cylindrical strength of 20 MPa (or 25MPa Cube strength).
- (b) The age of the concrete shall not be less than 14 days at the time of its erection provided it has achieved its specified 28 days strength.

Segment shall be stacked with three-point support in curing tank / stacking yard, or as approved by NMRCL Curing shall be done using sprinkler system (assisted by steam curing in the initial stages

if adopted) and it has to be ensured that all parts of segment are water cured during water curing period.

11.3.5. **Cleaning, transportation and erection of Segments**

Before transportation of segment, mating surface shall be cleaned by water rinsing or sand blasting as approved by the Engineer.

When sand blasting is employed surface shall be abraded to an extent that:

- Bond breaker such as wax applied during match casting is removed.
- Laitance is removed so that small aggregates are just exposed.
- Cleaned surface is neither polished nor excessively rough.

Two methods of erection have been suggested: Side beams method, and as an allowed alternate, the top beams method. Only the side -beams method is referred to in these special specifications. The launching girder (or more accurately, the "assembly truss") is capable of supporting all the loads within permissible limits as stipulated in codes and transferring it to the temporary cross girder, which transfer the loads directly on pile cap using trestles. The launching girder envisaged is slightly greater than 2 spans. It must also be able to negotiate curves and accommodate for the camber if any of the structure. As far as practical, ""* the movement of segments shall be done at the deck level of the already constructed portion of the continuous length so that the disturbance to traffic at the ground level is minimized. Mobile crane of adequate capacity and boom length shall be mobilized by the Contractor for transferring the segment from ground level to deck level for the purpose. The launching girder should be capable of lifting the segments for the span to be erected from below and in case required, it should also be capable of feeding the segments from the rear end over the already erected span.

A suitable number of separate sets of launching girders are essential in order to proceed at the contemplated pace for completion of project in time. However, Contractor shall furnish the construction scheme and nos. of launching girders, he proposes to deploy in order to ensure completion of project within scheduled time.

It is emphasized that for precast segmental construction only one-end pre-stressing shall be used. The superstructure shall be constructed "span by span" sequentially.

The diaphragm segments shall need specific additional temporary supports under the webs during those various stressing operations. Those temporary supports shall be flexible enough in rotation. The precise load transfer during the stressing operations between the various supports shall be monitored at least once with adequate jacks during the destructive testing of one span in precast yard. It is emphasized that

- The spans must be assembled on a higher level to avoid conflicts with already built concrete shear key.
- The launching truss supports must be at same location than temporary bearings.

11.4. MISCELLANEOUS

The entire construction work shall be geared towards minimizing disruptions to road traffic. Also, the occupation of roads during all construction activities shall be reduced to a minimum and subject to the approval of the Engineer. Reinforcement shall be fabricated in cages in casting yard for piles, pile caps and piers before being brought into position for expediting the activities.

All elements of sub-structure below bearing pedestals viz piles, pile caps, piers and pier caps shall each be cast in single pour.

Design & Drawings of LG and temporary works:

All temporary works such as formwork, false work, staging, launching girder, cantilever form traveler scheme etc. shall be designed by the Contractor. The permissible stresses in materials of formwork, false work, staging, launching girder & cantilever form traveler shall be same as for permanent structure. All calculations and drawings of the same including construction sequence shall be checked and verified by independent agency appointed by contractor. Only after the checking of the same, the calculations and drawings (along with soft copy in CD ROM) shall be submitted to Engineer for approval well in advance of work.

All temporary works shall be also inspected by the independent agency and independent report shall be submitted to Engineer. All temporary works shall be robust, safe and constructed such a way that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerances. It is the responsibility of the Contractor to obtain the results required by the Engineer, whether or not some of the work is sub-contracted. Approval of the temporary works by the Engineer shall not diminish the Contractor's responsibility for the satisfactory performance of the same, nor for the safety and co-ordination of all operations.

For pier formwork, it shall be ensured that total deflection (taking account of combined deflection of plate, stiffness, walers or any other supporting arrangement) shall not be more than 3mm.

All the formwork, launching truss and cantilever form traveler and other selected temporary works shall be tested for the load including factor of safety for which the truss/formwork is designed before use in works at no extra cost

The design of false work should be such as to facilitate easy and safe access to all parts for proper inspection.

Methodology for removal of form should be planned as a part of total form work design process.

In case of pre-stressed concrete work, careful consideration shall be given to re-distribution of loads due to pre-stressing.

Shop drawings and design calculations for construction procedures

The contractor shall submit according to a schedule, complete details and information concerning the method, materials, equipment and procedures he proposes to use. These shall be called "Method statements". Method Statements shall be submitted sufficiently in advance of the start of superstructure field construction operations, so as to allow the Engineer adequate review period, which shall not be less than 30 days. The submittals shall invariably include step-by-step casting, curing, lifting, and stacking, transportation and erection procedure. The contractor's Method Statements shall also include all calculations, drawings and information as may be relevant

11.5. LOAD TESTING OF LAUNCHING GIRDER

Contractor shall conduct full scale load traveler test of all launching girder prior to using it for execution purpose. Such tests are required to be done for all the launching girders engaged for project, even if the similar design of launching is adopted.

Nothing extra will be payable for conducting such test and the rate shall be included in lumpsum price of price schedule.

NOTE: The above instructions are applicable for segmental construction. In case contractor proposes single or twin U girder, he should submit detailed method statement showing casting, stacking, handling, transporting and launching scheme for the prior approval of engineer.

SECTION-12

STEEL BRIDGE GIRDER ERECTION

SECTION- S.12**12. STEEL BRIDGE GIRDER ERECTION**

(Fabrication and erection as per RDSO guidelines to be incorporated)

12.1. STRUCTURAL STEEL ERECTION WORK - GENERAL**12.1.1. Scope of Specification**

This specification covers the scope of work for structural steel erection works, submittals by the Contractor, applicable codes of practice and the specifications for the materials to be used, including steel, bolts and nuts, washers etc. and the storage thereof.

12.1.2. Scope of Work

The scope of work for the contractor in respect of structural steel erection work shall cover, but shall not be limited to the following:

Preparation of complete erection sequence drawing based on the suggested erection scheme(s) as proposed by contractor, required for all the permanent and temporary structures including launching nose / truss.

Submission by the contractor, for examination by the Engineer, detailed particulars of the proposed method of erection of the superstructure steelwork, together with complete calculations relating to strength and deflection. If the erection scheme necessitates the strengthening of the permanent steel work, the contractor shall submit, for approval of the Engineer, the methods he proposes for making good the permanent steelwork after removing the temporary work. The contractor shall also submit the design and fabrication drawings incl. detailed calculations of launching nose / truss, counter weight, all temporary supports, staging, bracings etc. required for safe erection, for approval of the Engineer.

Providing all construction and transport equipment, tools, tackle and consumables, materials, labour and supervision required for the erection of the structural steelwork.

Receiving, unloading, checking and moving to storage yard / storage, guarding and upkeep of fabricated steelwork and other consumable materials and fasteners at site.

Compiling and furnishing detailed bill of materials of fabricated parts received from the fabricator.

Loading, Transportation and unloading of all fabricated structural steel materials from storage yard to erection site, handling, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location, according to approved erection drawings and / or as directed by the Engineer.

Setting out, aligning, keeping in plumb, bolting, welding and securely fixing the fabricated steel structures in accordance with the erection scheme, or as directed by the Engineer.

Requisite, site planning to all fabricated steelwork, as per requirements of related specification of the painting.

Carrying out all major modifications of the fabricated steel structures, as directed by the Engineer, including but not limited to the following:

- (a) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.
- (b) Cutting, chipping, filing, grinding etc. as required or preparation and finishing of site connections.
- (c) Drilling of holes which are either not drilled at all or are wrongly drilled.

12.1.3. Submittals

A. On commencement of the Project, the Contractor shall submit the following:

- i) Prior to the technical submittals, the contractor shall submit the proposed overall schedule for documentation such as calculations, erection drawings, shop / working drawings for all temporary structures etc. It is highlighted that structural steel member dimensions indicated in tender drawings are tentative only, and may be modified during final design stage.
- ii) A detailed list of all constructional Plant & Equipment, such as cranes, derricks, winches, welding sets, erection tools etc. their make, model, present condition and location, available to the contractor and the ones he will employ on the job to maintain the progress of work in accordance with the contract.
- iii) The total number of experienced personnel of each category, like fillers, welders, riggers etc., which he intends to deploy on the work.

B. The contractor shall submit a detailed erection programme for completion of the work in time and in accordance with contract. This will show, in a Proforma approved by the Engineer, the target programme, with details of erection proposed to be carried out in each week, details of major equipment required and an assessment of required strength of various categories of workers.

C. The contractor shall submit complete design calculations for any alternative sections (for permanent structure) proposed by him, for approval of the Engineer. Use of any alternative

section shall be subjected to approval of the Engineer. However, no escalation in unit price of work shall be allowed for such cases.

12.1.4. **Furnishing of information**

- A. Design drawings shall be furnished to the contractor and all such drawings shall form part of these Specifications.
- B. The Engineer reserves the right to make changes in the design drawings even after release for preparation of shop drawings to reflect addition, omission & modifications in data / details and requirements. Contractor shall consider such changes as part of these Specifications and the contract, and no claims shall be entertained on this account.
- C. Design drawings, approved by the Engineer, will show as appropriate the salient dimensions, design loads, sizes of members, location of openings at various levels and other necessary information required for the preparation of fabrication drawings, designs and erection details.
- D. It shall be clearly understood that the drawings of the Engineer are design drawings. The typical details of connection, cuts, notches, bend etc where shown in the design drawings are only for general guidance of the contractor. The contractor shall design and develop all such details based on the design forces and functional requirements.
- E. In case of variations between design drawings and specifications, the decision of the Engineer shall be final. Should the contractor, find any discrepancy in the information furnished by the Engineer, same shall be immediately brought to the notice of Engineer for resolution. The contractor shall obtain clarifications on discrepancies from Engineer before proceeding with the work.
- F. No detailed erection or shop drawings for temporary structures will be accepted for examination by the Engineer unless the same, have first been completely checked by the contractor's qualified structural engineer (independent agency to be appointed by contractor) and are accompanied by an erection plan showing the location of all pieces detailed. The contractor shall check and ensure that detailing of connections is carefully planned to obtain ease in erection of structures, including field-welded connections and / or bolting.
- G. No fabrication work shall be started by the contractor without prior approval of Engineer on the relevant drawings. Approval by the Engineer of any of the drawings shall not relieve the contractor of his responsibility to provide correct design of connections, workmanships, fit of parts, details, materials and errors or omissions of all work shown thereon. The approval of Engineer shall constitute approval of the size of members, dimensions and general arrangement, but shall not constitute approval of the connections between members and other details.

- H. Drawings, for approval, shall be submitted by the contractor in an orderly manner commensurate with erection sequence and approved construction programme.
- I. The contractor shall furnish ten prints of all approved final drawings including soft cop in CD ROM for interface / field use and record purpose.
- J. The drawings prepared by the Contractor, and all subsequent revisions thereof shall be at the cost of the Contractor, and no separate payments shall be made for the same. Revisions shall incorporate all modifications, field changes, substitutions etc. effected. The Lumpsum Prices quoted for fabrication work shall be deemed to include the cost of such drawing work.
- K. All the drawings shall be prepared in metric units. The drawings should preferably be of A-1 standard size, and the details shown therein shall be clear and legible. These drawings shall include but shall not be limited to the following:
- i) Assembly drawings, giving exact sizes of the sections to be used and identification marks of the various sections.
 - ii) Shop details of temporary structures together with detailed calculations.
 - iii) Detailed shop drawings for proper co-ordination with the concrete components to which the steel members shall be connected, as required.
 - iv) Any other drawings or calculations that may be required for proper completion of the works and clarification of the works of substituted parts thereof.
 - v) All 'as-built' drawings.

12.1.5. **Applicable Codes of Practice**

The following specifications, standards and codes are included as part of this Specification. All Standards, specifications, codes of practice current on the date of signing of agreement and referred to herein shall be applicable.

IS:800 (1984)	Code of Practice for General Construction in Steel.
IS:808 (1989)	Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle sections.
IS:800 (1984)	Covered Electrodes for Manual Metal Arc Welding of Carbon & Carbon - Manganese Steel.
IS:816 (1969)	Code of Practice for Use of Metal Arc welding for General Construction in Mild Steel.

IS:817 (1969)	Code of Practice for Training and Testing of Metal Arc Welders.
IS:919 (1993)	ISO System of Limits & Fits (Part 1 & Part 2)
IS:1148 (1982)	Hot Rolled Rivet Bars (upto 40 mm) for Structural Purposes.
IS:1182 (1983)	Recommended Practice for Radio Graphic Examination of Fusion Welded Butt joints in steel plates.
IS:1363 (1992)	Hexagon Head Bolts, Screws and Nuts of Product Grade C. (Part 1 to Part 3)
IS:1364 (1992)	Hexagon Head Bolts, Screws and Nuts of Product grade A & B. (Part 1 to Part 5)
IS:1367 (1991)	Technical Supply Conditions for Threaded Steel Fasteners.
IS:1852 (1985)	Rolling & Cutting Tolerances for Hot-Rolled Steel Product
IS:1977 (1975)	Structural Steel (Ordinary Quality)
IS:2016 (1967)	Plain Washers
IS:2062 (1992)	Steel for General Structural Purposes.
IS:2595 (1978)	Code of Practice for Radio Graphic Testing.
IS:3600 (1985)	Methods of Testing Fusion Welding joints (Part 1 to Part 9)
IS:3613 (1974)	Acceptance Tests for Wire Flux Combinations for Submerged Arc Welding
IS:3658 (1981)	Code of practice for Liquid Penetrant Flow, Detection.
IS:3757 (1985)	High Strength Structural Bolts
IS:4000 (1992)	High Strength Bolts in Steel Structures Code of Practice.
IS:4353 (1967)	Recommendations for Submerged Arc Welding of Mild Steel and Low Alloy Steel.

IS:4943 (1968)	Assessment of Butt and Fillet Fusion Welds in Steel Sheet, Plate and Pipe.
IS:5334 (1981)	Code of Practice for Magnetic Particle Flow Detection of Welds.
IS:5369 (1975)	General requirements for Plain Washers and Lock Washers.
IS:5372 (1975)	Taper Washers for Channels.
IS:5374 (1975)	Taper Washers for I Beams
IS:6623 (1985)	Specifications for High Strength Structural nuts.
IS:6649 (1985)	Specifications for hardening and tempering washers for high strength structural nuts.
IS:6755 (1980)	Double Coil Helical Spring Washers
IS:7215 (1974)	Tolerances for Fabrication of Steel Structure.
IS:7318 (1974) (Part I)	Approval Test for Welders when welding procedure approval is not required - fusion welding of steel.
IS:8500 (1974)	Structural steel - Micro alloyed (Medium and high Strength Qualities)
IS:8910 (1978)	General requirements of Supply of Weldable Structural Steel.
IS:9595 (1980)	Recommendations for Metal Arc Welding of Carbon & Carbon - Magnese Steels.
	RDSO Specifications and guide lines along with IR bridge manual to be referred for compliance.

12.1.6. **Storage of Materials**

12.1.6.1. **General**

All materials shall be so stored as to prevent deterioration, and to ensure the preservation of their quality and fitness for the work. If required by the Engineer, the materials shall be stored under cover the suitably painted for the projection against weather. Any material, which has deteriorated or has been damaged shall be removed from site and replaced by new members, as directed by the Engineer at no extra cost and time.

- A. Steel to be used in fabrication shall be stored in separate stacks clear of the ground, section wise and lengthwise.
- B. The storage area shall be kept clean and properly drained. Structural steel shall be so stored and handled to such a manner that members are not subjected to excessive stresses and damage. Girders and beams shall be placed in upright position. Long members shall be supported on closely spaced skids to avoid unacceptable deflection.

12.1.6.2. **Storage Yard**

- A. The Contractor shall be required to establish a suitable yard, at an approved location at site for storing the fabricated steel structures and other materials which will be delivered to site. The yard shall have proper facilities such as drainage and Lighting including access for cranes, trailers and other heavy equipment's.
- B. The Contractor shall have been deemed to have visited the site, prior to submission of his tender, to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc., all of which shall be carried out by the Contractor at his own cost and as directed by the Engineer.

12.1.6.3. **Covered Store**

All field connection materials, paints etc. shall be stored on racks and platforms, off the ground in a properly covered building by the Contractor.

12.2 **Field Bolts**

1. Requirements stipulated under bolting shall apply for field bolts. Field bolts, nuts and washers shall be supplied by the authorized fabricators of the structural member in excess of the nominal numbers required. Only HSFG bolts of class 8.8 shall be used.
2. At the time of assembly, the surfaces in contact shall be free of paint or any other applied finish, oil, dirt, loose rust, loose scale, burrs and other defects which would prevent solid seating of the parts or would interface with the development of friction between them.
3. In any other surface condition, including a machined surface, is specified, it shall be the responsibility of the Contractor to work within the slip factor specified for the particular case.
4. Each bolt and nut shall be assembled with washers of appropriate shape, quality and number in cases where plane parallel surfaces are involved. Such washers shall be placed under the bolt head or the nut, whichever is to be rotated during the tightening operation. The rotated nut or bolt head shall be tightened against a surface normal to the bolt axis, and the appropriate tapered washer shall be used when the surfaces are not parallel. The angle between the bolts

- axis and the surface under the non-rotating component (i.e., the bolt head or the nut) shall be 90 + 3 degree. For angles outside these limits, a tapered washer shall be placed under the non-rotating component. Tapered washers shall be correctly positioned.
5. No gasket or other flexible material shall be placed between the holes. The holes in parts to be joined shall be sufficiently well aligned to permit bolts to be freely placed in position. Driving of bolts is not permitted. The nuts shall be placed so that the identification marks are clearly visible after tightening. Nuts and bolts shall always be tightened in a staggered pattern and where there are more than four bolts in any one joint, they shall be tightened from the centre of the joint outwards.
 6. If, after final tightening, a nut or bolt gets slackened off for any reason, the bolt, nut and washer or washers shall be discarded and not used again.

12.3 Structural Steel Work Painting Works

12.3.1 General

12.3.1.1 Scope of specification

This Specification covers the scope of painting, methods for the surface preparation, application of paints and precautions to be taken for the painting of structural steel work. It covers the supply and delivery of all necessary materials, labour, scaffolding, tools, equipment and everything that is necessary for the job completion on schedule.

12.3.1.2 Applicable Codes

The following Specifications, Standards and Codes are included as part of this Specification. All standards and Codes of practice referred to herein shall be the current editions during the currency of project including all applicable official amendments and revisions.

In case of discrepancy between this Specification and those referred to herein, this specification shall govern. In case of discrepancy between Contract drawings and this specification, the Contract drawings shall govern.

IS: 102 (1962)	:	Ready Mixed Paint, Brushing, Red lead, Non Setting, Priming
IS: 159 (1981)	:	Ready Mixed Paint, Brushing, Acid Resisting for Protection against Acid Fumes, Colour as required.
IS: 341 (1973)	:	Brushes, Paints and Varnishes, Flat
IS: 384 (1979)	:	Brush, paint and varnish i) Oval Ferrule Bound ii) Round Ferrule bound
IS: 487 (1985)	:	Temporary Corrosion Preventive Grease, Soft film, Cold Application
IS: 958 (1975)	:	Temporary Corrosion Preventive, Fluid, Hard film, solvent

		deposited.
IS:1153 (1975)	:	Temporary Corrosion Preventive, fluid, hard film, solvent deposited
IS:1477 (1971)	:	Code of practice for painting of Ferrous metals in building Part I – Pretreatment Part II – Painting
IS:1674 (1960)	:	Temporary corrosion preventive fluid, soft film, solvent deposited.
IS:2074 (1992)	:	Ready mixed paints, red oxide - Zinc Chrome, Priming

12.3.2 Products and Materials

12.3.2.1 Paint

1. All paint delivered to the site shall be ready mixed, in original sealed containers, as packed by the paint manufacturers, and no thinners shall be permitted.
2. Paint shall be stirred frequently to keep the pigment in suspension.

12.3.2.2 Storage of Paints

1. All paints shall be stored strictly in accordance with the requirements laid down by the paint manufacturers. The storage area shall be well ventilated and protected from sparks, flame, direct exposure to sun or excessive heat, preferably located in an isolated room or in a separate building.
2. All paint containers shall be clearly labeled to show, paint identification, date of manufacture, batch number, order number and special instructions in legible form. The containers shall be opened only at the time of use. Paints which have liveried, gelled or otherwise deteriorated during storage, shall not be used. Paints for which the shelf life specified by the supplier has expired shall not be used.

12.3.3 Execution

12.3.3.1 Painting system

Painting work shall be carried out as detailed in Table 11.1 follows:

**TABLE 11.1
PAINTING SPECIFICATIONS**

DESCRIPTION	GENERAL SURFACE	
FABRICATION SHOP	EXTERNAL SURFACES	INTERNAL SURFACES
Surface Treatment	Abrasive blast cleaning to minimum SA-2.5 SIS-055900 near - white blast cleaning	Abrasive blast cleaning to minimum SA-2.5 SIS-055900 near - white blast cleaning
1 st Under - Coat	Inorganic zinc silicate primer (self-curing solvent type) DFT – 75 µm shall be Berger Zinc Anode 11 or approved equivalent. The primer should be applied by spray only.	Epoxy Zinc phosphate primer polyamide cured DFT-35µm
2 nd Under-Coat	Epoxy zinc phosphate primer polyamide cured DFT - 35µm shall be Berge Epilux 610 Primer or approved equivalent. The primer should be applied by spray or brush only.	Epoxy zinc phosphate primer polyamide cured DFT-35 µm shall be Berger Epilux 610 Primer or approved equivalent. The primer should be applied by spray or brush only.
3 rd Under-Coat	Epoxy zinc phosphate primer polyamide cured DFT-35 µm shall be Berge Epilux 610 Primer or approved equivalent. The primer should be applied by spray or brush only.	Polyamide cured coaltar epoxy coating DFT 100 µm
4 th Under Coat	Epoxy high build micaceous iron oxide coating polyamide cured DFT-90 µm shall be Berger Epilux 4 High Build MIO. The primer should be applied by spray or brush only.	Polyamide cured coal tar epoxy coating DFT 100 µm
ERECTION SITE	EXTERNAL SURFACES	INTERNAL SURFACES
Intermediate Coat	Acrylic polyurethane finish aliphatic isocyanate cured DFT-30 µm shall be Berger thane or approved equivalent applied by spray or brush in approved	NA

	colour.	
Finis Coat	Acrylic polyurethane finish aliphatic isocyanate cured DFT-30 µm shall be Berger thane or approved equivalent applied by spray or brush in approved colour.	NA

INTERNAL SURFACE = are those which will become inaccessible after fabrication.

EXTERNAL SURFACE = are those which are prone to humidity and moisture from the atmosphere.

The DFT (dry film thickness) shall be measured after completion of each coat.

12.3.3.2 Surface Preparation

12.3.3.2.1 General

The work shall be carried out in accordance with IS: 1477 (1971) (Part 1). Any oil, grease, dust or foreign matter deposited on the surface after preparation shall be removed and care shall be taken to ensure that the surface is not contaminated with acids, alkalis or other corrosive chemicals.

All welding areas shall be given special attention for removal of weld flux slag, weld metal splatter, weld head oxides, weld flux fumes silvers and other foreign objects before blasting. If deemed necessary by the Engineer, acid washing and subsequent washing with clean water shall be used.

Any rough seams will have to be ground and must be inspected and approved by the Engineer - before application of the coatings.

The last finish paint shall be applied after structural steel erection and slab construction.

12.3.3.2.2 Mixing and Thinning

1. All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments, before use and during application, to maintain homogeneity. All pigmented paints shall be strained after mixing to remove skins and other undesirable matters.

2. Dry pigments, pastes, tinting pastes and colours shall be mixed and / or made into paint so that all dry powders get wetted by vehicles and lumps and particles are uniformly dispersed.
3. Additives that are received separate such as curing agents, catalysts, hardeners etc. shall be added to the paint as per the manufacturer's instructions. These shall be promptly used within the pot life specified by the manufacturers and unused paint thereafter shall be discarded.
4. Thinners shall not be used unless essential for proper application of the paint and approved by the Engineer. Where thinners are used, they shall be added during the mixing process and the type and quantity of thinner shall be in accordance with the instructions of paint manufacturer.

12.3.4 Paint Application

12.3.4.1 General

1. Paint shall be applied in accordance with the manufacturer recommendations and as supplemented by these specifications. The work shall generally follow IS:1477 (1971) (Part II). Prior approval of the Engineer shall be taken in respect of all primers and / or paints, before their use in the works.
2. Paint shall generally be applied by brushing except that spraying may be used where specified and for finish coats only when brushing may damage the prime coats. Roller coat or other method of paint application shall not be used unless specifically authorized.
3. Spraying paint shall not be adopted on red lead or zinc rich paints. Daubers may be used only when no other method is practicable for proper application in difficult accessible areas.
4. Paint shall not be applied when the ambient temperature is 10° C and below. For paints which dry by chemical reaction the temperature requirements specified by the manufacturer shall be met with. Also, paint shall not be applied in rain, wind fog or at relative humidity of 80% and above or when the surface temperature is below dew point, resulting in consideration of moisture. Any wet paint exposed to damaging weather conditions shall be inspected after drying and the damaged area repainted after removal of the paint.
5. Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots. The film thickness shall not be so great as to detrimentally affect either the appearance or the service life of the paint.
6. Each coat of paint shall be allowed to dry sufficiently before application of the next coat, to avoid damages such as lifting or loss of adhesion. Undercoats having glossy surface shall

be roughened by mild sand papering to improve adhesion of subsequent coats. Successive coats of same color shall be tinted, whenever practical, to produce contrasts and help in identifying the progress of the work.

12.3.4.2 Brush Application

1. Proper brushes shall be selected for a specific work piece. Round or oval brushes which conform to IS:487 (1985) are better suited for irregular surfaces, whereas flat brushes which conform to IS: 384 (1979) are convenient for large flat areas. The width of flat brushes shall not generally exceed 125 mm.
2. Paint shall be applied in short strokes depositing a uniform amount of paint in each stroke followed by brushing the paint into all surface irregularities, crevices and corners and finally smoothing or levelling the paint film with long and light strokes at about right angles to the first short strokes. All runs and sags shall be brushed out. The brush marks left in the applied paint shall be as few as practicable.

12.3.4.3 Spray Application

1. The spraying equipment shall be compatible with the paint material and provided with necessary gauges and controls. The equipment shall be cleaned and free from dirt, dried paint, foreign matter and solvent before use.
2. The paint shall be applied by holding the gun perpendicular to the surface at a suitable distance and moved in a pattern so as to ensure deposition of a uniform wet layer of paint. All runs and sags shall be brushed out immediately. Areas not accessible to spray shall be painted by brush or dauber.
3. Water trap acceptable to Engineer shall be furnished and installed on all equipment used in spray painting.

12.3.4.4 Shop Painting

1. The painting system specified in Table 11.1 above shall be followed.
2. Surfaces in contact during shop assembly shall not be painted. Surfaces which cannot be painted but require protection shall be given a rust inhibitive grease conforming to IS:958-1975 or solvent deposited compound conforming to IS: 1153 91975) or IS: 1674 (1960) or treated as specified in the drawing.
3. Surface to be in contact with concrete shall not be painted.

4. The shop coats shall be continuous over all edges, including ends meant for jointing at site by bolting, except where the paint could be detrimental to bolting. In such cases, no paint shall be applied within 50 mm, and the unprotected surface shall be given a coat of corrosion inhibitive compound.
5. The unpainted area shall be cleaned prior to welding. The welded joint shall be cleaned and de-staged, and immediately after covered by the same paint as has been used for the remaining surface.

12.3.4.5 Protection of Paintwork

1. The Contractor shall provide measures as necessary to prevent damage to the work and to other property or persons through all cleaning and painting operations. Paint or paint stains which result in other unsightly appearance on surfaces not designated to be painted shall be removed or obliterated by the contractor at this cost.
2. All painted surfaces that in the opinion of the Engineer are damaged in anyway, shall be repaired by the contractor at his own cost with materials and to a condition equal to that of the requirements specified in these specifications.
3. If in the opinion of Engineer, any other work would have caused dust, grease or foreign materials to be deposited upon the painted surfaces, the painted surfaces shall be thoroughly cleaned. At the time of commissioning of the work, the painting shall be completed and the surfaces shall be undamaged and clean.
4. The areas for high-strength bolts shall be protected by masking tape against undercoat application at the fabrication shop. Immediately prior to erection any rust in the paint are shall be removed by power wire brushing to a standard equivalent to SA3.

12.3.4.6 Site painting

After the erection of structures at the site, the contractor shall provide the necessary treatment as specified in Table 11.1 "PAINTING SPECIFICATIONS".

Surface which have not been shop coated, but require surface treatment shall be given necessary surface preparation and coats at site as specified in the Table 11.1 above.

12.4 Additional Specifications for Launching

Truss launching for longer spans:

- a) Preferably no road traffic blocking will be used. Multiple day / night short blocks of 1h to 1h30 maximum are acceptable to ensure safety.
- b) Launching scheme shown in Tender drawings is suggestive only. Contractor has to provide his own proposed launching scheme and supporting calculations with the offer.
- c) Contractor has to provide principles of nose / truss connection details in tender.

- d) Truss design composite girder requirements will govern over nose / launching equipment requirements.
- e) Contactor will submit and get approval from Engineer of the detailed design of the full launching equipment and scheme before starting the launching.
- f) Contractor will coordinate with Bangalore Traffic Police and Engineer before and during the launching contractor to develop detailed traffic diversion scheme.
- g) Tentative allowable bearing pressure for temporary supports foundation concrete blocks shall be assumed at 10 tonnes / sqm.
- h) For location of storage and fabrication yard relevant clause of N.I.T shall be referred. Contractor shall indicate and justify in tender the proposed total needed yard area for the purpose.
- i) Any necessary precaution by proper and secure fixing shall be taken by the contractor to prevent the fall of any object onto the road below during the whole erection period.
- j) A minimum 15 m clear width (4 lanes) shall be kept during the whole construction period. These lanes can be obtained as 4 or 2+2.

12.5 Mode of Measurement

The cost of steel bridge girder is included in Lumpsum price of Price Schedule. The quoted lumpsum price shall also includes the following:

- a. Erection of fabricated parts (fabrication and transportation of various parts / components including HSFG bolts / nuts / washers from workshop to storage yard will be done by approved sub-contractors)
- b. Receiving, unloading and keeping in safe custody and upkeep of all fabricated parts including HSFG bolts / nuts / washers at storage yard.
- c. Loading, transportation and unloading of all fabricated structural steel materials including HSFG bolts / nuts / washers from site storage yard to erection site, handling, assembling, bolting, welding if necessary and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and / or as directed by the Engineer.
- d. Tightening of HSFG bolts for the field erection of fabricated parts. However, supply of HSFG bolts and its compatible nuts and washers will be arranged / supplied at the storage yard by approved sub-contractor.
- e. Preparation of complete detailed erection drawings and detailed calculation based on suggested erection sequence and design drawings as given by Engineer or alternative scheme proposed by contractor and approved by Engineer.
- f. Preparation of complete detailed fabrication drawings for all temporary structures such as temporary nose, staging, temporary support, bracing required for all permanent and temporary structures.
- g. All tools, plants and equipment's / machinery

- h. All other consumables including fuel and lubricants etc.
- i. All safety and protection arrangements to be made at site / storage yards for road users, public and workmen.

SECTION-13

ROADWORK

K-RIDE

SECTION – S.13**13. ROADWORK****13.1 Control of Traffic**

The contractor shall take all necessary precautions in co-ordination with and to the requirements of all the competent authorities concerned to protect the work from damage until such time as the seal coat or surface treatment has developed sufficient strength to carry normal traffic without any damage to it.

The new work shall be opened to traffic only after it is authorised by the Engineer. The contractor shall submit a detailed traffic diversion/or control and regulation plan taking all safety measures during the course of work permitted by the concerned authorities to the Engineer for his consent before start of work.

The contractor shall take all precautions to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are available, traffic shall be temporarily diverted while the work is in progress depending on volume of traffic and subject to approval by Traffic Police. Adequate signs, signals, barriers and lamps for the warning and guidance of traffic shall be provided at all times during the course of the work till it is opened to traffic.

The Contractor shall take all reasonable precautions to protect traffic against accident, damage or disfigurement by construction equipment, tools, and materials, splashes and smirches of bitumen/bituminous material or any other construction materials and shall be responsible for any claims arising from such damage or disfigurement. Traffic signs erected shall be in accordance with the IRC Standards and/or as prescribed and approved by the Traffic Police Department.

13.2 Granular Sub-Base (Non-Bituminous)

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these specifications or as per MORTH standards, as acceptable to Highway authorities & road owing agency. The material shall be laid in one or more layers according to lines, grades and cross-sections shown on the drawings.

13.2.1 Material

The Material to be used for the work shall be natural sand, moorum, gravel, crushed stone, or combination thereof depending upon the grading specified in MORTH specifications for Roads and Bridges. The material shall be free from organic or other deleterious constituents.

13.2.2 Physical requirements

The material shall have a 10 percent fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with BS:812 (Part III). The water absorption value of the coarse aggregate shall be determined by IS:2386 (Part 3); if this value is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS: 383. CBR Value shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.

13.2.3 Strength of sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

13.2.4 Construction Operations

1. Preparation of sub-grade

Immediately prior to the laying of sub-base, the sub-grade already finished or existing surface shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 – 100 KN smooth wheeled roller. Damage to the subgrade shall be made good before sub base is laid.

2. Spreading and compacting

The approved sub-base material shall be spread on the prepared sub-grade by a grader of suitable type and adequate capacity.

When the sub-base material consists of combination of materials, mixing shall be done mechanically by the mix-in-place method.

The equipment used for mix-in-place construction shall be approved equipment capable of mixing the material to the desired degree.

Moisture contents of the loose material at the time of compaction shall be checked in accordance with IS: 2720 (Part 7) and suitably adjusted. Rolling procedure shall be as described under relevant Subsection except stated herein.

Rolling shall be continued till the density achieved is at least 98% of the maximum dry density for the material determined as per IS:2720 (Part 8).

13.2.5 Control of Traffic

Control of traffic shall be as described under Subsection 12.1.

13.3 Water-bound Macadam Sub-base/ Base (Non-Bituminous)

13.3.1 Description

The work shall consist of furnishing, placing, watering and compacting sub-base material mechanically interlocked by rolling and bounded together with screening and/ or binding material to the required degree on a prepared sub-grade/ sub-base or the existing surface as the case may be in accordance with these Specifications, and to the lines, levels, grades, dimensions and cross sections as shown on Drawings and/ or required by the Engineer.

13.3.2 Materials

1. Coarse aggregate

The coarse aggregates shall be hard and durable crushed stones, free from deleterious matter conforming to one of the gradings as set forth in Table 12.3.1, the physical requirements given in Table 12.3.2 subject to the Engineer's consent.

2. Screenings

Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate or of gravel (other than round material) or moorum as approved by Engineer. However, where permitted non-plastic material such as moorum may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing through 75 micron sieve does not exceed 10 percent.

3. Binding material

Binding material to be used for water-bound macadam as a filler material meant for preventing ravelling, shall be a suitable material and having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS : 2720 (Part-5).

Table 13.3.1
Grading requirements of coarse aggregates

Grading	Size Range	IS Sieve Designation	Percent Passing by weight
1	90 mm to 45 mm	125 mm 90 mm 63 mm 45 mm 22.4 mm	100 90-100 25-60 0-15 0-5
2	63 mm to 45 mm	90 mm 63 mm 53 mm 45 mm 22.4 mm	100 90-100 25-75 0-15 0-5
3	53 mm to 22.4 mm	63 mm 53 mm 45 mm 22.4 mm 11.2 mm	100 95-100 65-90 0-10 0-5

Note: The compacted thickness for a layer with Grade 1 shall be 100 mm while for a layer with Grade 2, it shall be 75 mm.

Table 12.3.2 Physical requirements of coarse aggregates or water-bound macadam sub-base and base courses

Sl.No.	Test	Test Method	Requirement (Maximum)
1.	*Los Angeles Abrasion value or	IS :2386 (Part-4)	50 per cent
2.	* Aggregate Impact value	IS :2386 (Part-4)	40 per cent
3.	*Flakiness Index	IS :2386 (Part-1)	15 per cent

*

Aggregate may satisfy requirements of either of the two tests

13.3.3 Construction Method

1. Preparation of Sub-grade/ sub-base

- a) The surface of the sub-grade/ sub-base or existing surface shall be shaped and prepared to the lines, levels, grades, dimensions and cross sections as shown on the Drawings. Damage to or deterioration of sub-grade/ sub-base shall be made good before sub-base/ base is overlaid.

b) Inverted Choke

If water bound macadam is to be laid directly over the sub grade, without any intervening pavement or soling course, a 25 mm course of screenings or coarse sand shall be spread and compacted on the prepared subgrade before application of the coarse aggregate. In case of fine sand or silty or clayey sub grade, a 100 mm insulating layer of screenings or coarse sand shall be laid, the gradation of which will depend on drainage requirements. Alternatively, appropriate geosynthetics performing functions of separation and drainage layer may be used over the prepared sub-grade subject to the satisfaction of the Engineer.

2. Spreading coarse aggregates

- a) The coarse aggregates of specified size and grading shall be spread uniformly in layers with each compacted layer thickness not more than 100mm for Grading 1 and 75 mm for Grading 2 and in a manner that prevents segregation into fine and coarse materials.
- b) Sub-base/ or base material shall contain moisture nearly equalising the optimum moisture content at the time of compaction.
- c) Immediately after each layer has been spread and shaped satisfactorily, each layer shall be thoroughly compacted with suitable and adequate compaction equipment. Rolling operations shall begin from the outer edge of roadbed towards the centre, gradually in a longitudinal direction; except on super-elevated curves, where rolling shall begin at the lower edge and progress towards the upper edge. The rolling shall be continued until the aggregates are thoroughly keyed, well-bounded and firmly set in its full depth.

3. Tolerance

The finished sub-base/ base at any point shall not vary more than 15mm below and 12mm above the planned grade or adjusted grade with 3m straight edge applied to the surface parallel to the centreline of the road. With the template laid transversely the maximum permissible variation from specified profile shall be 12mm and 8mm respectively.

The sub-base/ base course completed in each day's work shall have an average thickness not less than the required thickness. Sub-base/ base course which does not conform to the above requirements shall be reworked.

13.4 Bituminous Materials

13.4.1 Materials

Materials shall meet the requirements of the relevant IS Codes. These shall be of the following types.

1. Cut back Bitumen

1.1 Cut back bitumen shall be Rapid Curing (RC), Medium Curing (MC) or Slow Curing (SC) conforming to IS : 217.

2. Cationic Emulsion

Bitumen emulsions of the cationic type for roads shall conform to IS: 8887. Emulsified bitumen shall be Rapid Setting (RS), Medium Setting (MS), or Slow Setting (SS). The physical and chemical requirements of the three types emulsions shall comply with the requirements specified in Table 1 of IS: 8887.

3. Paving Bitumen

Paving bitumen shall be conforming to IS: 73 and of the following two types:

Type 1 Paving bitumen from non-waxy crude shall satisfy the requirements given in Table 1 of IS: 73.

Type 2 Paving bitumen from waxy crude shall satisfy the requirements given in Table 2 of IS: 73. The temperature at application of bituminous materials shall be maintained as per manufacturer's instructions and/or as directed by the Engineer's Representative.

An anti-stripping and Bonding agent should be used in all final restoration road works. It should conform to IS: 14982-2001 Specifications. The percentage can be from 0.5% to 1.25% by weight of bitumen content. The optimum dose can be ascertained using M.O.S.T. / BIS guidelines.;

13.4.2 Methods of Storage and Handling

Asphaltic material shall be handled and stored with due regard for safety and in such a way that at the time of use in the work the material conforms to the Specifications. Following precautions shall be taken while using these materials:

1. Work with these materials shall be carried out in good weather conditions and it shall be carried out in warm and dry weather, and not in wet or extremely cold weather.
2. Emulsified asphalt shall be handled with care and not subjected to mechanical shocks or extremes of temperature likely to cause separation of the asphalt. Emulsified asphalt showing sign of separation shall not be used.
3. During heating, no water or moisture shall be allowed to enter the boiler.

4. Heating of bitumen shall be done to the correct temperature range, as prescribed by the manufacturer for the grade used. The temperature shall be controlled with the use of a suitable thermometer, and the material shall be drawn and used while still at such temperature as is prescribed by manufacturer or in accordance with MOST specifications.
5. It shall be ensured that mixing of ingredients is thorough and all particles of aggregates are coated uniformly and fully.

13.5 Prime Coat

13.5.1 Description

This work shall consist of the cleaning and preparing of the surface to be primed to specified lines, grade, and cross-section, booming and clearing thoroughly and applying bituminous material in accordance with these Specifications.

13.5.2 Materials

The choice of the primer shall depend upon the porosity characteristics of the surface to be primed. The primer shall be Medium Curing Cutback (MC) and the particular grade to be used for the work shall have the consent of the Engineer. Slow setting Cationic emulsion conforming to IS : 8887 may also be used. Sampling and testing of bituminous primer shall be as per IS : 217, IS : 454 and IS : 8887.

13.5.3 Construction Methods

1. Weather Limitations

Prime coat shall not be applied at a time when the surface is wet or when the weather is foggy, rainy or windy.

2. Equipment

The equipment used for the work shall include a power broom and primer material distributor spraying it uniformly at specified rates and temperatures. It shall be equipped with self-heating arrangement, suitable pump, adequate capacity compressor and spraying bar with nozzles having constant volume or pressure system. Spraying by manual methods may be allowed for inaccessible or small areas with the consent of the Engineer.

3. Cleaning Surface

Immediately prior to applying the prime coat the surface to be primed shall be swept clean from all loose dirt and other objectionable material and shall be shaped to the required lines, grades, cross section.

4. Application of bituminous primer

The primer material shall be applied by means of a distributor at rates usually from 0.8 to 1.4 litres per square metre and at a temperature within the allowable range corresponding to the material used and porosity condition of surface over which it is laid .The temperature of primer at time of application may vary from 400 C to 600 C for cutback bitumen and 400 C to 600 C for bitumen emulsion

Prime coat shall be allowed to penetrate for at least 48 hours to allow penetration into the base course and aeration of volatile from the primer material, then covered with clean dry sand or stone screening. Areas containing an excess or deficiency of priming material shall be corrected by the addition of sand or primer.

13.6 Tack Coat

13.6.1 Description

This work shall consist of furnishing and applying bituminous material to an existing road surface or to an existing bituminous prime coat surface which has dried out or preparatory to laying another bituminous layer over it.

13.6.2 Materials

The material for tack coat shall be a bituminous or cut back emulsion of suitable type and grade.

13.6.3 Construction Methods

1. Cleaning Surface

The whole surface on which the tack coat is to be applied shall be cleaned of dust and any extraneous material before the start of application of tack coat by using a power broom or any other equipment/ method.

2. Application of tack coat material

The tack coat material shall be applied uniformly by means of a distributor at controlled rates as per MORTH specifications and at the temperature within the allowable range corresponding to the material used It shall be done with self propelled or towelled bitumen . Surfaces of structures and trees adjacent to the areas being treated shall be protected in such a way as to prevent their being spattered or marred

13.7 Bituminous Macadam

13.7.1 Description

The work shall consist of one or more applications of compacted crushed aggregates premixed with bituminous binder (suitable grade) to a primed non-bituminous surface or previously constructed bituminous surface and in conformity with the lines, grades, dimensions and cross-sections shown on the Drawings This shall comprise of a single course of 50mm to 75mm thickness as specified in the approve or as Directed by Engineer.

13.7.2 Materials

1. Bitumen

The bitumen shall be paving bitumen of suitable grade approved by the Engineer and conforming to IS :73.

2. Additives

Adhesion and Ant-stripping agent shall be added to the bitumen subject to Engineer's consent at the required percentage of additive. The additive shall be thoroughly mixed with the bituminous material in accordance with the manufacturer's instructions.

3. Aggregates

Aggregates shall consist of clean and hard crushed stone free from dust, clay, dirt and any other deleterious matter. The physical requirements shall be as given in Table 12.7.1. Aggregates shall conform to one of the two gradings given in Table 12.7.2 depending on the compacted thickness; the actual grading shall have the consent of the Engineer.

Table 13.7.1
Physical requirements of aggregates for bituminous macadam

Test	Test Method	Requirement (maximum)
Los Angeles Abrasion value	IS :2386 (Part-4)	40 per cent
* Aggregate Impact value	IS :2386 (Part-4)	30 per cent
Flakiness Index and Elongation Indices (Total)	IS : 2386(Part-1)	30 per cent
Coating and Stripping of	AASHTO T-	Minimum retained

	Bitumen aggregate mixtures	182	coating 95%
	Soundness : (i) Loss with Sodium Sulphate 5 cycles (ii) Loss with Magnesium Sulphate 5 cycles		12 percent 18 percent
	Water absorption IS :	2386(Part-3)	2 per cent

* Aggregates may satisfy requirements for either of the two tests.

IS Sieve Designation	Per cent by weight passing the sieve	
	Grading 1	Grading 2
45.0mm	100	-
26.5mm	75-100	100
22.4mm	60-95	75-100
11.2mm	30-55	50-85
5.6mm	15-35	20-40
2.8mm	5-20	5-20
90.0 micron		

Bitumen content for pre mixing shall be 4% by weight of total mix unless otherwise approved by Engineer.

13.7.3 Construction Method

1. Weather and Control of Work

The work of laying shall not be undertaken during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when the atmospheric temperature in shade is 15°C or less. The Engineer may order work to cease temporarily on account of adverse weather, unsatisfactory condition of materials, equipment or any conditions which he considers may affect the work adversely.

2. Cleaning and Preparation of Surface

Prior to the application of binder, loose dirt and other objectionable material shall be removed from the surface to be treated by means of the power broom or blower or both. If this does not provide a uniformly clean surface, additional sweeping shall be done by hand, using stiff brushes or similar brooms. The areas inaccessible to the cleaning means shall be cleaned manually. The sweeping shall extend 200mm beyond each edge of the area to be treated.

Adherent patches of objectionable material shall be removed from the surface by steel scraper or other approved method and where the Engineer so directs the scraped area shall be washed down with water and hand brooms.

No application of bituminous material shall be undertaken until the surface has been cleaned to the satisfaction of the Engineer.

Before application of the bituminous material any necessary preliminary patching of the surface of the road (To fill in potholes.) shall be done to the complete satisfaction of the Engineer.

Tack coat shall be applied in accordance with these Specifications. Prime coat if required, shall conform to Subsection 12.5.

3. Plant and Equipment

All plant used by the Contractor for the preparation, hauling and placing of asphalt mixtures shall be subject to the consent of the Engineer and shall minimise smock, dust and noxious emission and odours. These shall generally meet the following requirements:

- a. The mixing plant shall be a batching plant and shall have adequate capacity sufficient to supply the finisher on the road continuously when spreading the asphaltic mix at normal speed and required thickness.
- b. Scale for any weigh box shall be designed to be accurate to within 1% of the maximum load required and shall be fully automatically controlled. The Contractor shall provide and have at hand not less than ten 25 kilograms weights for frequent testing of all scales.
- c. Weigh box or hopper shall include a means for accurately weighing each bin size of aggregate in a weight box or hopper, suspended on scales, ample in size to hold a full batch without running over.
- d. The asphaltic materials shall be stored in storage tanks designed to keep the temperature of the asphaltic material at maximum temperature of 1100 C. The properties of the asphaltic material kept in that storage tanks shall be in good condition before mixing. The plant shall be provided with a circulating system to ensure continuous circulation between the storage tank and the mixer.
- e. The plant shall be provided with a cold bin for feeding the aggregates. Bin shall have a calibration gate and a mechanical means to insure uniform feeding of the aggregates into the drier as required by the Engineer.
- f. The rotary drier shall be capable of drying and heating the aggregates to the specified temperature
- g. The plant shall be provided with plant screens capable of screening all aggregates to the specified sizes
- h. The plant shall include at least 3 hot bins for storing the aggregates fed from the drier after passing through the screen. Each bin shall be provided with an overflow pipe to prevent any backing up of material into other bins.

- i. The plant shall be provided with asphaltic control unit by weighing to obtain the proper amount of asphaltic material in the mix within the tolerance specified for the job-mix.
- j. The batch mixer shall be an approved twin pugmill type and capable of producing a continuous uniform mixture within the job-mix tolerances. The mixer capacity shall not be less than 1,000 kilogram batch.
- k. An armoured thermometer reading from 500 C to 2000 C shall be fixed in the asphaltic feed line at a suitable location near the discharge valve at the mixer unit. The plant shall be further equipped with an electric pyrometer, or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically or indicate the temperature of the heated aggregate.
- l. The plant shall be equipped with a dust collector.
- m. The plant shall be equipped with accurate positive means to govern the time of mixing and to maintain it constant. The time of mixing shall be divided into two steps, dry mixing and wet mixing. For dry mixing, the aggregate from hot bins shall be mixed for a period of 5-15 seconds. For wet mixing, the mixing time shall begin with the start of the asphalt spray after dry mixing. The wet mixing shall take about 30-45 seconds. The mixing time shall be extended if in the consideration of the Engineer the material obtained is not homogeneous.

4. Equipment for Hauling and placing

- a. Trucks for hauling asphaltic mixtures shall have tight, clean, and smooth metal beds that have been sprayed with soapy water, thinned fuel oil, or lime solution to prevent the mixing from adhering to the beds (The amount of sprayed fluid shall however be kept to the practical minimum. Each load shall be covered with a canvas or other suitable material of such size as to protect the mixture from the weather). Any truck causing excessive segregation of material by its spring suspension or other contributing factors, or that shows oil leaks in detrimental amounts, or that causes undue delays, shall upon direction of the Engineer be removed from the work until such conditions are corrected.
- b. The equipment for spreading and finishing shall be mechanical, self powered pavers, capable of spreading and finishing the mixture true to the lines, grades, dimensions and cross sections. The pavers shall be equipped with hoppers and distributing screws of the reversing type to place the mixture evenly.

The pavers shall maintain trueness of grade and confine the edges of the pavement to true lines without the use of stationary side forms. The equipment shall include blending or joint leveling devices for smoothing and adjusting longitudinal joints between lanes. The assembly shall be adjustable to give the cross-section shape prescribed and shall be so designed and operated as to place the thickness or weight per square metre of material required.

Pavers shall be equipped with activated screeds and devices for heating the screeds to the temperature required for the laying of the mixture without pulling or marring.

The term "screed" includes any cutting, crowing, or other practical action that is effective in producing a finished surface of the evenness and texture specified, without tearing, shoving, or gouging.

If, during construction, it is found that the spreading and finishing equipment in operation leaves in the pavement surface tracks or indented areas or other objectionable irregularities, the use of such equipment shall be discontinued and other satisfactory spreading and finishing shall be provided by the Contractor forthwith.

5. Preparation and transport of mix

Bituminous macadam mix shall be prepared in a hot-mix plant either owned by the Contractor or it may be taken from an approved hot mix plant before supply of mix for the work, consent for the use of the mix shall be taken from the Engineer. The hot-mix plant should be of adequate capacity of batch mix type with the features as described under Subsection 15.7.3(3) or otherwise approved by Engineer unless some work specific features are required and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. The plant shall meet the overall requirements through stringent quality control practices.

The mineral aggregates shall be dried and heated to a temperature between 1500 C and 1630 C. The contractor shall submit for consent the exact temperature to the Engineer. Surfaces of aggregates shall be clean and free of carbon and unburnt fuel oil. The aggregates, immediately after heating, shall be screened into three or more fractions and conveyed into separate bins ready for combining and mixing with asphaltic material.

The dried mineral aggregates prepared as prescribed above, shall be combined in the plant in the amount of each fraction of aggregate required to meet the job-mix formula for the particular mixture. The proper amount of asphaltic material shall be distributed over the mineral aggregate and the whole thoroughly mixed for a period of at least 30 seconds, or longer if necessary to produce a homogeneous mixture in which all particles of the mineral aggregates are coated uniformly. The total mixing time shall be regulated by a suitable locking means.

The mixture shall when emptied from the mixer be at a temperature between 1500 C and 1630 C even for tolerances.

The mixture shall be transported from the mixing plant to the point of use in vehicles conforming to the requirements of Subsection 15.7.3 (4)(a) unless otherwise approved by the Engineer.

6. Application of the Pre-mix

The application of the mix shall proceed immediately after application of tack coat. The mix shall be spread immediately by means of self-propelled mechanical paver with suitable screeds capable of spreading, tamping, and finishing the mix true to lines, levels, dimensions and cross-sections specified. Any bare or insufficiently filled areas shall be re-treated by the mechanical spreader or

covered by hand as necessary to give uniform and complete coverage. Any aggregate spread in excess of the agreed rate shall be scattered and evenly distributed on the road or otherwise removed and stockpiled. The temperature of the mix at the time of laying shall be in the range of 120 or 1600 C.

7. Rolling

After the spreading of the mix, the rolling shall be done by road roller of suitable type and capacity. Rolling shall start as soon as possible after the material has been spread and it shall be completed within limited time frame, and to meet this, the Contractor shall deploy a set of rollers. Rolling shall be done with care to avoid unduly roughening of the pavement surface. It shall commence at the edges and progress towards the centre longitudinally except that on super-elevated and unidirectional cambered portions, it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The speed of the rollers shall not exceed 5 kilometre per hour for steel wheeled rollers and 7 kilometre per hour for pneumatic tired rollers and shall be at all times slow enough to avoid displacement of the hot mixture. Any displacements occurring as a result of reversing the direction of the roller or from any other cause shall at once be corrected with rakes and fresh mixture where required. Care shall be exercised in rolling not to displace the line and grade of the edges.

Rolling shall progress continuously as may be necessary to obtain uniform compaction while the mixture is in a workable condition and until all roller marks are eliminated.

Heavy equipment or rollers shall not be permitted to stand on the finished surface until it has thoroughly cooled or set.

Any petroleum products dropped or spilled from the vehicles or equipment employed by the Contractor upon any portion of the pavement under construction is cause for the removal and replacement of the contaminated pavement by the Contractor.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed material. Rolling shall then be continued until the entire surface has been rolled to 95 % of the average laboratory density, and there is no crushing of aggregates. and all roller marks are eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3rd width. The roller wheels shall be kept damp to prevent premix from adhering to the wheels and being picked up. In no case shall fuel/ lubricating oil be used for this purpose.

Along kerbs, man-holes etc., and at any other locations where proper consolidation by rollers is not practicable, alternative means such as steel rammers shall simultaneously be used to secure adequate consolidation.

13.7.4 Surface Control

1. Surface Regularity

Maximum permissible undulation in longitudinal profile with 3m straight edge shall be as 12mm. Maximum permissible variation from specified cross profile under camber template shall be as 8mm. Surface evenness requirements in respect of both longitudinal and cross profiles should be simultaneously satisfied.

Tests for conformity with the specified crown and grade shall be made immediately after initial compaction, and variations shall be corrected by removing or adding materials as may be necessary. Rolling shall then be continued as specified. After final rolling, the smoothness of the course shall be checked again and any irregularity of the surface exceeding the permissible limits corrected as agreed by the Engineer's Representative, including removal and replacement.

2. Surface Finish

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, without any delay. If there is to be any delay, the course shall be covered with the seal coat. The seal coat in such cases shall be considered incidental to the work and shall not be paid separately.

13.7.5 Control of Traffic

This shall be as described under Subsection 12.1 above.

13.8 Open-graded Pre-mix Carpet

13.8.1 Description

This work shall consist of laying and compacting an open-graded carpet generally of 20mm thickness or as otherwise specified in a single course composed of suitable small sized aggregates premixed with a bituminous binder on a previously prepared base to serve as a wearing course.

13.8.2 Materials

1. Binder

Binder shall be bitumen of suitable grade meeting the requirements of the work and other environmental conditions. This shall be conforming to the requirements of IS : 73, IS : 217 and IS : 454 or other approved cut back bitumen as applicable.

2. Coarse aggregates

Coarse aggregates consist of crushed stones and shall be clean, strong, durable, and free from organic or other deleterious materials. The aggregates shall be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable doses.

The aggregates shall meet the requirements given in Table 12.7.1 except that the water absorption shall be limited to 1 per cent. The Stone Polishing Value as measured by BS : 812-(Part-114) shall not be less than 55.

3. Proportioning of Materials They shall comprise of a mix of stone chipping 13.2mm size (passing 22.4 mm sieve and retained on 11.2 mm size) and 11.2 mm size (passing 13.2 mm sieve and retained on 5.6 mm sieve.)

The contractor shall propose material proportions to the Engineer for his consent.

13.8.3 Construction Methods

1. Weather and Control of Work This shall be as carried out per Subsection 12.7.3(1).
2. Cleaning and Preparation of Surface This shall be as carried out per Subsection 12.7.3(3).
3. Tack Coat This shall be applied as per Subsection 12.6.
4. Preparation and transport of Premix The binder shall be heated to a temperature appropriate to the grade of bitumen in boilers of suitable design avoiding local overheating and ensuring a continuous supply.

The aggregates shall be dry and suitably pre-heated to the required temperature before they are placed in a mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. Mixing shall be continuous and thorough to ensure a homogeneous mixture in which all particles are coated uniformly and the discharge temperature shall be within the specified range.

The mixing of binder with chippings shall be continued until the chippings are thoroughly coated with binder. The mix shall be discharged and immediately transported from mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and the mix being transported should be covered in transit and protected from any kind of damage.

5. Spreading and Rolling

Immediately after the application of tack coat, premixed material shall be spread by means of mechanical paver finisher truly to lines, levels, dimensions and cross section as specified. The areas not covered by the mechanical means shall be treated with manual means for which the Engineer has given his consent.

6. Rolling

This shall be carried out as per Subsection 12.7.3(7)

13.8.4 Control of Traffic

Subsection 12.1 shall be followed.

13.9 Bituminous Concrete

13.9.1 Description

This work shall consist of a surfacing of single-layer bituminous concrete of specified thickness on previously prepared bituminous surface to the lines, grades, dimensions and cross section as shown on Drawings. It shall be 25mm/40mm thick as required by Engineer.

Materials

1. Bitumen

The bitumen shall be paving bitumen of suitable penetration grade within the range S 35 to S 90 or A 90 to IS: 73. The actual grade of bitumen to be used shall be appropriate to the requirements of the work and environmental conditions.

2. Coarse aggregates

The aggregates shall satisfy the physical requirements given in Table 15.7.1. Flakiness index shall not exceed 30% and water absorbed not more than 1%

3. Fine aggregates

Fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75 micron sieve, consisting of crushed run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or other deleterious substances.

4. Filler

Filter shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement. The filter shall be graded within following limits:

IS Sieve	Per cent passing by weight
600 micron	100
300 micron	95 – 100
75 micron	85 – 100

The filter shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filter is cement or lime. When coarse aggregate is gravel, 2 per cent of mass of total aggregate of Portland cement or hydrated lime shall be added and percentage of fine aggregate reduced accordingly. Cement or lime is not required when the gravel is lime stone.

5. Aggregate gradation

Mineral aggregates, including filler shall be so graded or combined as to conform to grading set forth in Table 15.9.1 below

Table 13.9.1

Sieve Designation	Per cent by weight passing through sieve for		
	25mm thick Grade 1	25-40mm thick Grade 2	>40mm thick Grade 1
26.5mm			100
22.4mm		100	75-100
13.2mm	100	80-100	--
11.2mm	90-100	75-95	50-85
5.6mm	60-80	55-75	20-40
2.8mm	40-55	40-55	5-20
710micron	20-30	20-30	--
300micron	15-25	15-25	--
180micron	10-20	10-20	--
90micron	5-11	5-11	0.5

13.9.2 Mix Design

1. Requirement of Mix

Apart from conformity with grading and quality requirements of individual ingredients, the mix shall also meet the requirements set forth in Table 15.9.2.

Table 13.9.2

Sl.No.	Description	Requirements
1.	Marshall stability (ASTM Designation : D-1559) determined on Marshall specimens compacted by 75 compaction blows on each end	820 Kg (1800 pounds)

2.	Marshall flow (mm)	Minimum 2-4
3.	Per cent air voids in mix	3-5
4.	Per cent voids in mineral aggregate (VMA)	Minimum 11-13
5.	Percent voids in mineral aggregates filled by bitumen (VFB)	65-75
6.	Binder content, per cent by weight of mix	Minimum 4.5
7.	Water sensitivity (ASTM : D-1075) loss of Stability on immersion in water at 60 deg. C	Minimum 75% Retained strength
8.	Swell Test (Asphalt Instt. MS-2, No. 2)	Maximum 1.5%

2. Binder content

Binder content shall be so determined as to achieve the requirements of the mix set forth in Table 12.9.2. Marshall method for arriving at binder content shall be adopted.

3. Job Mix Formula

Before starting work the Contractor shall submit to the Engineer for his consent. The job mix formula for the mixture shall fix a single percentage of aggregate passing each required sieve size, a single percentage of asphalt to be added to the aggregate, and a single temperature at which the mixture is to be delivered on the road, all of which shall fall within the ranges of the composition and the temperature limits. The formula shall give the following details:

- I. Source and location of all materials
- II. Proportions of all materials as described under :
 Binder - as percentage by weight of total mix
 Coarse aggregate/ Fineaggregate/ Mineral Filler - as percentage by weight of total aggregate including Minera Filler
- III. A single definite percentage passing each sieve for the mixed aggregate (VideTable 12.9.1)
- IV. The results of test as per specifications obtained by the contractor
- V. Test results of physical characteristics of aggregates to be used
- VI. Mixing temperature and compacting temperature

4. Application of job-mix formula and Allowable Tolerances

The approved job mix formula shall remain effective unless and until modified. Each day as many samples of the materials and mixtures shall be taken and tested considers necessary for checking the required uniformity of the mixture.

All mixture furnished shall conform to the job-mix formula within the range of tolerances set in forth in Table 12.9.3.

Table 13.9.3
Permissible variations from the job-mix formula

Sl.No.	Description of Ingredients	Permissible Variation by Weight of Total mix in Percentage
1	Aggregate passing 13.2mm sieve and larger	+/- 8
2	Aggregate passing 9.5mm sieve and 4.75mm sieve	+/- 7
3	Aggregate passing 2.36mm sieve & 1.18mm sieve	+/- 6
4	Aggregate passing 600 micron sieve & 300 micron sieve	+5
5	Aggregate passing 150 micron sieve	+4
6	Aggregate passing 75 micron sieve	+3
7	Binder	+0.3
8	Mixing Temperature (Centigrade)	+10

When unsatisfactory results or changed conditions make it necessary, a new job mix shall be submitted to the Engineer.

Should a change in a material be encountered or should a change in a source of material be made, a new job mix formula shall be submitted before the mixture containing the new material is delivered.

13.9.3 Construction Methods

8. Weather Limitation

The control over the weather conditions shall be as described under Subsection 12.7.3 (1) above.

9. Progress of Work

No work shall be performed when there is insufficient hauling, spreading or finishing equipment, or labour to ensure progress at a rate not less than 75% of the capacity of the mixing plant.

10. Preparation of Existing Surface

The surface on which the mix is to be laid shall be swept thoroughly and cleaned of all loose dirt and other objectionable material using mechanical broom immediately before start of work. In

portions where mechanical means cannot reach, the surface shall be prepared, shaped and conditioned to specified levels, grade and cross-fall (camber).

11. Preparation of Mix

A Hot-mix plant of adequate capacity and capable of producing a proper and uniform quality mix shall be used for preparing the mix. The plant may be either a weigh batch type or volumetric proportioning continuous or drum mix type. The plant shall have co-ordinated set of essential units capable of producing uniform mix as per the job-mix formula.

The temperature of the binder at the time of mixing shall be in the range of 150 to 163 degree C and of aggregates in the range of 155 to 163 degree C, provided also that at no time shall the difference in temperature between the aggregates and binder exceed 14 degree C. The Contractor shall submit the exact temperatures and total mixing time for the consent of the Engineer. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particle of mineral aggregates are coated uniformly.

12. Transportation and Delivery of Mix.

The mix shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for the transport shall be clean and be covered in transit.

13. Spreading and Finishing

The mix transported from the hot mix plant to the site and shall be spread by means of a self-propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to specified grade, elevation, and cross-section. However, in restricted locations and narrow widths, where available equipment cannot be operated, other suitable means shall be employed subject to the consent of the Engineer. The mixture shall be laid upon an approved surface and only when weather conditions are considered suitable. The temperature of the mix, at the time of laying, shall be in the range of 120 degree C to 160 degree C.

The prime coat and tack coat to be applied shall be as per Subsections 12.5 and 12.6 respectively.

Spreading, finishing and compacting of the mix shall be carried out during daylight hours only, unless satisfactory illumination is provided by the Contractor.

14. Compaction of Mixture

Immediately after spreading of mix by paver, it shall be thoroughly and uniformly compacted by rolling with a set of self-propelled rollers moving at a speed not more than 5 km per hour, **immediately** following close to the paver. Generally with each paver, two steel wheeled tandem rollers and one pneumatic tired roller will be required. The initial or breakdown rolling shall be with 8 to 10 ton static weight smooth three wheeled steel roller and finish rolling with 6 to 8 ton tandem

roller. The breakdown mrolling shall preferably be followed by an intermediate rolling with a smooth wheel pneumatic roller of 10 to 25 ton having a tire pressure of 7kg/sqcm moving with a speed not more than 7 km per hour and shall be at all times slow enough to avoid displacement of the hot mixture. Means shall be provided for checking and adjusting the tire pressure on the job at all times. All compaction operations, i.e., breakdown rolling can be accomplished by using vibratory roller of 8 to 10 ton static weight. During initial or breakdown rolling and finished rolling, the vibratory shall be switched off. The joints and edges shall be rolled with a 8 to 10 ton three wheeled static roller. No delays in rolling the paved surface shall be tolerated, the breakdown roller must be right up to the paver at all times and the intermediate pneumatic roller right up to the breakdown roller. The compaction of the asphaltic concrete shall be controlled by temperature as follows:

Roller	Temperature
Breakdown	120°C - 135°C
Pneumatic	95°C - 115°C
Finishing	< 65°C

Rolling procedure shall be as specified under Subsection 12.7.3 (7).

Rolling shall be continued till the density achieved is at least 98% of that of laboratory Marshall specimen. Rolling operations shall be completed in all respects before the temperature of the mix falls below 100 degree C.

15. Joints

Both longitudinal and lateral joints in successive courses shall be staggered so as not to be one above the other. Longitudinal joints and edges shall be constructed true to delineating lines parallel to the centre line of the road.

Longitudinal joints shall be offset by at least 150mm from those in the lower course.

Longitudinal and transverse joints shall be made in a careful manner so that well bonded and sealed joints are provided for the full depth of the course.

Surface regularity

Surface shall be tested for undulations in longitudinal and cross profiles with 3 m straight edge and crown template respectively. Crown template shall conform to the typical cross section.

Maximum permissible undulation in longitudinal profile with 3m straight edge shall be as 8mm.

Maximum permissible variation from specified cross profile under camber template shall be as 4mm.

Surface evenness requirements in respect of both longitudinal and cross profiles should be simultaneously satisfied.

Protection of the pavement from traffic

Subsection 12.7.5 shall apply except as stated below.

Section of the newly finished works shall be protected from traffic of any kind until the mixture has cooled to approximately ambient air temperature and well set.

13.10 Seal Coat

13.10.1 Description

This work shall consist of application of a seal coat for sealing the voids in a bituminous surface laid to the specified levels, grade, and cross fall. Seal coat used shall be of premix type unless otherwise approved by the Engineer.

13.10.2 Materials

1. Binder

The binder shall be bitumen of a suitable grade appropriate to the requirements of the work and other environmental conditions as directed by the Engineer and satisfying the requirements of IS : 73, 217, 454 or other cut back as applicable.

2. Aggregates

The aggregates shall be sand or grit and shall consist of clean, hard, durable, dry particles and shall be free from dust, soft or flaky/ elongated material, organic matter or other deleterious substances. The aggregates shall pass 2.36mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cum per 10 sq m area.

13.10.3 Construction Methods

1. Preparation of base

The seal coat shall be applied immediately after laying of bituminous course which is required to be sealed. Before application of seal coat materials, the surface shall be cleaned free of any dust or other objectionable matter.

2. Preparation and Application of Mix

Mixtures of approved type shall be employed for mixing aggregates with suitable bituminous binder. The binder shall be heated in boilers of suitable design, to a temperature appropriate to the grade of bitumen. The aggregates shall be clean, dry and suitably heated to a temperature before the same are placed in the mixture. Mixing of binder with aggregates to specified proportions shall be continued till the latter are thoroughly coated with the former.

The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed.

3. Rolling

As soon as sufficient length has been covered with pre-mixed material, the surface shall be rolled with 8-10 ton smooth wheeled steel, suitable vibratory or other equipment. As regards procedure for rolling it shall be as specified under Subsection 12.7.3 (7).

4. Control of Traffic

Subsection 12.1 shall apply.

13.11 Cement Concrete Pavements

13.11.1 General

This work shall consist of constructing Plain/ or Reinforced Cement Concrete Pavements as required in accordance with these Specification and in conformity with the lines, levels, grades and dimension in accordance with the design.

13.11.2 Materials

1. General

The concrete materials viz. cement, aggregates, water, steel reinforcement, admixtures shall be in accordance with Section 5 on concrete except as specified herein.

2. Dowel and Tie bars Dowel bars shall be plain round bars

They shall be free from burring or other deformation restricting slippage in the concrete. Before delivery to the Works, one half of the length of each dowel bar shall be painted with one coat of bituminous material.

Tie bars shall be deformed bars free from oil, dirt, loose rust and scale.

These shall conform to the requirements of IS : 432, IS : 1139 and IS : 1786 as relevant.

3. Sleeves

The sleeves for dowel bars of expansion joints shall be of plastic material. This shall be designed to cover the dowels specified by the Designer, with a closed end, and with a suitable stop to hold the end of the sleeve a distance equal to the thickness of joint filler or at least 30mm from the end of the dowel bar. These shall be of such design that they do not deflect or

collapse during construction, and the arrangement of sleeves shall be in accordance with these Specifications.

4. Waterproof Membrane

Where Waterproof membrane is to be provided, it shall be an impermeable polythene plastic sheeting. Where an overlap of underlay material is necessary this shall be at least 300mm. Water shall not be allowed to pond on the membrane which shall be completely dry when the concrete is laid.

5. Jointing Materials

a. Joint Filler

The expansion joint fillers shall conform to the requirements of IS: 1838. They shall be punched to admit the dowels where called for as specified by the Designer. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened closely together securely and accurately to shape by stapling or other satisfactory positive fastening.

b. Joint Primer

Joint primer shall be fully compatible with the joint sealant and shall be applied strictly in accordance with the manufacturer's instructions.

c. Joint Sealing Compound

The Sealing Compound of hot poured, elastomeric type shall conform to AASHTO M282 and cold applied sealant shall be in accordance with BS 5212 (Part 2).

13.11.3 Equipment and Tools

1. General

The concrete paving shall be carried out by use of mechanised method. Equipment and tools necessary for handling materials and performing the work shall have the consent of the Engineer as to design, type, capacity and mechanical, condition shall be at the site of the work before work is started. In special cases like a very short length of road to be laid at a location, other methods may be approved by Engineer.

2. Batching and Mixing Plant

This shall be of suitable type, capacity and make meeting the requirements of work.

3. Paving Equipment

The concrete shall be placed with an approved fixed form or slip form paver with independent units designed to (i)spread, (ii)consolidate, screed and float finish, (iii)texture and cure the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary and so as to provide a dense and homogeneous pavement in conformity with the plans and Specifications.

Vibrators for full width vibration of concrete paving slabs may be either the surface pan type or the internal type. They may be attached to the spread finisher. They shall not come in contact with the joint, sub base or side forms.

The frequency of the surface vibrators shall not be less than 3500 impulses per minute and for the internal type not less than 5000 impulses per minute. The variable vibration setting shall be provided in the machine.

At least two spare vibrators and one generating unit shall be on hand in case of any breakdown of the vibrating equipment being used.

4. Concrete Saw for joint cutting

The mechanical saw for cutting concrete shall be adequately powered to cut rapidly with a water-cooled diamond edge saw blade to the depth required. A water tank with flexible hoses and pump shall be made available in this activity on priority basis. The Contractor shall have at least one standby saw in good working condition.

5. Forms

Straight side forms shall be metal forms having a thickness of at least 5mm and have a depth equal to the prescribed edge thickness of the pavement slab.

Curved forms shall be of the radius called for as specified by the Designer and acceptable flexible forms shall be installed with that radius. Built-up forms with horizontal joints shall not be used. Forms shall be free from kinks, bend or wraps. Forms shall not deflect more than 6 mm when tested as a simple beam with a span of three metres under a load equal to that which the finishers or other construction equipment will exert on them. The top of the form shall not vary from a three metre straight edge by more than 3mm at any point and the side by more than 6mm at any point.

The forms shall contain provision for locking together tightly the ends of abutting form sections and for secure setting.

13.11.4 Construction Methods

1. Preparation of Sub-base

The sub-base, which shall generally be of water-bound macadam (WBM) conforming to Subsection 3.3. The sub base shall be wetted adequately or provided with a water proof membrane so that it does not absorb any water from the concrete to be laid over it. Concrete shall not be placed on any portion of the sub-base until the consent of the Engineer is given.

2. Setting Forms

The sub-base under the forms shall be compacted and cut to grade so that forms, when set to the position are within + 3mm of a straight line formed by the top of the forms. If the sub-base is found to be below the required grade at the form line, the grade line shall be lifted by placing lean concrete mix 1:4:8 beneath the form and setting the form when it is set. Imperfections and variations above grade shall be corrected by tamping or cutting to the degree required.

The alignment and grade elevations of the forms shall be checked and the necessary corrections made by the Contractor immediately before and after placing the concrete. When any form has been disturbed or any roadbed has become unstable, the form shall be reset and rechecked. On final setting of the forms, these shall be checked for at least half the length of pavement to be concreted in a particular day before concreting commences on that day. While concreting long lengths, the setting up of forms to the exact grade and alignment shall be in advance of the concreting operation by at least 60 m.

Forms shall be cleaned and oiled prior to the placing of concrete. The forms shall be removed not earlier than 24 hours after the concrete has been laid.

3. Preparation of Concrete

a. Trial Mix / Mix Design

Subsection 12.2.1 shall be followed Minimum grade of concrete to be used is M25.

b. Batching, Mixing and Transporting Materials

Subsection 12.2.4 shall apply.

The Ready-Mixed Concrete (RMC) shall conform to Subsection 12.2.4 (5).

4. Placing Concrete

Concrete shall be placed only on a prepared sub-base as specified in Subsection 3.12.2. No concrete shall be placed around structures until they have been brought to the required grade and alignment nor until expansion joint material has been placed around them.

The concrete shall be spread, compacted and finished by a mechanical paver and in accordance with Subsection 12.11.3 (3). The mixing and placing of concrete shall progress only at such a rate as to permit proper finishing, protecting and curing of the pavement.

The truck mixers, truck agitators and other approved hauling equipment shall be equipped with means for discharge of concrete into the hopper of the paver without segregation of the materials. In all cases, the temperature of the concrete shall be measured at the point of discharge from the delivery vehicle.

The acceptance criteria regarding level, thickness, surface regularity, texture, finish, strength of concrete and all other quality control measures for hand laid concrete shall be the same as in the case of machine laid work.

The concrete shall be thoroughly consolidated against and along the faces of all forms by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the sub-base or a side form. In no case shall the vibrator be operated longer than 30 seconds in any location. The vibrator shall be inserted in the concrete and worked along the full length and both sides of a joint.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket on to a joint assembly. Except at construction joints, concrete shall be shovelled against both sides of the joint simultaneously, maintaining equal pressure on both sides. It shall be deposited to a height of approximately 5 cm more than the depth of the joint, and shall be vibrated avoiding honeycombing/ voids . The vibrator shall be inserted in the concrete and worked along the full length and both sides of the joints Subsection 12.2.6 shall also apply.

5. Initial strike-off and Placement of Reinforcement

Where the concrete is laid in two layers, the bottom layer of concrete shall be struck off for the full width between longitudinal construction joint true to crown at the required distance below the finished surface elevation, for placement of reinforcement or for placement of a top layer of the required thickness.

The striking-off shall be accomplished by use of the finishing machine, unless some other approved device is allowed. The reinforcement shall be placed as called for by the Designer and pouring of concrete over it shall only be allowed after placement of reinforcement is proper in all respects and approved by the Engineer.

6. Joints

(a) General

Joints shall comply with the design approved for the construction.

A strip of the preformed expansion joint filler shall be placed around each structure which extends into or through the pavement before concrete is placed.

(b) Transverse Expansion Joints

These shall be formed at the design spacings. The material for a transverse joint shall be assembled at the roadbed, and placed into position as a unit.

(c) Transverse Contraction Joints

Transverse Contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement. Transverse contraction joints shall also include load transfer dowel-bars where these are specified by the Designer.

The contraction joints shall be cut as soon as the concrete has undergone initial hardening and is hard enough to take up the load of joint sawing machine without causing damage to the slab.

Grooves shall be at right angles to the centreline of the pavement and shall be true to line, subject to a tolerance of 5 mm in the width of the slab.

Any procedure for sawing joints that results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete and cutting of the joints.

Load transfer assemblies for transverse contraction joints shall consist of dowel bars without sleeves and an approved auxiliary spacing and supporting element.

The assembly shall be placed into position so that the dowels are parallel to the centreline and shall be staked into position in such a way as to hold the assembly securely in position throughout construction.

(d) Longitudinal Joints

Longitudinal joints shall be constructed in conformity with the design. Planes of weakness shall be created by forming or cutting grooves in the surface of the pavement in accordance with the applicable provisions of this Section. When adjacent lanes of pavement are constructed separately, steel side forms shall be used which will form a keyway along the construction joint. The bars may be bent at angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is poured.

(e) Transverse Construction Joint

Transverse construction joints shall be placed whenever concreting is completed after a day's work or is suspended for more than duration permissible for continuous pouring of concrete. Joints shall be formed by placing installing bars or suitable bulkhead material so that a vertical face with approved key is formed or shall be butt joints formed with suitable material so that a vertical face is formed with no key. No tie bars shall be necessary when key joints are formed but dowel bars of the same dimensions and at the same spacing as for contraction joints shall be necessary at all butt joints.

7. Finishing**(a) Machine Finishing**

As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine or tools to the grades and cross sections specified by the Designer and to a level slightly above grade so that when properly consolidated and finished the surface of the pavement will be at the exact level and grade. The machine or tool shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture, true to grade and cross section.

Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without lift, wobble or other variation tending to effect the precision finish.

After concrete has been placed on both sides of the joint and struck off, the installing bar or channel cap shall be slowly and carefully withdrawn, the concrete shall be carefully spaded and additional freshly mixed concrete worked into any depression left by the removal of the installing bar. A diagonal finishing machine shall be used if available.

(b) Hand Finishing

A portable screed shall be provided for use. The screed shall be at least 60 cm longer than the width of the slab to be struck off and consolidated. It shall be of approved shape, sufficiently rigid to retain its shape and constructed either of metal or of other material shod with metal. (If necessary, a second screed shall be provided for striking off the bottom layer of concrete).

The screed shall then be placed on the forms and slip along them, without lifting, in a combined longitudinal and transverse shearing motion moving always in the direction in which the work is progressing. If necessary this shall be repeated until the surface is of uniform texture, true to grade and contour, and free from porous areas.

8. Edging at Forms and Joints

After the concrete's initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, planes of weakness except when sawed transverse construction joints, and emergency construction joints shall be worked with an approved tool and rounded to a radius of 5 mm. A well defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

All joints shall be tested with a straight edge before the concrete has set, and correction shall be made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

9. Surface Texture

The surface of the carriage-way shall be textured by wire brushing in a direction at right angles to the longitudinal axis of the carriage-way. The pavement shall be given this broomed texturing as soon as surplus water has risen to the surface.

The wire brushes shall be either mechanically operated or manual methods may be allowed depending upon the type of paver being used on the Work. In either case the wire broom shall be not less than 450 mm wide with two rows of spring steel. At least two brooms in working order shall be on the site at all times.

The surface texturing shall be completed before the concrete is in such condition that the surface is torn or unduly roughened by the brooming. The broomed surface shall be free from rough areas, porous areas, irregularities, or depressions.

10. Surface Requirements

After the concrete has hardened sufficiently, the surface shall be given a further test for trueens, using an approved 3 m straight edge laid on the surface. Any portion of the surface, when tested in the longitudinal direction, which shows a variation or departure from the testing edge of more than 3.5mm but not exceeding 7mm shall be marked and immediately ground down with an approved grinding tool until the variation does not exceed 3.5mm.

Whenever the variation or departure from the testing edge is more than 7.0mm the pavement shall be removed and replaced. Such removal shall be of the full depth and width of the slab and at least 3m long.

11. Curing

Immediately after the surface texturing, the surface and sides of the slab shall be cured by approved curing method for not less than 7 days. During this period measures shall be taken to prevent the loss of moisture.

The concrete shall not be left exposed between stages of curing.

The surface shall be inspected regularly to ascertain the earliest time at which it is able to withstand the spreading of moisture retaining material. This shall be by ponding of water or spreading and wetting either two layers of burlap or two mats of cotton / jute or a layer of sand or other approved highly absorbent material. Whatever material is used it shall be kept continuously moist for not less than 7 days and to a degree which will ensure that 100% humidity is maintained adjacent to the concrete surface. A membrane curing compound meeting the requirements of BS 7542 may be used subject to the consent of the Engineer.

Concrete surfaces which are subjected to heavy rainfall within three hours after the curing compound has been applied shall be resprayed by the method and the coverage specified above.

Concrete surfaces to which membrane curing compounds have been applied shall be adequately protected for the duration of the entire curing period from the pedestrian and vehicular traffic, except as required for joint sawing operations and surfaces tests, and from only other cause which will disrupt the continuity of the membrane. The curing membrane so formed shall be maintained intact for a period of not less than 14 days. The entire surface shall be protected from the effects of solar radiation and in addition by the use of frames covered with material with heat and light reflecting properties.

Concrete liable to be affected by running water shall be adequately protected from the damage during the setting period.

12. Removing Forms

Forms shall be removed only after stipulated period and carefully so as to avoid damage to the pavement.

13. Protection of Pavement

The Contractor shall erect and maintain suitable barricades and shall employ watchmen to exclude public traffic and that of his employees and agents from the newly constructed pavement until opened for use. These barriers shall be arranged as not to interfere with public traffic on any lane intended to be kept open and necessary signs and lights shall be maintained by the Contractor clearly indicating any lanes open to the public. Where any stipulated public traffic lane is contiguous to the slab or lane being placed, the Contractor shall provide, erect,

and subsequently remove a substantial temporary guard fence along the prescribed dividing line, which shall be maintained there and protected by signages until the slab is opened to traffic. The Contractor's plan of operation shall be such as to obviate any need for encroachment on the public traffic lane or lanes under use .

The same shall be approved by the local competent authority.

Any part of the pavement damaged by traffic or other cause prior to its final acceptance shall be repaired or replaced by the Contractor.

14. Sealing Joints

Before the pavement is opened to traffic, and as soon after the curing period as is feasible, all joints both longitudinal and transverse, shall be filled with the material approved for use as seal.

Both primer and sealing compound shall be treated and applied strictly in accordance with the manufacturer's specifications/ instruction and by use of approved equipment.

The sealing material shall be poured into each joint opening as directed by the Engineer. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

SECTION-14
REINFORCED EARTH

SECTION- S.14**14. REINFORCED EARTH**

The work shall be carried out as per the Cl. 3100 of latest edition of (MORT&H) as published by Indian Roads Congress.

MEASUREMENT:

The measurement for reinforced soil wall shall be in Square metres of finished work of each face and shall be measured in the plane of final inclination specified in the drawings. The measurement of length shall be the finished work along the length of the road. The measurement of height along the slope shall be done from the top level of the footing on which the fascia element is placed to the top of the capping beam.

The rates shall include cost of material, labour, plant, royalties, handling, storage and transportation expenses, cost of bed block, levelling pads, fascia elements, capping beam, connectors, reinforcing elements, scaffolding, supply of the specified filter media materials including drainage arrangement, supply of soil fill for the reinforced as well as unreinforced zone of the quality specified in the design/ drawings, placing, spreading and compaction through mechanical means.

The rate shall include full compensation for design, drawings and testing of materials.

The rate shall include the cost of investigations, design and construction of ground improvement measures.

Measurement for friction slab and crash barriers is included in the lumpsum price quoted in the price schedule. The rates of above items of work are included in the lumpsum price of price schedule.

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SECTION-8C

Safety, Health and Environment (SHE) Manual

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K-RIDE

“NAME OF WORK: “DESIGN AND CONSTRUCTION OF ELEVATED VIADUCT OF LENGTH 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 Km) INCLUDING RAMPS AND FORMATION IN EMBANKMENTS /CUTTINGS INCLUDING BLANKETING, MAJOR BRIDGES, MINOR BRIDGES, RUB, ROB, ROR, RETAINING WALL, SACRIFICIAL RETAINING WALL AND DRAINS, UTILITY DIVERSIONS OF AT-GRADE SECTION OF LENGTH 17.551 Km (CH: -0.964 Km to CH:-0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) AND OTHER RELATED INFRASTRUCTURAL WORKS FROM BENNIGANAHALLI TO CHIKKABANAVARA, EXCLUDING STATION BUILDINGS, OF CORRIDOR - 2 OF BENGALURU SUBURBAN RAILWAY PROJECT (BSRP)”.

The proposed work is in connection with the Corridor- 2 of Suburban railway work between Benniganahalli and Chikkabanavara from approx. Km: (-) 0.964 to 24.425 (Including sidings).

- A. **“Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.**

This bid is for construction of elevated (viaduct) structures comprising pile foundation/open foundation, Piers, cast in situ /pre-cast post tensioned pier cap and cast in situ/ precast portal beams. Elevated structure includes, Pre-cast PSC I – Girder, PSC T– Girder, Pre-cast Box segments/ Pre-cast full span U Girder including casting, transporting, launching and erection in position, the work also includes road widening, side drains & other allied works, and construction of service roads at required locations. Design, construction & maintenance of at least 3 nos of Site /project offices for Engineer and an office at each of the casting yards for Site Engineers are also kept in the scope of the bid.

- B. **“Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.**

This bid is for construction of at-grade section comprising, earthwork in embankment in cutting and filling, Major Bridges, Minor Bridges, ROB/RUB’s, including side drains & allied works approach road work viz., Retaining wall, Sacrificial retaining wall, R E Wall, elimination of level crossings by constructing RUB’s and construction of service roads at required locations.

PART – I SHE MANAGEMENT

1.0 GENERAL

1.1 Scope

1.1.1 This document defines the principal requirements of the Employer on Safety, Health and Environment (SHE) associated with the contractor / sub-contractor and any other agency to be practiced at construction worksites at all time.

1.2 Definition / languages

1.3 Definitions and Abbreviations

- a) Environment- The total surroundings of an organism including water, air and land and other living creatures.
- b) Environmental Pollutant means any solid, liquid or gaseous substance present in such concentration as may be or tend to be injurious to environment.
- c) Environmental Pollution means the presence in the environment of any environmental pollutant.
- d) Nuisance is annoyance, which results from any construction activity that affects the material comfort and quality of life of the inhabitants of the area surrounding the construction site.
- e) Monitoring is the use of direct or indirect reading field instrumentation to provide information regarding the levels of pollutants released during construction.
- f) Construction Site is the contract limits for construction. It shall be all the area within the limits of the work as shown on the Plans. Construction site shall also include staging, and debris disposal areas and transportation routes to and from these areas.
- g) Noise is any unwanted sound disturbance of the environment around the area of construction operations.
- h) Decibel is a measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power) with respect to a standardized reference quantity.
- i) A - weighted Noise levels in Decibels (referenced to 20 micro-asca) as measured with A-weighting network of standard sound level meter, abbreviated dB (A).
- j) Energy Equivalent Level (L_{eq}) is the level of a steady noise which has the same energy as the fluctuating noise level integrated over the period of measurement. L_{max} is the maximum Noise Level during the period of measurement.
- k) L_{10} and L_{90} is the percentile exceeding levels of sound which is exceeded 10% and 90% of the time of measurement.

any substance or article which is required to be disposed.

- m) Suspended Particulate Matter is abbreviated as SPM and measured in $\mu\text{g}/\text{m}^3$.
- n) Environmental Quality Management Manual is abbreviated as EQM.
- o) Air Monitoring and Control Plan is abbreviated as AMCP.
- p) Noise Monitoring and Control Plan is abbreviated as NMCP.
- q) Ministry of Environment and Forests, Government of India is abbreviated as MOEF.
- r) Central Pollution Control Board, New Delhi is abbreviated as CPCB.
- s) Karnataka State Pollution Control Board as KSPCB:

1.3.1 In this document

- i) The use of 'shall' indicates a mandatory requirement.
- ii) The use of 'should' indicates a guideline that is strongly recommended.
- iii) The use of 'may' indicates a guideline that is to be considered.
- iv) 'SHE' means Safety, Health and Environment.
- v) Employer means Karnataka Rail Infrastructure Development Ltd., (K-RIDE).
- vi) Chief Safety Officer means an officer nominated by who is overall responsible for monitoring all SHE functions prescribed in this document.
- vii) BOCWA means Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996
- viii) BOCWR means Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998
- ix) DG means Director General of Ministry of Labour, Govt. of India.
- x) BOCWWCA means Building and Other Construction Workers' Welfare Cess Act, 1996
- xi) BOCWWCR means Building and Other Construction workers welfare Cess rules 1998
- xii) Building and other construction workers' (Regulation of Employment and Condition of service) Karnataka rules, 2006.
- xiii) Notifications (Central and state) – collection of cess.
- xiv) The Factories Act, 1948.

1.4 Application of this document

- 1.4.1 This document applies to all aspects of the contractor's scope of work, including all aspects conducted by sub-contractors and all other agencies. There shall be no activity associated to the contract, which is exempted from the purview of this document.

1.5 Purpose of this document

1.5.1 The objective of these guidelines is to ensure that adequate precautions are taken to avoid accidents, occupational illness and harmful effects on the environment during construction.

1.5.2 This document:

- i) Describes the SHE interfaces between Employer and the Contractor.
- ii) Details the processes by which the contractor shall manage SHE issues while carrying out the work under the contract.
- iii) Describes by reference, the practices and procedures as given in the K-RIDE Project Safety, Health & Environment manual for best SHE performance.

1.5.3 These requirements shall be read together with K-RIDE Project SHE Manual, OHSAS 18001-1999 Occupational Health and Safety Management System and ISO 14001: 2004 Environmental Management Systems. Definition of key terms used in these requirements related to OHSAS 18001 and ISO 14001 standards are found in K-RIDE's Project SHE Manual.

2.0 'SHE' TARGETS AND GOALS

2.1 The SHE targets, goals and aim for the Works are to achieve:

- i) Zero total recordable injuries.
- ii) Zero reportable environmental incidents
- iii) All personnel inducted in accordance with the approved contractor SHE plan
- iv) Total compliance of conducting inspections and audits as per approved SHE plan
- v) 100% incident recording and reporting
- vi) 100% adherence of usage of appropriate PPEs at work.
- vii) Executing construction work with least disturbance to the environment, adjoining road users and traffic.

3.0 COMPLIANCE

3.1 Memorandum of Understanding (MOU)

3.1.1 A Memorandum of Understanding placed at **Appendix No 1** shall be executed after the award of contract before commencement of work by the contractor with regard to various provisions on Safety, Health and Environment to be practiced during the construction work.

3.2 K-RIDE's SHE Policy and Management Systems

3.2.1 The construction works shall be undertaken in accordance with K-RIDE's SHE Policy and Management Systems as amended from time to time provided in Project SHE Manual.

3.3 Indian statutory requirements

3.3.1 Primary statutory regulations

K-RIDE

(BYPL-BAW/AT GRADE & ELEVATED)

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- 3.3.1.1 Contractor shall develop thorough understanding about Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996, Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules 1998, the building & other construction workers welfare cess act 1996 and Building and Other Construction Workers welfare Cess rules 1998, Building and Other Construction Workers [Regulation of Employment & Conditions of Service] (Karnataka) Rules, 2006, Notification [Central & State] – Collection of Cess, not only to satisfy the Inspectors' perspective but the use of legislation as the strong tool for effective SHE management at construction worksites. Contractor is strongly advised to practice the principle of voluntary compliance.
- 3.3.1.2 In order to facilitate the contractor for better understanding on the various provisions of the above Act and Rules, a tabulated information highlighting the Sections/Rules referring to the corresponding registration of contractors, maintenance of registers and records, hours of work and wages, cess & welfare, medical facilities and safety requirements are given in **Appendix No. 2**. It is an indicative one and not a limiting list.
- 3.3.2 In addition, the construction works shall be undertaken in accordance with all applicable legislation and Indian statutory requirements as amended from time to time listed below but not limiting to:
- i. Electricity Act 2003 and Rules therein
 - ii. National Building Code of India, 2016
 - iii. Factories Act, 1948.
 - iv. Motor Vehicles Act 1988 and The Central Motor Vehicles Rules, 1989.
 - v. Indian Road Congress Code IRC: SP: 55-2001 'Guidelines on Safety In Road Construction Zones.
 - vi. The Petroleum Act, 1934 and Rules therein
 - vii. Gas Cylinder Rules, 2016
 - viii. Indian Explosives Act. 1884, along with the Explosives substance Act 1908 and the Explosives Rules 1983
 - ix. The (Indian) Boilers Act, 1923
 - x. The Public Liability Insurance Act 1991 and Rules therein
 - xi. Minimum Wages Act, 1948 and Rules therein
 - xii. Contract Labor Act, 1970 and Rules therein
 - xiii. Child and Adolescent Labour (Prohibitions & Regulations) Act, 1986 and Rules therein
 - xiv. Environment Protection Act, 1986 and Rules therein
 - xv. Environmental Impact Assessment Notification- 2006
 - xvi. Notification for use of fly ash, 2017.
 - xvii. National Green Tribunal Act, 2010
 - xviii. Air (Prevention and control of Pollution) Act, 1981
 - xix. Water (Prevention and Control of Pollution) Act, 1974

- xx. The Noise Pollution (Regulation & Control) Rules, 2000
- xxi. Notification on Control of Noise from Diesel Generator (DG) sets, 2002
- xxii. Recycled Plastic Usage Rules, 1998
- xxiii. Notification, Central Ground Water Board, Act January 1997
- xxiv. Manufacture, Storage & Import of Hazardous Chemicals Rules, 1989
- xxv. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013 along with the Rules and Regulations therein.
- xxvi. The Hazardous Waste (Management & Handling) Rules, 1989
- xxvii. Karnataka Preservation of Trees Act, 1976 & Rules therein, Batteries (Management and Handling) Rules, 2001
- xxviii. Fly ash utilization notification, Sept 1999 as amended in August 2003
- xxix. Guidelines of Karnataka Urban Arts Commission
- xxx. Mysore Tramway Act.
- xxxi. Workman Compensation Act, 1923 along with allied Rules
- xxxii. Indian Railway Manual of AC Traction Maintenance and Operation
- xxxiii. IRP Way Manual
- xxxiv. Code on Wages 2019, as and when notified by the Government.
- xxxv. Code on Social Security 2020, as and when notified by the Government.
- xxxvi. Industrial Relations Code, 2020, as and when notified by the Government.
- xxxvii. Occupational Health, Safety and Working conditions code, 2020, as and when notified by the Government.

3.3.3 Employees Compensation Act, 1923 along with allied Rules

3.3.3.1 The Contractor shall ensure that all his Employees / Workmen are covered under 'Employees Compensation Act' and shall pay compensation to his workmen as and when the eventuality for the same arises.

3.3.4 Notwithstanding the above Act/Rules, there is nothing in those to exempt the contractor from the purview of any other Act or Rule in Republic of India for the safety of men and materials.

3.3.5 If the requirements stated in this document are less stringent than or in conflict with the country's applicable legislation, the latter shall apply.

3.4 International Standards, Guidelines & ISO Certifications

3.4.1 The works should be undertaken in accordance with the applicable international guidelines, standards and specifications on SHE and every contract shall aim to achieve ISO certifications listed below during the currency of the contract:

OHSAS 18001-1999 : Occupational Health and Safety Management System.
ISO 14001-2004: Environmental Management Systems.

- 3.4.2 The process of certification shall start immediately after the award of the work and complete within reasonable time. Towards this, the contractor shall undertake the required steps including appointment of ISO consultant for obtaining the certification on Occupational Health and Safety Management System and Environment Management System.
- 3.4.3 In case of failure on the part of the contractor, the Employer at the cost of the contractor shall do the same.

4.0 CONTRACTOR SHE POLICY AND PLAN

- 4.1 The contractor as per Section 39 of the BOCW Act shall formulate a SHE policy and get it approved by DG respectively and display it at conspicuous places at work sites in Kannada, Hindi and other languages understood by the majority of construction workers.
- 4.2 Within 4 weeks of the notification of acceptance of the tender, the Contractor shall submit a detailed and comprehensive Contract specific SHE Plan. The SHE Plan shall include detailed policies, procedures and regulations which, when implemented, will ensure compliance of the contract provisions. The SHE Plan shall include the following but not be restricted to:
- i) A statement of the Contractor's policy, organisation and arrangements for SHE
 - ii) The name(s) and experience of person(s) within the Contractor's proposed management who shall be responsible for co-ordinating and monitoring the Contractor's SHE performance;
 - iii) The number of SHE staff who shall be employed on the Works, their responsibilities, authority and line of communication with the proposed Contractor's agent;
 - iv) A statement of the Contractor's policy and procedures for identifying and estimating hazards, and the measures for addressing the same;
 - v) A list of SHE hazards anticipated for this Contract and sufficient information to demonstrate the Contractor's proposals for achieving effective and efficient health and safety procedures;
 - vi) A description of the SHE training courses and emergency drills which shall be provided by the Contractor, with an outline of the syllabus to be followed;
 - vii) Details of the safety equipment which shall be provided by the Contractor, including personal protective equipment;
 - viii) A statement of the Contractor's policy and procedures for ensuring that Contractor's Equipment used on the Project Site are maintained in a safe condition and are operated in a safe manner;
 - ix) A statement of the Contractor's policy and procedures for ensuring that sub-contractors comply with the Contractor's safety plan;

- x) A statement of the Contractor's disciplinary procedures with respect to SHE related matters, and
 - xi) A statement of the Contractor's procedure for reporting and investigating accidents, dangerous occurrences or occupational illnesses
- 4.3 The Contractor shall, from time to time and as necessary are required by the Employer to produce supplements to the SHE Plan such that it is at all times a detailed, comprehensive and contemporaneous statement by the Contractor of his site safety, industrial health and environment obligations, responsibilities, policies and procedures relating to work on Site. Any and all submissions of supplements to the SHE Plan shall be made to the Employer in accordance with the agreed procedures.
- 4.4 If at any time the SHE plan is, in the Employer's opinion, insufficient or requires revision or modification to ensure the security of the Works and the safety of all workmen upon and visitors to the Site, the Employer may instruct the Contractor to revise the SHE plan and the Contractor shall within 7 days submit the revised plan to the Employer for review.
- 4.5 Any omissions, inconsistencies and errors in the SHE Plan or the Employer's acceptance or rejection of the SHE Plan and/or supplements thereto shall be without prejudice to the Contractor's obligations with respect to site safety, industrial health and environment and shall not excuse any failure by the contractor to adopt proper and recognized safety practices throughout the execution of the Work.
- 4.6 The Contractor shall adhere to the SHE Plan and shall ensure, as far as practically possible, that all sub-contractors of all tiers require that contracting parties each have a copy of the Site SHE Plan and comply with its provisions.
- 4.7 The details of contents to be covered in the site SHE plans are given in **Appendix No 3**.

5.0 DESIGNER'S ROLE

5.0 Designer's role in Safety, Health and Environment

5.1 Designer's primary role includes to minimize the risk to health and safety of those who are going to construct, maintain, clean, repair, dismantle or demolish the structures and anyone else like adjoining road users/general public, who might be affected by the work.

5.2 General philosophy

5.2.1 When considering health and safety in designer's work, they shall be expected to do what is reasonable at the time the design is prepared. It may be possible for hazards, which cannot be

addressed at the feasibility stage to be looked at during detailed design. In deciding what is reasonably practicable, the risk to health and safety produced by a feature of the design has to be weighed against the cost of excluding the feature. The overall design process does not need to be dominated by a concern to avoid all risks during the construction phase and maintenance. However, a judgement has to be made by weighing up one consideration against another so the cost is counted not just in financial terms, but also those of fitness for purpose, aesthetics, buildability or environmental impact. By applying these principles, it may be possible to make decisions at the design stage, which will avoid or reduce risks during construction work. In many cases, the large number of design considerations will allow a number of equally valid design solutions. What is important is the approach to the solutions of design problems. This should involve a proper exercise of judgement, which takes account of health and safety issues.

5.3 Hierarchy of Risk Control

5.3.1 Designers shall need, so far as reasonably practicable, to avoid or reduce risks by applying a series of steps known as the hierarchy of risk control or principles of prevention and protection. The steps to be adopted shall include the following:

- i) consider if the hazard can be prevented from arising so that the risk can be avoided (e.g., alter the design to avoid the risk);
- ii) if this cannot be achieved, the risk should be combated at source (e.g., ensure the design details of items to be lifted include attachment points for lifting);
- iii) failing this, priority should be given to measures to control the risk that will protect all people;
- iv) only as a last resort should measures to control risk by means of personal protection be assumed (e.g., use of safety harnesses).

5.4 Duty to provide health and safety risks in the drawing itself

5.4.1 In case of situations where the designers have carried out the design work and concluded that there are risks, which are not reasonably practicable to avoid, detailed information shall be given about the health and safety risks, which remain. This information needs to be included with the design to alert others to the risks, which they cannot reasonably be expected to know. This is essential for the parties who have to use the design information.

5.4.2 If the designers' basic design assumptions affect health or safety, or health and safety risks are not obvious from the standard design document, the designer shall provide additional information. The information shall include a broad indication of the assumptions about the precautions for dealing with the risks. The information will need to be conveyed in a clear manner; it shall be included on drawings, in written specifications or outline method statements. The level of detail to be recorded will be determined by the nature of the hazards involved and the associated level of risk.

5.5 Employer's approval

5.5.1 Every structure like scaffold, false work, launching girder, earth retaining structures etc. shall have its design calculations included in the method statements in addition to health and safety risks. Employers' designer or his approved proof check consultants as applicable as per the contract conditions shall approve all these designs.

5.6 Any non-standard structures like trestles made up of re-bars or structures which are very old, corroded, repaired for many times etc. for which no design calculations can be made accurately from any national standards, shall not be allowed to be used at sites even for short duration.

5.7 If any of the above-mentioned clauses are not adhered penalty shall be imposed depending upon the gravity of the unsafe act and or condition

6.0 CONTRACTOR SHE ORGANIZATION

6.1 Education and Experience

6.1.1 The contractor shall appoint the required SHE personnel as prescribed in General Instruction **K-RIDE/SHE/CEO/001** (enclosed at the end) based upon the statutory requirement and establish the safety organization based upon the contract value. The minimum educational qualification and the work experience are given in General Instruction **K-RIDE/SHE/CEO/002**

6.1.2 In order to effectively interact on labour welfare matters with the Employer and the statutory authorities enforcing the labour welfare legislations every contractor shall employ a full time Labour Welfare Officer duly qualified and experienced as per clause 6.1.1.

6.2 Conduct and Competency

6.2.1 The conduct and functioning of the contractor SHE personnel shall be monitored by the Employer. Any default or deficiency shall attract penalty as per details given under penalty clause **56.0** of this document.

6.2.2 The Contractor shall ensure that all personnel are competent to perform the job assigned to them. In the event that the Contractor is unable to demonstrate the competency of any person whose activities can directly impact on the Works' SHE performance, the Employer shall remove that person from the site without any procedural formalities.

6.3 Approval from Employer

- 6.3.1 The name, address, educational qualification, work experience and health condition of each personnel deployed for SHE jobs shall be submitted to the Employer in the format prescribed for the purpose for comments and approval well before the start of the work. Only on approval by the Employer these personnel are authorized to work. In case any of the SHE personnel leaves the contractor the same shall be intimated to the Employer. The contractor shall recruit new personnel and fill up the vacancy.
- 6.4 Responsibility of SHE personnel
- 6.4.1 For all works carried out by the contractor and his sub-contractors, the responsibility of ensuring the required SHE manpower lies with the main contractor only. The minimum required manpower indicated by the Employer includes the sub-contractors' work also. It shall be the responsibility of the main contractor to provide required SHE manpower for all the works executed by all contractors. Necessary conditions shall be included in all sub-contract documents executed by the main contractor.
- 6.5 Employment status of SHE personnel
- 6.5.1 No contractor shall engage SHE manpower from any outsourcing agencies in which case the effectiveness would be lost. All SHE manpower shall be on the payroll of the main contractor only and not on the payroll of any subcontractor or outsourcing manpower agencies etc. This condition does not apply to positions like traffic marshals who are engaged almost on a daily requirement basis.
- 6.6 Reporting of SHE personnel
- 6.6.1 All SHE personnel are to report to the Chief SHE Manager who shall report directly to the Chief Project Manager. The Employer shall monitor adherence to this procedure at all times. In case of non-adherence penalty shall be levied as indicated in the penalty clause.
- 6.7 Inadequate SHE personnel
- 6.7.1 In case if the contractor fail to provide the minimum required manpower as illustrated in General Instruction K-RIDE/SHE/CEO/001 or fail to fill up vacancies created within 14 days, the same shall be provided by the Employer at contractor's cost. Any administrative expenses involved, providing the same like paper advertisement or manpower consultant charges, etc. shall also be at the cost of contractor.
- 6.8 Prohibition of performance of other duties

6.8.1 As per Schedule VIII of BOCWR no SHE personnel shall be required or permitted to do any work which is unconnected to, inconsistent with or detrimental to the performance of the SHE duties for respective category mentioned in General Information **K-RIDE/SHE/CEO/001**.

6.9 Facilities to be provided to SHE personnel

6.9.1 As per schedule VIII of BOCWR, the contractor shall provide all SHE personnel with such facilities, equipment and information that are necessary to enable him to discharge his duties effectively.

6.9.2 The minimum Employer's requirements of such facilities / equipment's to be provided for SHE personnel are given in the General Instruction **K-RIDE/SHE/CEO/003**

7.0 **CONTRACTOR SHE COMMITTEE**

7.1 All employees should be able to participate in the making and monitoring of arrangements for safety, industrial health and environment at their place of work. The establishment of site SHE committees in which employees and Contractor and sub-contractor management are represented can increase the involvement and commitment of employees. The contractor shall ensure the formation and monitor the functioning of contractor SHE committees.

7.2 Terms of Reference

7.2.1 The Terms of Reference for the committee shall be as follows;

- i) To establish company safety policies and practices
- ii) To monitor the adequacy of the contractor's site SHE plan and ensure its implementation
- iii) To review SHE training
- iv) To review the contractor's monthly SHE report.
- v) To identify probable causes of accident and unsafe practices in building or other construction work and to suggest remedial measures.
- vi) To stimulate interest of Employer and building workers in safety by organizing safety week, safety competition, talks and film-shows on safety, preparing posters or taking similar other measures as and when required or as necessary.
- vii) To go round the construction site with a view to check unsafe practices and detect unsafe conditions and to recommend remedial measures for their rectifications including first-aid medical and welfare facilities.
- viii) Committee team members should perform a site inspection before every committee meeting and to monitor SHE inspection reports.

- ix) To bring to the notice of the Employer the hazards associated with use, handling and maintenance of the equipment used during the course of building and other construction work
- x) To suggest measures for improving welfare amenities in the construction site and other miscellaneous aspect of safety, health and welfare in building or other construction work.
- xi) To look into the health hazards associated with handling different types of explosives, chemicals and other construction materials and to suggest remedial measures including personal protective equipment.
- xii) To review the last safety committee meeting minutes and to take action against persons/sub-contractors for non-compliance if any.

7.3 Within 14 days of award of contract, the SHE committee shall be constituted and notification regarding the same shall be communicated to the members and employees as per the format provided in **Form No SF 001**

7.4 Site SHE Committee meeting shall be conducted at least once in a **month** with the minimum members listed below:

Chairman	Project Manager
Secretary	SHE Manager (In-charge)
Members	<ul style="list-style-type: none"> i) Labour Welfare Officer ii) In charge of plant and machinery iii) In charge of site electrics iv) In charge of stores. v) Senior Managers/ Engineers heading different sub functions. vi) Sub – contractor’s representative vii) Labour Contractor’s representative viii) Workers’ representative ix) Co-contractor representative. x) SHE staffs
Employer’s Representatives	K-RIDE SHE in charge and other representatives

- 7.5 Construction SHE Committee meeting shall be conducted at least once in a **week** with the minimum members listed below:

Chairman	Project Manager
Secretary	SHE Manager (In-charge)
Members	<ul style="list-style-type: none"> i) Labour Welfare Officer ii) In charge of plant and machinery iii) In-charge of site electricity iv) Senior Managers / Engineers heading different sub functions v) Sub- Contractor's representative vi) Labour contractor's representative vii) Workers' representatives viii) All SHE Staffs

7.6 Co-contractors' participation

7.6.1 In case of depot, station and other contiguous areas where more than one main contractors are working together, the Employer shall instruct the other contractors to join for the monthly SHE committee meeting of the main civil contractor, so as to discuss and decide about the common provision of security, lighting, toilet, drinking water etc. and sharing the maintenance cost of the same etc.

7.6.2 The general principle for sharing the cost shall be either based on the contract value of works executed at the contiguous area or the daily average number of workmen employed by each contractor in the contiguous area.

7.7 Minimum time between two monthly SHE Committee meetings

7.7.1 A minimum period of **21 days** shall be maintained between any two SHE monthly committee meetings.

7.8 Agenda

7.8.1 The Secretary shall circulate the agenda of the meeting at least seven working days in advance of the scheduled date of the meeting to all members.

7.8.2 The agenda should broadly cover the following:

- i) Confirmation of minutes
- ii) Chairman's review/overview of site SHE performance / condition
- iii) Previous month SHE statistics
- iv) Incident and Accident Investigation / dangerous occurrence / near miss report
- v) Site SHE inspection
- vi) Sub-contractors' SHE issues
- vii) Safety presentation by Members
- viii) Report from Employer
- ix) Matters arising
- x) Any other business

7.9 Minutes of the meeting

7.9.1 The Minutes of the meeting shall be prepared as per the format provided at **Form No SF 002** and sent to all members within 2 working days preferably by mail/fax followed by hardcopy. Safety Committee meeting minutes shall also be displayed in the notice board for wider publicity to all concerned.

7.10 Disciplinary Action

7.10.1 The chairman shall inform the members of any outstanding issues in the meeting and in case of repeated offence/ non-compliance by some members or other co/sub-contractors and propose suitable disciplinary action including provisions of monetary penalty as per the relevant contract clauses, the Employer shall ensure that the same is implemented.

8.0 ID CARD AND FIRST DAY AT WORK, SHE ORIENTATION TRAINING

8.1 The Contractor shall ensure that all personnel working at the site receive an induction SHE training explaining the nature of the work, the hazards that may be encountered during the site work and the particular hazards attached to their own function within the operation. The training shall cover the contents as given in the General Instruction **K-RIDE/SHE/CEO/004**.

8.2 All personnel shall be issued a photo identity card of size 85mm x 55mm duly signed by the authorized representative of the contractor before they are engaged for any work as per the format given in the General Instruction **K-RIDE/SHE/CEO/005**

8.3 Contractor shall also issue personnel SHE handbook in a language known to the workers, which provides information on SHE and emergency procedures that all personnel working on contract are required to know and the need to follow. Contractor shall ensure that this is distributed and its content introduced to all personnel working at the site.

9.0 SHE TRAINING

9.1 The behavior of people at all levels of the contractor is critical for SHE performance.

9.2 The contractor shall organize quality SHE training to engage Managers, supervisors and other personnel in behavioral change and improve safety performance.

9.3 The Contractor shall analyze the training requirements for all the employees and initiate a training program to demonstrate that all persons employed, including subcontractors, are suitably qualified, competent and fit. This will include:

- i) Detailed Job descriptions for all personnel, to include their specific SHE responsibilities
- ii) Specification of qualifications, competency and training requirements for all personnel

- iii) Assessment and recording of training needs for all personnel, including subcontractors' employees in the workforce, vendor representatives and site visitors
 - iv) A system for assessing new hirers e.g. previous training
 - v) A means of confirming that the system is effective
 - vi) A matrix and schedule of training requirements, covering general, task-specific and SHE-related training, showing the training frequency and interval between refresher courses
 - vii) Timely, competent delivery of training courses
- 9.4 The contractor shall arrange behavioral-based training programs for all the executives to identify recognize and eliminate unsafe act and unsafe conditions.
- 9.5 The minimum Employer's requirement of training needs for various categories of employees are given in general instruction **K-RIDE/SHE/CEO/006**
- 9.6 The contents of SHE training to Managers/Supervisors as given in general instruction **K-RIDE/SHE/CEO/007** shall be conducted.
- 9.7 The refresher-training program to all employees shall be conducted once in six months.
- 9.8 Toolbox talk as given in the Employer's Project SHE manual shall be conducted to all high-risk workmen every day.
- 9.9 On-the spot practical skill development training on height safety including scaffold safety, crane safety, welding safety, electrical safety, traffic safety for marshals shall also be conducted to all foremen/ workmen who were associated to the concerned jobs.
- 9.10 Every employee including workman shall take safety Oath daily without fail.
- 9.11 All vehicle drivers including heavy vehicle operators shall be trained on defensive driving at Central Training Institute KSRTC, Shanthinagar Bangalore, or any other driving institute registered under Motor Vehicles Act.
- 9.12 All the above listed training programs except at clause **9.11** shall be organized by the contractor only after taking approval from the Employer for the training faculty / organization, content and durations.
- 9.13 In case of failure on the part of the contractor to provide all the above-mentioned training programs to all employees in time, the same shall be provided by the Employer through accredited agencies if required by formulating a common scheme to all contractors. Any administrative expenses and training fee towards the same shall be at the cost of the contractor.

10.0 SHE INSPECTION

- 10.1 The contractor shall evolve and administer a system of conducting SHE inspections and other risk management analysis on a periodical basis.
- 10.2 The purpose of SHE inspection is to identify any variation in construction activities and operations, machineries, plant and equipment and processes against the SHE Plan and its supplementary procedures and programs.
- 10.3 Following SHE inspections program shall be adopted.
- i) Planned General Inspection
 - ii) Routine Inspection
 - iii) Specific Inspection
 - iv) Other Inspection
- 10.3.1 Planned General Inspection
- 10.3.1.1 Planned general inspections are performed at predetermined intervals and it usually involves the representation from both Contractor and the Employer.
- 10.3.1.2 Inspections that will be classified under this inspection program are:
- i) Monthly contractor and sub-contractors site safety committee Inspection.
 - ii) Weekly safety inspection by construction supervisors (Contractors and Sub-contractors).
 - iii) Daily safety inspection by contractor site SHE team.
- 10.3.2 Routine Inspection
- 10.3.2.1 Routine inspections are often referring to the inspection of work site, equipment and temporary structures performed by site and equipment operators and temporary structure erectors.
- Inspections that will be classified under this inspection program are:
- i) Daily Inspection of plant and equipment by operator
 - ii) Weekly Inspection of scaffold by scaffolding supervisor
 - iii) Monthly Inspection of electrical hand tools by competent electrical supervisor
 - iv) Quarterly Inspection of temporary electrical systems by competent electrical supervisor
 - v) Half-yearly inspection of lifting machinery, lifting appliances, equipment and gears by Govt. approved competent person.

10.3.2.2 The list mentioned above is not exhaustive. Contractor may add additional categories. Contractors' Site SHE Manager will ensure that a system of routine inspections are carried out periodically to all plants, equipment, powered tools and any other temporary structures that will pose a hazard to operators and workmen.

10.3.3 Specific Inspection

10.3.3.1 Specific inspections are performed on activities without a predetermined date. Competent supervisors usually perform inspections for ensuring an activity whether it is executed in accordance to a general set of rules; method statement submitted or developed procedures.

The following are examples that will be commonly performed as required on the construction site:

- i) Inspection performed before a heavy lifting operation.
- ii) Inspection performed before and after the entry of person into a confined space.
- iii) Inspection performed before and after a welding and gas cutting operation.
- iv) Inspection of formwork before concreting by formwork erector.

The list mentioned above is not exhaustive. The contractor shall ensure that a competent supervisor inspects all high-risk processes and activities.

10.3.4 Other Inspection

Other inspections include the following:

- i) Mandatory Inspections by Labour Department of Government.
- ii) K-RIDE site SHE management team

10.3.5 The contractor shall prepare all required safety inspection checklist for all activity operations and equipment. Checklists will be prepared based on the Indian standards, rules and regulations and Employer's requirements. The formats provided in the Project SHE manual may be referred.

10.3.6 All inspection records and reports will be properly kept and filed for audit purpose. Inspection reports of Planned General Inspection and Routine Inspection will be used for discussion during Safety Committee Meetings.

11.0 SHE AUDIT

11.1 General

11.1.1 The purpose and scope of SHE audit is to assess potential risk, liabilities and the degree of compliance of construction Safety, Health and Environmental plan and its supplementary procedures and programs against applicable and current SHE legalisation regulations and requirements of the employer.

11.1.2 Project Manager holds the ultimate responsibility in ensuring implementation of SHE audit program during the construction work.

11.2 Monthly Audit Rating Score (M A R S)

11.2.1 Monthly Audit Rating Score (MARS) will be performed once in a month. A team consisting of Project manager and Employer representative based on the pre-designed score-rating format will conduct it. The details of the pre-designed monthly audit score rating formats are given in the Project SHE manual.

11.2.2 This Monthly SHE Audit Rating Score (MARS) report will enable the Employer to evaluate the general compliance by the Contractor with the Conditions of Contract, the Employer's Project SHE Manual and the Contractor's site specific SHE Plan.

11.2.3 Monthly Audits will be conducted in accordance with K-RIDE Guidelines. The Project Manager accompanied by the Employer's representatives shall carry out the Audit. The Contractor's senior manager and SHE in-charge should also be invited to attend.

11.2.4 Timing

The Monthly Audit Rating Score (MARS) should be conducted at least 7 days prior to the scheduled date of Monthly SHE Committee meeting.

11.2.5 Evaluation

11.2.5.1 The numerical scoring has been weighed on a 1-10 scale. The audit team will use their observations noted in evaluating the points to be awarded against each of the elements of the audited section. Wherever some topics and sub-topics are not applicable the score rating need not be given. The overall audit ratings shall be achieved by:

$$\text{Overall Audit rating} = \frac{\text{Actual Score Achieved}}{\text{Maximum Possible Score}} \times 100$$

11.2.5.2 The criticality of the required actions for the respective sections of the Audit will be classified as:

Sl. No.	Score	Description	Action
1	< 60%	Immediate	Require Contractor to rectify within 24 hours
2	< 75%	Improvement Necessary	Contractor rectification within 7 days and confirmed in writing to Employer
3	< 90%	Improvement Desirable	Contractor rectification within one month and confirmed in writing to Employer

11.2.6 Report

A copy of each Audit Report will be sent to Employer and to all subcontractors, with whom it will then be discussed in detail at the Monthly SHE Committee Meeting in order to ensure that any corrective actions are agreed upon.

11.3 Monthly Electrical Safety Audit

11.3.1 A team comprising of contractor's senior SHE (Electrical) engineer and Employer's representative shall conduct monthly electrical safety audit covering the following and submit the report to Employer.

- i) Electrical accidents investigation findings and remedy
- ii) Adequacy of power generation and power requirements
- iii) Power distribution and transmission system in place
- iv) Updated electrical single line diagram showing the current condition of power source and distribution including the IP44 DBs arrangement.
- v) Electrical protection devices – selection, installation and maintenance.
- vi) Earth or ground connection and earth pit maintenance details
- vii) Education and training of electrical personnel undertaken
- viii) Routine electrical inspection details
- ix) Electrical maintenance system and register.
- x) Name plate details of major electrical equipment
- xi) Classified zones in the site, if any.

11.4 External SHE audits

11.4.1 External SHE audits are to be conducted by external agencies that are competent with ISO qualified auditors with the prior approval of the Employer.

11.4.2 Areas of competence of Audit team

11.4.2.1 Practical understanding of BOCW Act and Rules, statutory requirements on health/medical and welfare of workmen, construction hazards and its prevention and control, traffic management, electrical safety, rigging, safety of construction equipment and environment management.

11.4.2.2 Audit shall be conducted as per the guidelines of ISO, ILO, and national standards. Audit report shall also be presented as per the above formats.

11.4.3 External SHE audit shall be conducted on a quarterly basis throughout the currency of the contract.

11.4.4 Targets of SHE Audit:

The contents and coverage of the external audit shall include the following items

11.4.4.1 SHE management

- i) Organization
- ii) Communication and Motivation
- iii) Time office
- iv) Inspection
- v) Emergency preparedness
- vi) Budget allocation
- vii) Education and Training
- viii) Work permit system

11.4.4.2 Technical

- i) Building and Structure
- ii) Construction operational safety
- iii) Material safety
- iv) Hand tools and Power tools
- v) Electrical system
- vi) Safety Appliances
- vii) Fire prevention and control
- viii) Housekeeping
- ix) Maintenance and Machinery safety
- x) First-aid and Medical Facilities
- xi) Welfare measures

xii) Environmental Management

11.4.5 Audit Documents

11.4.5.1 Contractor shall make the below listed documents available for the review by the Audit team.

- i) SHE policy
- ii) SHE manual
- iii) SHE Rules and Regulation
- iv) SHE organization chart
- v) Annual SHE objectives / programs
- vi) Accident / near miss statistics and analysis
- vii) SHE Training program / records for all personnel
- viii) Operating manuals and maintenance manual of all equipment's
- ix) Safe worthiness certificates of all lifting appliances and gears
- x) Medical fitness record for all personnel
- xi) Risk identification, assessment and control details
- xii) Environmental management reports
- xiii) Emergency management records including mock drill

11.4.5 Audit Preparation

- i) Audit team members are required to gather information by observations through interviews and by checks of hardware and documentation.
- ii) Audit team shall prepare checklist to cover all parts based on SHE legislations rules and regulations and K-RIDE requirements.
- iii) Audit team members shall verify the facts and findings leading to the identified gaps and weakness.
- iv) Audit leader has overall responsibility for reaching a conclusion.

11.4.7 Reporting

11.4.7.1 Audit report shall be prepared and directly sent to the Employer within 7 days of conducting the audit with a copy to the contractor.

11.4.8 Report contents

- i) Executing summary - based on the finalized checklists as written the findings to the Employer by the audit team members, the audit leader will compile a concise and accurate summary of observations and findings.

- ii) Introduction - this will contain basic information regarding the facilities or organization audited, the specific audit dates (inclusion of those for preparation and post-audit activities).
- iii) Principal positive findings - This will contain the summary of positive aspects as observed by the auditors. It will also contain highlights of those issue, which may warrant dissemination as best practice regarding methodology used or achievement.
- iv) Audit Findings - All audit findings as detailed in the audit checklists shall be grouped together as priority 1 and 2 as detailed below in a separate listing.
 - a) Priority 1: Actions to rectify gaps or weakness should generally be implemented within 2 – weeks, if risk potential is high or unacceptable.
 - b) Priority 2: Actions should be generally implemented or rectified with a maximum of 3 – 4 weeks, if not rectified would create a likelihood of minor injury or business loss.

11.4.9 Conformity Report & Action by Employer

11.4.9.1 The auditor shall inspect the site after 14 days of conducting initial audit for checking the adequacy of implementation of items maintained under priority 1 by the contractor and shall submit a conformity / non-conformity report to the Employer with a copy to the contractor.

11.4.9.2 The auditor shall again inspect after 28 days of conducting initial audit for checking the adequacy of implementation of items mentioned under priority 2 by the contractor and shall submit a conformity / non-conformity report to the Employer with a copy to the contractor.

11.4.9.3 In case of non-conformity of items mentioned by auditor, the Employer shall take necessary steps including stoppage of work and or imposing any penalty for getting the item implemented.

11.4.10 Failure of contractor to conduct External SHE Audit

11.4.10.1 If the contractor fails to conduct the external SHE audit in time, the Employer at the cost of contractor shall get it done.

12.0 SHE COMMUNICATION

12.1 The contractor shall take every effort to communicate the Safety, Occupational health and Environment management measures through posters campaigns / billboards / banners / glow signs being displayed around the work site as part of the effort to rise safety awareness amongst to the work force. Posters should be in Hindi, English and other suitable language deemed appropriate. Posters / billboards / banners/ glow signs should be changed at least once in a month to maintain the impact.

12.2 The list indicated are the minimum requirements of the Employer and the contractor is encouraged to further the SHE communication activities by formulating suitable reward schemes for safety performers and any other activities, which deem fit for the purpose.

13.0 SHE SUBMITTALS TO THE EMPLOYER

13.1 The contractor's SHE management should send the following reports to the Employer periodically:

- i) Daily Reporting of total no of workmen (as given in Clause **13.2**)
- ii) Monthly SHE Report (as given in Clause **13.3**)
- iii) SHE Committee Meeting Minutes (as given in Clause **7.9.1**)
- iv) SHE Inspection Reports
- v) SHE Audit Reports
 - a) Monthly Audit Rating Score (MARS) report
 - b) External SHE Audit
 - c) Electrical Safety Audit
- vi) Air and Noise Quality monitoring report

13.2 Daily Reporting of total number of workmen

13.2.1 The contractor shall report to the Employer the total number of workmen engaged by all including any subcontractor within 2 hours of starting of any shift in any day. This reporting shall be the primary duty of the Chief SHE Manager of the contractor and reporting shall be through tele-fax / email. The onus of checking the receipt of the same by the Employer lies with the contractor. If the information is not received or received more than 2 hours after starting of the shift, penalty shall be levied as per relevant clause.

13.3 Monthly SHE Report

13.3.1 The contractor shall prepare a monthly SHE report consisting of the following and submit 3 copies within 7th of next month to the Employer as specified in the Project SHE manual.

- i) Monthly man-hour details as specified in the Project SHE manual
- ii) Monthly accident / incident details as specified in the Project SHE manual
- iii) SHE committee details
- iv) Details of SHE training conducted in the month
- v) SHE Inspection
- vi) SHE internal audit details like electrical audit etc.

- vii) SHE Communication activities under taken in the month indicating the number of posters displayed and balance availability in stock.
- viii) Air quality / Noise monitoring details
- ix) Toolbox talks details
- x) PPE details: Quantity purchased, issued to the workmen and stock available.
- xi) Details on IP 44 panel boards, lighting poles, welding and cutting equipments, Ladders, Hoists, tools & tackles.
- xii) Monthly Lux meter study results
- xiii) Housekeeping
- xiv) Barricade maintenance details
- xv) No of critical excavations
- xvi) Health & Welfare activities
- xvii) Safety walk conducted by Contractors' Project Manager in the month
- xviii) SHE Activities Planned for next month

14.0 ACCIDENT REPORTING AND INVESTIGATION

14.1 Reporting to Employer

14.1.1 All accidents and dangerous occurrences shall immediately be informed verbally to the Employer. This will enable the Employer to reach to the scene of accident / dangerous occurrences to monitor/assist any rescue work and/or start conducting the investigation process so that the evidences are not lost.

14.1.2 Reports of all accidents (fatal / injury) and dangerous occurrences shall also be sent within 24 hours as per format provided in the Employer's Project SHE manual.

14.1.3 No accident / dangerous occurrences is exempted from reporting to the Employer.

14.1.4 Any willful delay in verbal and written reporting to the Employer shall be penalized as per relevant clause.

14.2 Reporting to Govt. organizations

14.2.1 In addition to the above verbal and written reporting to the Employer, as per Rule 210 of BOCWR, notice of any accident to a worker at the building or construction site that:

- a) causes loss of life; or

- b) disables a worker from working for a period of 48 hours or more immediately following the accident;
- c) shall forthwith be sent by telegram, telephone, fax, or similar other means including special messenger within four hours in case of fatal accidents and 72 hours in case of other accidents, to:
 - i) the Regional Labor Commissioner, wherein the contractor has registered the firm/work
 - ii) the board with which the worker involved was registered as a beneficiary;
 - iii) Director General and
 - iv) the next of kin or other relative of the worker involved in the accident;

14.2.2 Further, notice of accident shall be sent in respect of an accident which

- a) causes loss of life; or
- b) disables the injured worker from work for more than 10 days to
 - i) the officer-in-charge of the nearest police station;
 - ii) the District Magistrate or, if the District Magistrate by order so desires, to
 - iii) the Sub-Divisional Magistrate

14.2.3 In case of an accident causing minor injury, first-aid shall be administered and the injured worker shall be immediately transferred to a hospital or other place for medical treatment.

14.2.4 Where any accident causing disablement that subsequently results in death, notice in writing of such death, shall be sent to the authorities mentioned in clause 14.2.1 and 14.2.2 above within 72 hours of such death.

14.2.5 Reporting of dangerous occurrences:

14.2.5.1 The following classes of dangerous occurrences shall be reported to the Inspector having jurisdiction, whether or not any disablement or death caused to the worker, namely:

- a) collapse or failure of lifting appliances, or hoist, or conveyors, or similar equipment for handling of building or construction material or breakage or failure of rope, chain or loose gears; or overturning of cranes used in construction work;
- b) falling of objects from height;
- c) collapse or subsidence of soil, tunnel, pipe lines, any wall, floor, gallery, roof or any other part of any structure, launching girder, platform, staging, scaffolding or means of access including formwork;
- d) explosion of receiver or vessel used for storage of pressure greater than atmospheric pressure, of any gas or gases or any liquid or solid used as building material;
- e) fire and explosion causing damage to any place on construction site where building workers are employed;

- f) spillage or leakage of any hazardous substance and damage to their container;
- g) collapse, capsizing, toppling or collision of transport equipment;
- h) leakage or release of harmful toxic gases at the construction site;

14.2.6 In case of failure of launching girder, lifting appliance, loose gear, hoist or building and other construction work, machinery and transport equipment at a construction site, such appliances, gear, hoist, machinery or equipment and the site of such occurrence shall, as far as practicable, be kept undisturbed until inspected by the Authorities;

14.2.7 Every notice given for fatal accidents or dangerous occurrences shall be followed by a written report to the concerned Authorities under Section 39 of BOCWA and the Director General in the specified Form XIV of BOCWR.

14.3 Accident investigation

14.3.1 General

14.3.1.1 Investigations should be conducted in an open and positive atmosphere that encourages the witnesses to talk freely. The primary objective is to ascertain the facts with a view to prevent future and possibly more serious occurrences

14.3.1.2 Accidents and Dangerous Occurrences which result in death, serious injury or serious damage must be investigated by the Contractor immediately to find out the cause of the accident/occurrence so that measures can be formulated to prevent any recurrence.

14.3.1.3 Near misses and minor accidents should also be investigated by the Contractor as soon as possible as they are signals that there are inadequacies in the safety management system.

14.3.2 Procedure of incident investigation

14.3.2.1 It is important after any accident or dangerous occurrence that information relating to the incident is gathered in an organized way. The following steps shall be followed;

Take photographs and make sketches

Examine involved equipment, workplace or material and the environmental conditions

Interview the injured, eye-witnesses and other involved parties

Consult expert opinion where necessary

Identify the specific contractor or sub-contractor involved.

14.3.2.2 Having gathered information; it is then necessary to make an analysis of incident

- a) Establish the chain of events leading to the accident or incident

- b) Find out at what stage the accident took place
- c) Consider all possible causes and the interaction of different factors that led up to the accident and identify the most probable cause. The cause of an accident should never be classified as carelessness. The specific act or omission that caused the accident must be identified.

14.3.2.3 The next stage is to proceed with the follow-up action

Report on the findings and conclusions

Formulate preventive measures to avoid recurrence

Publicise the findings and the remedial actions taken

14.4 Employers' independent incident investigation

- 14.4.1 In case of fatal / dangerous occurrence the Employer shall also conduct independent investigation. Contractor and his staff shall extend necessary co-operation and testify about the accident.
- 14.4.2 The contractor shall take every effort to preserve the scene of accident till the Employer completes the investigation.
- 14.4.3 All persons summoned by the Employer in connection to witness recording shall obey the instructions without delay. Any willful suppression of information by any person shall be removed from the site immediately and / or punishable as per relevant penalty clause.

15.0 EMERGENCY PREPAREDNESS PLAN

- 15.1 The Contractor shall prepare as required under Rule 36 of BOCWR, an Emergency Response Plan for all work sites as a part of the Contractor SHE Plan. The plan shall integrate the emergency response plans of the Contractor and all other subcontractors. The Emergency Response Plan shall be submitted for approval to the Director General. It shall detail the Contractor's procedures, including detailed communications arrangements, for dealing with all emergencies that could affect the Site. This includes where applicable, injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue.
- 15.2 The contractor shall ensure that an Emergency Response Plan is prepared to deal with emergencies arising out of:
 - i) Fire and explosion
 - ii) Collapse of lifting appliances and transport equipment
 - iii) Collapse of building, sheds or structure etc.
 - iv) Gas leakage or spillage of dangerous goods or chemicals
 - v) Bomb threatening, Criminal or Terrorist attack
 - vi) Drowning of workers

- vii) Landslides getting workers buried floods, Earthquake, storms and other natural calamities.
- 15.3 Arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.
- 15.4 Contractors shall require to tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.
- 15.5 Contractor shall conduct an onsite emergency mock drill once in every month for all his workers and his subcontractor's workers.
- 15.6 It shall be the responsibility of the contractor to keep the Local Law & Order Authorities informed and seek urgent help, as the case may be, so as to mitigate the consequences of an emergency. Prompt communication to K-RIDE, telephonically initially and followed by a written report, shall be made by the contractor.
- 16.0 EXPERTS/AGENCIES FOR SHE SERVICES**
- 16.1 Contractors may utilise the services of experts/agencies empanelled under Rule 250 of BOCWR for the purpose of training, internal audit and any other SHE services with prior approval of the Employer.
- 16.2 As an aide to contractors, a list of experts/agencies and the offered service are given in General Instruction **K-RIDE/SHE/CEO/010** for ready reference. In addition to it if the contractor would like to use any expert/agencies' services for any SHE activities the same can also be allowed provided that they are competent and meet to the general requirements of Employer. In every case prior approval of the Employer is mandatory.

PART – II SAFETY

17.0 HOUSEKEEPING

- 17.1 Housekeeping is the act of keeping the working environment cleared of all unnecessary waste, thereby providing a first-line of defense against accidents and injuries.
- 17.2 Contractor shall understand and accept that improper housekeeping is the primary hazard in any construction site and ensure that a high degree of housekeeping is always maintained. Indeed “Cleanliness is indeed next to Godliness”
- 17.3 Housekeeping is the responsibility of all site personnel, and line management commitment shall be demonstrated by the continued efforts of supervising staff towards this activity.
- 17.4 General Housekeeping shall be carried out by the contractor and ensured at all times at Work Site, Construction Depot, Batching Plant, Labour Camp, Stores, Offices and toilets/urinals. Towards this the Contractor shall constitute a special group of housekeeping personnel as per General Instruction **K-RIDE/SHE/CEO/001**. This group shall ensure daily cleaning at work sites and surrounding areas and maintain a register as per the approved format by the Employer.
- 17.5 Adequate time shall be assigned to ensure that good housekeeping is maintained. Team of housekeeping squad shall carry out this.
- 17.6 The contractor shall be responsible to provide segregated containers for disposal of debris at required places and regular cleaning of the same.
- 17.7 Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the surrounding area from excavated soil, rubbish etc., which may cause inconvenience to and endanger the public. The barricade especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the Employer. These shall be maintained in one line and level.
- 17.8 The structure dimension of the barricade, material and composition, its colour scheme, K-RIDE logo and other details shall be in accordance with specifications laid down in tender document.
- 17.9 All stairways, passageways and gangways shall be maintained without any blockages or obstructions. All emergency exits passageways, exits fire doors, break-glass alarm points, fire fighting equipment, first aid stations, and other emergency stations shall be kept clean, unobstructed and in good working order.

- 17.10 Lumber with protruding nails shall be bent or removed and properly stacked.
- 17.11 All surplus earth and debris are removed/disposed of from the working areas to officially designated dumpsites. Trucks carrying sand, earth and any pulverized materials etc. in order to avoid dust or odour impact shall be covered while moving.
The tyres of the trucks leaving the site shall be cleaned with water, wherever the possibility of spillage on carriageways meant for regular road traffic exists.
- 17.12 No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.
- 17.13 Roads shall be kept clear and materials like: pipes, steel, sand boulders, concrete, chips and brick etc. shall not be allowed on the roads to obstruct free movement of road traffic.
- 17.14 Water logging or bentonite spillage on roads shall not be allowed. If bentonite spillage is observed on road endangering the safety of road users, the contractor shall be penalized as per relevant clause.
- 17.15 Proper and safe stacking of material are of paramount importance at yards, stores and such locations where material would be unloaded for future use. The storage area shall be well laid out with easy access and material stored / stacked in an orderly and safe manner.
- 17.16 Flammable chemicals / compressed gas cylinders shall be safely stored.
- 17.17 Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas shall be removed to identified locations(s).
- 17.18 All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified location(s).
- 17.19 Empty cement bags and other packaging material shall be properly stacked and removed.
- 17.20 The Contractor shall ensure that all his sub-contractors maintain the site reasonably clean through provisions related to house keeping

18.0 WORKING AT HEIGHT

18.1 Definitions

18.1.1 "Access" and "egress" include ascent and descent.

- 18.1.2 "Fragile surface" means a surface, which would be able to fail if any reasonably foreseeable loading were to be applied to it.
- 18.1.3 "Line" includes rope, chain or webbing
- 18.1.4 "Personal fall protection" means -
- a) a fall prevention, work restraint, work positioning, fall arrest or rescue system, other than a system in which the only safeguards are collective safeguards; or
 - b) Rope access and positioning techniques;
- 18.1.5 "Work at height" means -
- a) Work in any place, including a place at or below ground level;
 - b) Obtaining access to or egress from such place while at work, except by a staircase in a permanent workplace,

Where, if protective measures were not taken, a person could fall a distance liable to cause personal injury;
- 18.1.6 "Work equipment" means any machinery, appliance, apparatus, tool or installation for use at work (whether exclusively or not) and includes
- a) A guard-rail, toe-board, barrier or similar collective means of protection
 - b) A working platform
 - c) A net, airbag or other collective safe guard for arresting falls.
 - d) Personal fall protection system
 - e) Ladders
- 18.1.7 "Working platform"
- a) means any platform used as a place of work or as a means of access to or egress from a place of work;
 - b) Includes any scaffold, suspended scaffold, cradle, mobile platforms, trestle, gangway, gantry and stairway which is so used
- 18.2 Organisation and planning
- The contractor shall ensure that work at height is
- i) properly planned for any emergencies and rescue
 - ii) appropriately supervised; and
 - iii) Carried out in a manner, which is reasonably practicable safe.

- 18.3 The contractor shall ensure that work at height is carried out only when the weather conditions do not jeopardize the health or safety of persons involved in the work.
- 18.4 **Competence**
The contractor shall ensure that no person engages in any activity, including organization, planning and supervision, in relation to work at height or work equipment for use in such work unless he is competent to do so or, if being trained, is being supervised by a competent person.
- 18.5 **Avoidance of risks from work at height**
The contractor shall ensure that work is not carried out at height where it is reasonably practicable to carry out the work safely otherwise than at height.
- 18.6 Where work is carried out at height, the contractor shall take suitable and sufficient measures as given below to prevent, so far as is reasonably practicable, any person **falling a distance liable to cause personal injury**.
- a) His ensuring that the work is carried out
 - i) from an existing place of work; or
 - ii) (in the case of obtaining access or egress) using an existing means, complying to the requirements as given in clause **18.15**.
Where it is reasonably practicable to carry it out safely and under appropriate ergonomic conditions; and
 - b) where it is not reasonably practicable for the work to be carried out in accordance with sub-paragraph (a), his providing sufficient work equipment for preventing, so far as is reasonably practicable, a fall occurring.
- 18.7 Where the measures taken under clause **18.6** do not eliminate the risk of a fall occurring, every contractor shall
- a) so far as is reasonably practicable, provide sufficient work equipment to minimize -
 - i) the distance and consequences; or
 - ii) where it is not reasonably practicable to minimize the distance, the consequences, of a fall; and
 - b) Without prejudice to the generality of clause **18.4** provide such additional training and instruction or take other additional suitable and sufficient measures to prevent, so far as is reasonably practicable, any person falling a distance liable to cause personal injury.

18.8 Selection of 'work equipment' for work at height

- 1) The contractor, in selecting work equipment for use in work at height, shall
 - a) give collective protection measures priority over personal protection measures; and
 - b) take account of
 - i) the working conditions and the risks to the safety of persons at the place where the work equipment is to be used;
 - ii) in the case of work equipment for access and egress, the distance to be negotiated;
 - iii) the distance and consequences of a potential fall;
 - iv) the duration and frequency of use;
 - v) the need for easy and timely evacuation and rescue in an emergency; and
 - vi) any additional risk posed by the use, installation or removal of that work equipment or by evacuation and rescue from it;

- 2) The contractor shall select work equipment for work at height which:
 - a) Has characteristics including dimensions which:
 - i) are appropriate to the nature of the work to be performed and the foreseeable loadings; and
 - ii) allow passage without risk; and
 - b) Is in other respects the most suitable work equipment, having regard in particular to the purposes specified in **18.5** and **18.6**.

18.9 Fragile surfaces

18.9.1 The contractor shall ensure that no person at work passes across or near, or working on, from or near, a fragile surface where it is reasonably practicable to carry out work safely and under appropriate ergonomic conditions without his doing so.

18.9.2 Where it is not reasonably practicable to carry out work safely and under appropriate ergonomic conditions without passing across or near, or working on, from or near, a fragile surface, every contractor shall,

- a) ensure, so far as is reasonably practicable, that suitable and sufficient platforms, coverings, guard rails or similar means of support or protection are provided and used so that any foreseeable loading is supported by such supports or borne by such protection;

- b) Where a risk of a person at work falling remains despite the measures taken under the preceding provisions of this regulation, take suitable and sufficient measures to minimize the distances and consequences of his fall.

- 18.9.3 Where any person at work may pass across or near, or work on, from or near, a fragile surface, every contractor shall ensure that
 - a) prominent warning notices are so far as is reasonably practicable affixed at the approach to the place where the fragile surface is situated; or
 - b) Where that is not reasonably practicable, such persons are made aware of it by other means.

- 18.10 Falling objects

- 18.10.1 The contractor shall, where necessary to prevent injury to any person, take suitable and sufficient steps to prevent, so far as is reasonably practicable, the fall of any material or object.

- 18.10.2 Where it is not reasonably practicable to comply with the requirements of **18.9**, every contractor shall take suitable and sufficient steps to prevent any person being struck by any falling material or object which is liable to cause personal injury.

- 18.10.3 The contractor shall ensure that no material or object is thrown or tipped from height in circumstances where it is liable to cause injury to any person.

- 18.10.4 Every employer shall ensure that materials and objects are stored in such a way as to prevent risk to any person arising from the collapse, overturning or unintended movement of such materials or objects.

- 18.11 Danger areas

- 18.11.1 Without prejudice to the preceding requirements of these Regulations, every contractor shall ensure that
 - a) Where a workplace contains an area in which, owing to the nature of the work, there is a risk of any person at work
 - i) Falling a distance; or
 - ii) Being struck by a falling object,
 which is liable to cause personal injury, the workplace is so far as is reasonably practicable equipped with devices preventing unauthorised persons from entering such area; and

- b) Such area is clearly indicated.
- 18.12 Inspection of work equipment
- 18.12.1 The contractor shall ensure that, where the safety of work equipment depends on how it is installed or assembled, it is not used after installation or assembly in any position unless it has been inspected in that position.
 - 18.12.2 The contractor shall ensure that work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is inspected
 - a) At suitable intervals; and
 - b) Each time that exceptional circumstances which are liable to jeopardize the safety of the work equipment have occurred, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.
 - 18.12.3 Without prejudice to paragraph **18.12.1**, the contractor shall ensure that a working platform
 - a) Used for construction work; and
 - b) From which a person could fall 2 meters or more,Is not used in any position unless it has been inspected in that position or, in the case of a mobile working platform, inspected on the site, within the previous 7 days.
 - 18.12.4 The contractor shall ensure that the reports of all inspections are properly maintained and shown to the Employer as and when required.
 - 18.12.5 In this clause "inspection",
 - a) Means such visual or more rigorous inspection by a competent person as is appropriate for safety purposes;
 - b) Includes any testing appropriate for those purposes,
- 18.13 Inspection of places of work at height
- 18.13.1 The contractor shall so far as is reasonably practicable ensure that the surface and every parapet, permanent rail or other such fall protection measure of every place of work at height are checked on each occasion before the place is used.
- 18.14 Duties of persons at work
- 18.14.1 Any workmen employed by the contractor shall report to the supervisor about any defect relating to work at height which he knows is likely to endanger the safety of himself or another person.

18.14.2 Every workman shall use any work equipment or safety device provided to him for work at height by the contractor, in accordance with

- a) any training in the use of the work equipment or device concerned which have been received by him; and
- b) the instructions respecting that use which have been provided to him by the contractor as per the requirements of the Employer

18.15 Requirements for existing places of work and means of access or egress at height Every existing place of work or means of access or egress at height shall

- a) be stable and of sufficient strength and rigidity for the purpose for which it is intended to be or is being used;
- b) where applicable, rest on a stable, sufficiently strong surface;
- c) be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work to be carried out there;
- d) possess suitable and sufficient means for preventing a fall;
- e) possess a surface which has no gap
 - i) through which a person could fall;
 - ii) through which any material or object could fall and injure a person; or
 - iii) giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk;
- f) be so constructed and used, and maintained in such condition, as to prevent, so far as is reasonably practicable -
 - i) the risk of slipping or tripping; or
 - ii) any person being caught between it and any adjacent structure;
- g) where it has moving parts, be prevented by appropriate devices from moving inadvertently during work at height.

18.16 Requirements for guardrails, toe-boards, barriers and similar collective means of protection

- i) Unless the context otherwise requires, any reference in this section to means of protection is to a guardrail, toe-board, barrier or similar collective means of protection.
- ii) Means of protection shall
 - a) be of sufficient dimensions, of sufficient strength and rigidity for the purposes for which they are being used, and otherwise suitable;
 - b) be so placed, secured and used as to ensure, so far as is reasonably practicable, that they do not become accidentally displaced; and

- c) be so placed as to prevent, so far as is practicable, the fall of any person, or of any material or object, from any place of work.
- iii) In relation to work at height involved in construction work
 - a) the top guard-rail or other similar means of protection shall be at least 950 millimeters above the edge from which any person is liable to fall;
 - b) toe-boards shall be suitable and sufficient to prevent the fall of any person, or any material or object, from any place of work; and
 - c) any intermediate guardrail or similar means of protection shall be positioned so that any gap between it and other means of protection does not exceed 470 millimeters.
- iv) Any structure or part of a structure which supports means of protection or to which means of protection are attached shall be of sufficient strength and suitable for the purpose of such support or attachment.

18.17 Requirements for all Working Platforms

- i) Every working platforms requires a supporting structure for holding it
- ii) Any surface upon which any supporting structure rests shall be stable, of sufficient strength and of suitable composition safely to support the supporting structure, the working platform and any loading intended to be placed on the working platform.
- iii). Stability of supporting structure
Any supporting structure shall
 - a) be suitable and of sufficient strength and rigidity for the purpose for which it is being used;
 - b) in the case of a wheeled structure, be prevented by appropriate devices from moving inadvertently during work at height;
 - c) in other cases, be prevented from slipping by secure attachment to the bearing surface or to another structure, provision of an effective anti-slip device or by other means of equivalent effectiveness;
 - d) be stable while being erected, used and dismantled; and
 - e) when altered or modified, be so altered or modified as to ensure that it remains stable.
 - f) Have suitable base plates and properly footed thereby.
- iv). Stability of working platforms
A working platform shall
 - a) be suitable and of sufficient strength and rigidity for the purpose or purposes for which it is intended to be used or is being used;
 - b) be so erected and used as to ensure that its components do not become accidentally displaced so as to endanger any person;

- c) when altered or modified, be so altered or modified as to ensure that it remains stable; and
 - d) be dismantled in such a way as to prevent accidental displacement.
- v) Safety on working platforms
- A working platform shall
- a) be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work being carried out there;
 - b) possess a suitable surface and, in particular, be so constructed that the surface of the working platform has no gap
 - i) through which a person could fall;
 - ii) through which any material or object could fall and injure a person; or
 - iii) giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk; and
 - c) be so erected and used, and maintained in such condition, as to prevent, so far as is reasonably practicable
 - i) the risk of slipping or tripping; or
 - ii) any person being caught between the working platform and any adjacent structure.
- vi) Loading
- A working platform and any supporting structure shall not be loaded so as to give rise to a risk of collapse or to any deformation, which could affect its safe use.
- vii) Additional requirements for scaffolding
- Strength and stability calculations for scaffolding shall be carried out unless
- a) a note of the calculations, covering the structural arrangements contemplated, is available; or
 - b) it is assembled in conformity with a generally recognized standard configuration.
- viii) Depending on the complexity of the scaffolding selected, a competent person shall draw up an assembly, use and dismantling plan. This may be in the form of a standard plan, supplemented by items relating to specific details of the scaffolding in question.
- ix) A copy of the plan, including any instructions it may contain, shall be kept available for the use of persons concerned in the assembly, use, dismantling or alteration of scaffolding until it has been dismantled.

- x) The dimensions form and layout of scaffolding decks shall be appropriate to the nature of the work to be performed and suitable for the loads to be carried and permit work and passage in safety.
- xi) While a scaffold is not available for use, including during its assembly, dismantling or alteration, it shall be marked with general warning signs in accordance with and be suitably delineated by physical means preventing access to the danger zone.
- xii) Scaffolding may be assembled, dismantled or significantly altered only under the supervision of a competent person and by persons who have received appropriate and specific training in the operations envisaged which addresses specific risks which the operations may entail and precautions to be taken, and more particularly in
 - a) understanding of the plan for the assembly, dismantling or alteration of the scaffolding concerned;
 - b) safety during the assembly, dismantling or alteration of the scaffolding concerned;
 - c) measures to prevent the risk of persons, materials or objects falling;
 - d) safety measures in the event of changing weather conditions which could adversely affect the safety of the scaffolding concerned;
 - e) permissible loadings;
 - f) any other risks which the assembly, dismantling or alteration of the scaffolding may entail.

18.18 Requirements for collective safeguards for arresting falls

- i) Collective safeguard area by safety net, airbag or other collective safeguard for arresting falls
- ii) A safeguard shall be used only if
 - a) a risk assessment has demonstrated that the work activity can so far as is reasonably practicable be performed safely while using it and without affecting its effectiveness;
 - b) the use of other, safer work equipment is not reasonably practicable; and
 - c) a sufficient number of available persons have received adequate training specific to the safeguard, including rescue procedures.
- iii) A safeguard shall be suitable and of sufficient strength to arrest safely the fall of any person who is liable to fall.
- iv) A safeguard shall

- a) in the case of a safeguard which is designed to be attached, be securely attached to all the required anchors, and the anchors and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of safely supporting the foreseeable loading in arresting any fall and during any subsequent rescue;
 - b) in the case of an airbag, landing mat or similar safeguard, be stable; and
 - c) in the case of a safeguard, which distorts in arresting a fall, afford sufficient clearance.
- (v) Suitable and sufficient steps shall be taken to ensure, so far as practicable, that in the event of a fall by any person the safeguard does not itself cause injury to that person.

18.19 Requirements for personal fall protection systems

- i) A personal fall protection system shall be used only if
 - a) a risk assessment has demonstrated that
 - i) the work can so far as is reasonably practicable be performed safely while using that system; and
 - ii) the use of other safer work equipment is not reasonably practicable; and
 - b) the user and a sufficient number of available persons have received adequate training specific to the operations envisaged, including rescue procedures.
- ii) A personal fall protection system shall
 - a) be suitable and of sufficient strength for the purposes for which it is being used having regard to the work being carried out and any foreseeable loading;
 - b) where necessary, fit the user;
 - c) be correctly fitted;
 - d) be designed to minimise injury to the user and, where necessary, be adjusted to prevent the user falling or slipping from it, should a fall occur; and
 - e) be so designed, installed and used as to prevent unplanned or uncontrolled movement of the user.
- iii) A personal fall protection system designed for use with an anchor shall be securely attached to at least one anchor, and each anchor and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of supporting any foreseeable loading.
- iv) Suitable and sufficient steps shall be taken to prevent any person falling or slipping from a personal fall protection system.

18.20 Requirements for Ladders

- 1) Every contractor shall ensure that a ladder is used for work at height only if a risk assessment has demonstrated that the use of more suitable work equipment is not justified because of the low risk and
 - i) The short duration of use; or
 - ii) Existing features on site, which he cannot alter.
- 2) Only metal ladders shall be allowed. Bamboo ladders are prohibited.
- 3) Any surface upon which a ladder rests shall be stable, firm, of sufficient strength and of suitable composition safely to support the ladder so that its rungs or steps remain horizontal, and any loading intended to be placed on it.
- 4) A ladder shall be so positioned as to ensure its stability during use
- 5) A suspended ladder shall be attached in a secure manner and so that, with the exception of a flexible ladder, it cannot be displaced and swinging is prevented.
- 6) A portable ladder shall be prevented from slipping during use by -
 - i) securing the stiles at or near their upper or lower ends;
 - ii) an effective anti-slip or other effective stability device; or
 - iii) any other arrangement of equivalent effectiveness.
- 7) A ladder used for access shall be long enough to protrude sufficiently above the place of landing to which it provides access, unless other measures have been taken to ensure a firm handhold.
- 8) No interlocking or extension ladder shall be used unless its sections are prevented from moving relative to each other while in use.
- 9) A mobile ladder shall be prevented from moving before it is stepped on.
- 10) Where a ladder or run of ladders raises a vertical distance of 9 metres or more above its base, there shall, where reasonably practicable, be provided at suitable intervals sufficient safe landing areas or rest platforms.
- 11) Every ladder shall be used in such a way that
 - a) A secure handhold and secure support are always available to the user; and
 - b) The user can maintain a safe handhold when carrying a load unless, in the case of a step ladder, the maintenance of a handhold is not practicable when a load is carried, and a risk assessment has demonstrated that the use of a stepladder is justified because of
 - i) the low risk; and
 - ii) the short duration of use.

19.0 OVERHEAD PROTECTION

All contractors shall provide overhead protections as per Rule 41 of BOCWR

- i) Overhead protection should be erected along the periphery of every building which is under construction and the building height shall be 15m or above after construction.

- ii) Overhead protection shall be minimum 2m wide and the outer edge shall be 150mm higher than the inner edge and an angle not more than 20° to its horizontal sloping into the building.
- iii) Overhead protection shall not be erected more than a height of 5m from the base of the building.
- iv) Areas of inadvertent hazard of falling of material shall be guarded or barricaded or roped-off thereby by the contractor.

20.0 SLIPPING, TRIPPING, CUTTING, DROWNING AND FALLING HAZARDS

As per Rule 42 of BOCWR,

- i) All places should be free from dust, debris or similar materials.
- ii) Sharp projections or any protruding nails or similar objects shall be suitably guarded or shall even be avoided to make the place safe to work.
- iii) Contractor shall not allow workmen to work or use platforms, scaffolds/passageways or any walkways, which has water, or oil or similar substances spilt and has a slipping hazard, unless it is cleaned off or covered or sanded or saw dusted or make it safe with any suitable material.
- iv) When workers are exposed to areas where fall into water is possible, the contractor shall provide suitable and adequate equipment for saving the workers from drowning and rescuing from such hazard. If the Employer considers, the contractor shall provide well-equipped boat or launch, manned with trained personnel at the work place.
- v) Open side or opening where worker, equipment, vehicle or lifting appliance may fall at a building or outside shall be guarded suitably except in places of free access by reasons of nature of work.
- vi) Suitable safety net shall be provided at places of material / man falling is possible in accordance with national standards.

21.0 LIFTING APPLIANCES AND GEAR

21.1 Lifting appliances means a crane, hoist machinery, derrick, winch, gin pole, sheer legs, jack, hoist drum, slewing machinery, slewing bearing fasteners, luffing machinery sheaves, pulley blocks, hooks or other equipment used for lifting materials, objects or building workers and lifting gears means ropes, chain slings, shackles, hooks, lifting lugs, wire ropes, lifting eyebolts and eye nuts and other accessories of a lifting appliance.

21.2 No machine shall be selected to do any lifting on a specific job until its size and characteristics are considered against:

- i) the weights, dimensions and lift radii of the heaviest and largest loads
- ii) the maximum lift height, the maximum lift radius and the weight of the loads that must be handled at each

- iii) the number and frequency of lifts to be made
 - iv) how long the crane will be required on site
 - v) the type of lifting to be done (for example, is precision placement of loads important?)
 - vi) the type of carrier required (this depends on ground conditions and machine capacity In its operating quadrants) capacity is normally greatest over the rear, less over the side, and non-existent over the front
 - vii) whether loads will have to be walked or carried
 - viii) whether loads will have to be suspended for lengthy periods
 - ix) the site conditions, including the ground where the machine will be set up, access roads and ramps it must travel, space for erection and any obstacles that might impede access or operation
- 21.3 The contractor shall ensure that a valid certificate of fitness issued as per clause **21.5** is available for all lifting appliances including synchronized mobile jacks, pre-stressing hydraulic jacks, jacks fitted with launching girders etc. and Employers approval before inducting to the site. **Only after obtaining the approval from the Employer any lifting appliances and gear shall be used.**
- 21.4 The laminated photocopies of fitness certificate issued by competent person, the Employers' approval letter, the operators' photo, manufacturer's load chart and competency certificate shall always be either kept in the operator cabin or pasted on the visible surface of the lifting appliances.
- 21.5 All lifting appliances and loose gears shall be clearly marked for its safe working load and identification by stamping or other suitable means.
- 21.6 The contractor shall also maintain a register containing a system of identification of all tools and tackles, its date of purchase, safe working load, competent person date of examination etc.
- 21.7 Test and periodical examination of lifting appliances and gears
- 21.7.1 All lifting appliances including all parts and gears thereof, whether fixed or movable shall be thoroughly tested and examined by a competent person once at least in every six months or after it has undergone any alterations or repairs liable to affect its strength or stability. Within the validity, if the lifting appliances are shifted to a new site, re-examination by the same competent person for ensuring its safety shall also be done.
- 21.7.2 Contractors can utilize the services of any competent person as defined in Factories Act, 1948 and approved by Chief Inspector of Factories with the permission of the Employer.

21.7.3 All alarms and signals like automatic safe load indicators (SLI), boom angle indicators, boom extension indicators, over lift boom alarm, swing alarm, hydraulic safety valves, mechanical radius indicators, load moment indicators etc. shall be periodically examined and maintained always in working condition

21.8 Automatic safe load indicators

21.8.1 As stipulated in Rule 78 of BOCWKR 2006, no lifting appliances gear or any other material handling appliance is used, if:

- i) the Inspector having jurisdiction is not satisfied with reference to a certification of test or examination or to an authenticated record maintain as provided under these rules; and
- ii) in the view of such Inspector, the lifting appliance, lifting gear or any other material handling appliance is not safe for use in building or other construction work; and
- iii) no pulley block is used in building or other construction work unless the safe working load and its identification are clearly marked on such block.

21.9 Qualification of operator of lifting appliances and of signaler etc.

21.9.1 The contractor shall not employ any person to drive or operate a lifting machine like crane, hydra etc. whether driven by mechanical power or otherwise or to give signals to work as an operator of a rigger or derricks unless he

- i) is above twenty-one years of age and possesses a valid heavy transport vehicle driving licence as per Motor Vehicles Act, 1988 and Rules therein.
- ii) is absolutely competent and reliable
- iii) possesses the knowledge of the inherent risks involved in the operation of lifting appliances by undergoing a formal training at any institution of national importance acceptable to Employer
- iv) is medically examined periodically as specified in schedule VII of BOCWR.

21.10 General requirements of appliances

21.10.1 Out-of level

21.10.1.1 One of the most severe effects of being out-of fit level is that side loads develop in the boom. Because of side loads all mobile cranes lose capacity rapidly as the degree of out-of-level increases and therefore

21.10.2 Boom

- i) The boom is one of the more critical elements of the crane and must be in perfect condition at all time. No boom section with a bent lattice member shall be allowed
 - ii) All welds shall be crack and corrosion free
 - iii) No member of the boom shall be bent
 - iv) All telescopic boom shall be free from cracks, rust, flaking or cracked paint, bulges, greases or varnishes
- 21.10.3 The sweep area (work area) of the construction machinery shall be always free from obstructions.
- 21.10.4 All hydraulic piping and fittings shall be maintained leak proof.
- 21.10.5 The operator cab shall possess good and safe:
- i) structure, windows and windshield wipers
 - ii) Drivers chair and foot rest
 - iii) Control handles
 - iv) Cab instrumentation
 - v) Telecommunication
 - vi) Cab out fitting
 - vii) wind indicator with an adjustable set point shall be in a position representative for the wind on the crane. The indicator shall give continuous information regarding constant speeds and gusts.
- 21.11 Mandatory rigging requirements
- 21.11.1 Rigging shall be done under experienced and qualified rigger only.
- 21.11.2 The primary requirement in rigging shall be to assess the weight of load before attempting any lift.
- 21.11.3 All hooks shall be fitted with Master Rings having certificate of fitness from the competent person, so that the hooks are subjected to balanced vertical loading only.
- 21.11.4 Only four legged slings shall be allowed which includes master link (ring), intermediate master link (ring) if necessary, chain / wire rope sling, sling hook or other terminal fitting.
- 21.11.5 Hand spliced slings up to 32mm diameter shall not be used at site for any lifting purpose.
- 21.11.6 No load shall be slewed over public areas without stopping the pedestrians and road traffic first.

- 21.11.7 Requirements of outriggers
- i) All outriggers shall be fully extended and at all tyres are clear of the ground
 - ii) Heavy duty blocking having large bearing area shall be necessary to prevent sinking of floats
- 21.11.8 All loads shall have tag-lines attached in order to ensure that the load can be controlled at all times.
- 21.11.9 No close working to any live overhead power line is permitted without the operation of a strict Permit to Work.
- 21.11.10 Minimum lighting is to be ensured at all lifting operations.
- 21.12 Failure to do any of the above shall attract penalty from the Employer as per relevant clause

22.0 LAUNCHING OPERATION

- 22.1 As launching operation is one of the riskiest job, the contractor shall take utmost precaution at all stages like; planning, establishing casing yard, casting segments, transporting segments, fabrication and erection of launching girders, launching of segments, pre-stressing, auto launching of girders and dismantling of launching girders.
- 22.2 The contractor shall prepare a comprehensive Method Statement for the launching operation, adhering to the SHE conditions laid down in conditions of contract on SHE and project SHE manual. Particular reference shall be made to the provisions on working at height. As the entire process of launching has to be undertaken at an elevated level, the safety of workers and the girder is paramount important. The following general guidelines shall be adhered throughout the launching operation.
- i) Necessary 'working platforms' and fall protection anchorage arrangement shall be provided in the launching girder itself.
 - ii) Provisions for mounting light fittings shall also be made available in the launching girder.
 - iii) The casting yard shall be established ensuring the provision given in clause **38.0**
 - iv) The workmen engaged in fabrication of reinforcement, concreting the segment shall be provided with necessary PPEs including compulsory hand protection gloves.
 - v) Casting and curing of segment shall be undertaken under the direct supervision of the responsible engineer of the contractor.
 - vi) Trucks with valid registration, licence, safe worthiness certificate, Employer's approval certificate, and pollution under check certificate shall only be used for transport of segments

- vii) Drivers engaged for driving these trucks, shall be trained once in 6 months at specified locations as directed by the employer on defensive driving.
- viii) Drivers shall also have undergone proper medical examination as per relevant clause mentioned under 'Medical Facilities'.
- ix) The segments shall rigidly secured to the truck with necessary wooden wedges and necessary red indicators/safety tapes provided so that the vehicle is clearly seen by other road users both in day / night time.
- x) Every launching girder shall have a responsible engineer on duty all the time.
- xi) All the time from erection to dismantling the area between the two piers wherein launching is in progress shall always be barricaded.
- xii) Unloading of segments from trucks, lifting of segments, shifting of segments, gluing shall be done under the direct supervision of the approved engineer of the contractor.
- xiii) Auto launching shall be done only after approval from the Employer. After every auto launching the stability of launching girder shall be ensured.
- xiv) The vertical deflection of launching girder shall be monitored at all critical stages like with/without loads and after every auto launching.
- xv) A register containing all important operational details from erection to dismantling of launching girders shall be maintained and made available to Employer whenever called for.
- xvi) Test certificate for all lifting gears including Macalloy bars shall be maintained at a location closer to the launching girder itself so that it can be referred during all inspections.
- xvii) Adequate lighting at all-time shall be ensured in the entire area of operation.
- xviii) Access to drinking water & toilet shall be ensured to all workmen engaged for launching process.
- xix) Proper access ladders/stairways shall be maintained for safe ascending / descending of workmen / engineers.

22.3 Non-adherence to any of the clauses mentioned above shall be viewed seriously by the Employer and penalty levied as per relevant clause.

23.0 CONSTRUCTION MACHINERY

A large number of men and machinery are deployed by the contractors for Construction work, bridge rebuilding etc. It is therefore essential that adequate Safety measures are taken for safety of trains as well the workforce.

The following Measures should invariably adopt:

- (i) The contractor shall not start any work without the presence of K-RIDE Supervisor or his representative and contractors supervisor at site.
- (ii) Wherever the road vehicles and/or machinery are required to work in the close vicinity of railway line, the work shall be so carried out that there is no infringement to the railway's schedule of

dimensions. For this purpose, the area where road vehicles and/or machinery are required to ply, shall be demarcated and acknowledged by the contractor.

Special care shall be taken for turning / reversal of vehicles / machinery without infringing the Running track. Barricading shall be provided wherever justified and feasible as per site conditions.

- (iii) The look out and whistle caution orders shall be issued to the trains and speed restriction imposed where considered necessary. Suitable flagmen/ Detonators shall be provided where necessary for protection of trains.
- (iv) The supervisor / workmen should be counselled about safety measures.
A competency certificate to the contractor's supervisor as per proforma Annexed shall be issued by APM which will be valid only for the work which it has been issued.
- (v) The unloaded ballast / rails / sleepers / other P.Way materials after unloading Along track should be kept clear off moving dimensions and stacked as per the specified heights and distance from the running track.
- (vi) Supplementary site instructions, wherever considered necessary, shall be issued by the Engineer in Charge of K-RIDE.

The Engineer in-charge shall approve the methodology proposed to be adopted by the contractor, with a view to ensure safety of trains, passengers and workers and he shall also be ensure that the methods and arrangements are actually available at site before start of the work and the contractor's supervisors and the workers have clearly understood the safety aspect and requirements to be adopted / followed while executing the work. There shall be an assurance register kept at each site, which will have to be signed by both i.e.K-RIDE Supervisor or his representative as well as contractor's supervisor as a token of their having understood the safety precautions to be observed at site.”

23.1 Construction machineries may include dumpers and dump trucks, lift trucks and telescopic handlers piling rigs, vibro hammers, rail welding equipment's, mobile elevating work platforms, cranes, tipper lorries, lorry loaders, skip wagons, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, road rollers, locomotives, tankers and bowsers, trailers, hydraulic and mechanical breakers etc.

23.2 Safe worthiness certificate

23.2.1 Every construction equipment shall be in sound mechanical working condition and certified by either competent person under Factories Act or manufacturers' warranty in case of brand-new equipment's or authorized persons / firms approved by Employer before induction to any site.

- 23.2.2 Every such certificate shall have the date of purchase, main overhauling undertaken in the past, any accident to the equipment, visual examination details, critical components safety check, list of safety devices and its working condition, manufacturer's maintenance checklist, past projects wherein the equipment's were used etc. as its minimum content.
- 23.3 Reverse Horns
- 23.3.1 All Vehicles shall be fitted with audible reverse alarms and maintained in good working condition. Reversing shall be done only when there is adequate rear view visibility or under the directions of a banks man.
- 23.4 General operating procedures
- i) Drivers entering site shall be instructed to follow the safe system of work adopted on site. These shall be verbal instructions or, preferably, written instructions showing the relevant site rules, the site layout, delivery areas, speed limits, etc.
 - ii) No passengers shall be carried, unless specific seating has been provided in accordance with the manufacturers' recommendations.
 - iii) Working on gradients beyond any equipment's capability shall not be allowed.
 - iv) Prevention of dumper and dump truck accidents should be managed by providing wheel stops at a sufficient distance from the edges of excavations, spoil heaps, pits, etc.
 - v) The manufacturer's recommended bucket size must not be exceeded in excavators.
 - vi) If excavators operating on a gradient which cannot be avoided, it must be ensured that the working cycle is slowed down, that the bucket is not extended too far in the downhill direction, and that travel is undertaken with extreme caution. A large excavator must never be permitted to travel in a confined area, or around people, without a banksman to guide the driver, who should have the excavator attachment close in to the machine, with the bucket just clear of the ground. On wheeled excavators, it is essential that the tyres are in good condition and correctly inflated. If stabilizing devices are fitted, they should be employed when the machine is excavating.
 - vii) When the front shovel of the 180° backhoe loaders is being employed, the backhoe attachment shall be in its "travel" position, with the safety locking device in place.
 - viii) When operating the backhoe in poor ground conditions, the stabilizers tend to sink into the surface of the ground, reducing stability. Therefore, frequent checks shall be made for the stability of the machine. The loading shovel should always be lowered to the ground to stabilize the machine when the backhoe is employed.
 - ix) The netting operation of the skip wagons should be carried out prior to lifting the skip to reduce the risks of working on the rear platform
 - x) If a tractor dozer is employed on clearing scrub or felling trees, it shall be provided with adequate driver protection.

- xi) When two or more scrapers are working on the same job, a minimum distance of at least 25m shall be kept between them.
- xii) In case of hydraulic breakers, hydraulic rams and hoses shall be in good working condition

23.5 All wood working machines shall be fitted with suitable guards and devices such as top guard, riving knife, push stick, guards for drive belts and chains, and emergency stop switch easily accessible by the operator.

23.6 Penalty

23.6.1 If any of the above clauses are not adhered, penalty shall be imposed as per relevant clause depending upon the gravity of the unsafe act and or condition.

24.0 MACHINE AND GENERAL AREA GUIDING

24.1 The contractor shall ensure at the construction site all motors, cogwheels, chains and friction gearing, flywheels, shafting, dangerous and moving parts of machinery are securely fenced or legged. The fencing of dangerous part of machinery is not removed while such machinery is in motion or in use.

25.0 MANUAL LIFTING AND CARRYING OF EXCESSIVE WEIGHT

25.1 The contractor shall ensure at his construction site of a building or other construction work that no building worker lifts by hand or carries overhead or over his back or shoulders any material, article, tool or appliances exceeding in weight as said below as per Rule 38 of BOCWR, Unless aided by another building worker or device.

Person	Maximum weight in kg.
Adult man	55
Adult woman	30

25.2 No building worker aided by other building worker shall lift or carry weight higher than or exceeding the sum of total of maximum limits set out for each building worker separately as mentioned in the table above.

26.0 SITE ELECTRICITY

26.1 Competency of Electrical personnel:

26.1.1 The contractor shall employ qualified and competent electrical personnel as specified in general instruction **K-RIDE/SHE/CEO/001**.

26.2 Assessment of power

26.2.1 The contractor shall assess the size and location of the electrical loads and the manner in which they vary with time during the currency of the contract.

26.2.2 The contractor shall elaborate as to how the total supply is to be obtained / generated. The details of the source of electricity, earthing requirement, substation / panel boards, distribution system shall be prepared and necessary approval from Employer obtained before proceeding of the execution of the job.

26.2.3 The main contractor shall take consideration, the requirements of the sub / petty contractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators.

26.2.4 As the sub / petty contractors' small capacity generators create more noise and safety hazard, no small capacity diesel generators shall be allowed for whatsoever the type of job to be executed under this contract.

26.2.5 If any unsafe noise making small capacity diesel generators are found used by sub / petty contractors the main contractor shall only be penalized.

26.3 Work on site

26.3.1 The contractor shall also submit electrical single line diagram, schematic diagram and the details of the equipment for all temporary electrical installation and these diagrams together with the temporary electrical equipment shall be submitted to the Employer's for necessary approval. Failure to do so shall invite penalty as per relevant clause.

26.4 Strength and capability of electrical equipment

26.4.1 No electrical equipment shall be put into use where its strength and capability may be exceeded in such a way as may give rise to danger.

26.5 Adverse or hazardous environments

26.5.1 Electrical equipment, which may reasonably foreseeably be exposed to-

- (a) Mechanical damage;
- (b) The effects of the weather, natural hazards, temperature or pressure;
- (c) The effects of wet, dirty, dusty or corrosive conditions; or
- (d) any flammable or explosive substance, including dusts, vapors or gases, shall be of such construction or as necessary protected as to prevent, so far as is reasonably practicable, danger arising from such exposure.

26.6 Distribution system:

26.6.1 The contractor shall provide distribution system for control and distribution of electricity from a main AC supply of 50Hz for typical appliances,

- i) Fixed plant – 400V 3 phase
- ii) Movable plant fed via trailing cable over 3.75 kW – 400 3 phase
- iii) Installation in site buildings – 230V single phase
- iv) Fixed flood lighting – 230V single phase
- v) Portable and hand tools – 115V single phase
- vi) Site lighting - 115V single phase
- vii) Portable hand lamps – 115V single phase

26.7 Electrical protection circuits

26.7.1 Precautions shall be taken, either by earthing or by other suitable means, to prevent danger arising when any conductor (other than a circuit conductor) which may reasonably foreseeable become charged as a result of either the use of a system, or a fault in a system, becomes so charged. A conductor shall be regarded as earthed when conductors of sufficient strength and current-carrying capability to discharge electrical energy to earth connect it to the general mass of earth.

If a circuit conductor is connected to earth or to any other reference point, nothing which might reasonably be expected to give rise to danger by breaking the electrical continuity or introducing high impedance shall be placed in that conductor unless suitable precautions are taken to prevent that danger.

26.7.2 Appropriate electrical protection shall be provided for all circuits, against over load, short circuit and earth fault current.

- 26.7.3 The contractor shall provide sufficient ELCBs (maintain sensitivity 30 mA) / RCCBs for all the equipment's (including Potable equipment's), electrical switchboards, distribution panels etc. to prevent electrical shocks to the workers.
- 26.7.4 All protection devices shall be capable of interrupting the circuit without damage to any equipment's and circuits in case of any fault may occur.
- 26.7.5 Rating of fuses and circuit breakers used for the protection of circuits should be coordinate with equipment power ratings.
- 26.7.6 Protection against lightning shall be ensured to all equipment kept in open at sites.
- 26.7.7 Cables:

Before starting any excavation work adjacent to existing track, the contractor shall ensure that necessary permissions has been obtained and required precautions have been taken for doing such work in terms Joint Procedure Order (JPO). The penalties mentioned in the following JPO shall be levied on the contractor if such event occurs. The JPO is reproduced below:

“JOINT PROCEDURE ORDER FOR UNDERTAKING DIGGING WORK IN THE VICINITY OF UNDERGROUND SIGNALING, ELECTRICAL AND TELECOMMUNICATION CABLES”

- a) A number of Engineering works in connection with gauge conversion/doubling/third line are in progress on various railways, which require extensive digging work near the running track, in close vicinity of the working S&T cables carrying vital safety circuits as well as electrical cables feeding the power supply to cabins. ASM room, RRI Cabin, Intermediate Block Huts (IBH) etc. Similarly, S&T organization under open line or construction units under CAO/C, are executing various Signaling and Telecom works requiring digging of earth for laying of cables or casting of foundations for the erection of signal posts etc. RailTel is also executing the work of lying of quad cable and OFC on various Railways as a part of sanctioned works for exclusive use of Railways for carrying voice and data i.e., administrative and control communication, PRS, FOIS etc. or shared by RailTel Corporation of India Ltd. On certain sections, digging is also required for lying of electrical cable and casting of foundation for the erection of OHE masts by Electrical Dept. Generally, contractors employed by these organizations execute these works.
- b) However, while carrying out these works near working signaling, telecommunication and electrical cables, at times, cable cuts take place due to JCB machines working along the track or during the digging work being done by contractors carrying out the Civil Engineering Works. Similarly, such cable cuts are also resulting due to works undertaken by S&T or Electrical departments. Such cable faults result in the failure of vital signaling and telecommunication circuits & electrical installations.

- c) Henceforth, the following joint procedure shall be followed by Engineering, Electrical and S&T (and RailTel organization, wherever such works are being done by them) officers of the respective divisions and by the construction organization, while carrying out any digging work near to existing signaling & telecommunication and electrical cables, so that the instances of cable cut due to execution of works, can be controlled and minimized.
1. S&T Department (and RailTel, where they have laid the cables) and Electrical department shall provide a detailed cable route plan showing exact location of cable at an interval of 200m or wherever there is change in alignment so that the same is located easily by the Engineering official/contractor. In addition, S&T department and Electrical department shall also provide cable markers along the alignment of the cable. Sr. DSTE/DSTE or Sr. DEE/DEE of the divisions or Dy.CSTE/C or Dy.CEE/C shall make these cable route plans available to the Sr.DEN/DEN or Dy.CE/C, as the case may be, within 15 days in duplicate. Sr.DEN/DEN or Dy.CE/C will send copies to their field unit i.e. AEN/SE/P.Way & Works.
 2. Before taking up any digging activity on a particular work by any agency, Sr.DSTE/DSTE or Sr.DEE/DEE of the section shall be approached in writing by the concerned Engg. or S&T or Electrical officer for permitting to undertake the work. Sr.DSTE/DSTE or Sr.DEE/DEE, after ensuring that the concerned executing agencies including the contractor have fully understood the S&T and Electrical cable route plan shall permit the work in writing within 7 days of the request by concerned department.
 3. After getting the permission from S&T or Electrical department as the case may be, the relevant portion of the cable route plan shall be attached to the letter through which concerned Engineering issues permission to the contractor. Official for commencement of work and ensuring that the contractors have fully understood the cable route plan and precautions to be taken to prevent damage to the underground cables. The contractor shall be asked to study the cable plan and follow it meticulously to ensure that the safety of the cable is not endangered. Such a provision, including any penalty for default, should form part of agreement also. It is advisable that a suitable post of SE/Sig or SE/Tele or SE/Electrical (TRD or G) shall be created chargeable to the estimates of doubling/gauge conversion, which can help Engineering. Agencies in the execution of the work. However, basic responsibility will be of the department executing the work and the Contractor. Creation of posts is not mandatory.
 4. The SE/P.Way or SE/Works shall pass on the information to the concerned SE/Sig SE/Tele or SE/Electrical(TRD or G) about the works being taken up by the contractors in their sections at least 3 days in advance of the day of the Work. In addition Engineering control shall also be informed by SE/P.Way or SE/Works, who in turn shall pass on the information to the test room/network operation Centre of RailTel/TPC/Electrical control.
 5. On receiving the above information, SE/Sig or SE/Tele or SE/Electrical (TRD or G) shall visit the site on or before the date of taking up the work and issue permission to the contractor to commence the work after checking that adequate precautions have been taken to avoid the

damage to the cables. The permission shall be granted within 3 days of submission of such requests.

6. The name of the contractor, his contact telephone number, the nature of the work shall be notified in the Engineering control as soon as the concerned Engineering officials issue the letter authorizing commencement of work to the contractor. Test room shall be given copies. Test room shall collect any further details from the Engineering Control and shall pass it on to S&T/RailTel & Electrical officials regularly. In case the supervisors of concerned departments do not turn up on the day as advised in terms of para 4 and 5 above, the works of contractor should not be stopped on this account.
7. In case of works being taken up by the State Government, National Highway Authority etc., the details of the permission given i.e. the nature the work, kilometer etc. be given to the Engineering control including the contact person's number so that the work can be done in a planned manner. The permission letter shall indicate the contact numbers of Test room/network Operating Centre of RailTel/TPC/Elect. Control.
8. Where the nature of the work taken up by the Engineering department is such that the OFC or other S&T cables or Electrical cables is to be shifted and relocated, notice of minimum one week shall be given so that the Division/RailTel/Construction can plan the works properly for shifting. Such shifting works shall in addition, for security and integrity of the cables, be supervised by S&T supervisors/RailTel supervisors/Electrical Supervisors.
9. The concerned SE/P.Way/SE/Works/SE/Sig/SE/Tele/SE/Electrical (TRD or G) or RailTel supervisors supervising the work of the contractor shall ensure that the existing emergency sockets are not damaged in view of their importance in providing communication during accident/emergency.
10. In case of minor nature of works where shifting of cable is not required, in order to prevent damage to the cable, the Engineering contractor shall take out the S&T or optical fiber cable or Electrical cable carefully from the trench and place it properly alongside at a safe location before starting the earthwork under the supervision of SE/Sig or SE/Tele or SE/Electrical (TRD or G). The cable shall be reburied soon after completion of excavation with proper care including placement of the brick over the cable under the supervision of S&T or Electrical supervisors. However, the work will be charged to the concerned Engineering works. The responsibility for ensuring availability of SE (Signal), SE (Electrical) as per para 4 and 5 above lies with the respective department. The contractor will go ahead with the shifting of cables as per the program decided and he will not be held responsible for any cable cut.
11. In all the sections where major project are to be taken up/going on RailTel/S&T department shall deploy their official to take preventive/corrective action at site of work. As regards Electrical Department, the official may be deputed on need basis.

12. No new OFC or quad cable shall be laid close to existing track. It shall be laid close to the Railway boundary on one side of the Railway track to the extent possible to avoid any interference with the future works (doubling etc.). It shall be ensured in the new works of cable laying that the cable route is properly identified with electronic or concrete markers. Wherever multiple cables are laid in a trench, RFID markers may be provided for easy identification of the cable. Henceforth, wherever cable laying is planned, before undertaking the cable laying work, the cable route plan of the same shall be prepared by the Dy.CSTE/A or Dy.CEE/C and shall be got approved from the concerned Sr. DSTE/DSTE or Sr.DEE/DEE and also from the concerned Dy. CE/C for new lines and from the concerned Sr.DEN for all other projects including GC etc., to avoid possible damages in future. Such approvals shall be granted within 15 days of the submission of the request.
13. The works of excavating the trench and lying of the cable should proceed in quick succession, leaving a minimum time between the two activities.
14. In case damage caused to OFC/Quad cable or Electrical cable during execution of the work, the contractor is liable to pay a penalty for damaging the cable. Penalty shall not be levied in case of the following
- Detailed cable route plan as per clause C-1 not provided by concerned department or cable is not protected as per laid down procedures.
 - The alignment of the cable does not tally with the information provided to the contractor.
 - The cable depth is found to be less than 800 mm from normal ground level.
 - No representative of S&T department/RailTel was available at site guarding the cables on the fixed pre-determined date and time.

26.8.0 Penalty to be imposed for damages to cable shall be as under: -

Cable damaged	Penalty per location
Only Quad cable or Signaling cable	Rs.1.0 Lakh
Only OFC	Rs.1.25 Lakh
Both OFC & Quad	Rs.1.5 Lakh
Electrical Cable	Rs.1.0 Lakh

Necessary debit in this regard shall be raised on the department undertaking the work who shall in turn levy the penalty on the defaulting contractor. S&T department shall raise the debits in case of damage to OFC or Quad or Signaling cable and Electrical department shall raise the debits in case of damage to Electrical cable.

15. Railways will not lodge FIR with RPF in case of works being executed by authorized contractors of Railways who have been duly permitted to execute the works in accordance with this JPO. Joint note by the supervisors of the concerned department shall be prepared and the responsibility of the cable cut should be decided without involving RPF. The joint note deciding the fact whether the contractor should be penalized shall be completed in a day's time from the occurrence of cable cut.
In all other cases, when the cable is cut by an agency that was not permitted to execute any work, FIR should be lodged with RPF.
 16. While giving permission for taking up the works, concerned departments may note that earthwork by engineering contractors will normally be done by machines except in a few isolated locations where the quantity of earth work is very less.
 17. Railways shall make necessary correction in their future contract so that this JPO can also be enforced contractually.
 18. In case of damages to OFC, RailTel should be paid 5/6th of the penalty recovered. RailTel shall raise demands on the S&T department in this regard.
 19. All types of signaling & OHE bonds i.e. rail bond, cross bond and structure bond shall be restored by the contractor with a view to keep rail voltage low to ensure safety of personnel.
 20. Above joint circular shall be applicable for construction as well as open line organization of Engineering, S&T and Electrical.
 21. S&T cable and electrical cable route plan should be prepared by the concerned S&T and Electrical officers respectively and got approved as stipulated in para C-12 before undertaking the work. The completion cable route plan should be finalized block section by block section as soon as the work is completed.
 22. All cable laying works shall be executed as per laid down technical specifications, such as protection measures/protective cover, compaction of refilled material etc.
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- 26.8.1 Cables shall be selected after full consideration of the condition to which they shall be exposed and the duties for which they are required. Supply cable up to 3.3 kV shall be in accordance with BS 6346.
 - 26.8.2 For supplies to mobile or transportable equipment where operating of the equipment subjects the cable to flexing, the cable shall conform to any of these codes BS 6007 / BS 6500 / BS 7375.

- 26.8.3 Flexible cords with a conductor cross sectional area smaller than 1.5 mm² shall not be used and insulated flexible cable shall conform to BS 6500 and BS 7375.
- 26.8.4 Where low voltage cables are to be used, reference shall be made to BS 7375. The following standards shall also be referred to particularly for underground cables BS 6346 and BS 6708
- 26.8.5 Cables buried directly in the ground shall be of a type incorporating armour or metal sheath or both. Such cables shall be marked by cable covers or a suitable marking tape and be buried at a sufficient depth to avoid their being damaged by any disturbance of the ground. Cable routes shall be marked on the plans kept in the site electrical register.
- 26.8.6 Cabling passing under the walk way and across way for transport and mobile equipment shall be laid in ducts at a minimum depth of 0.6 meters.
- 26.8.7 Cables that need to cross open areas, or where span of 3m or more are involved, a catenary wire on poles or other supports shall be provided for convenient means of suspension. Minimum height shall be 6 m above ground.
- 26.8.8 Cables carrying a voltage to earth in excess of 65V other than supply for welding process shall have metal armor or sheath, which has been effectively earthed and monitored by the contractor. In case of flexible and trailing cables such earthed metal sheath and/or armor should be in addition to the earth core in the cable and shall not be used as the protective conductor.
- 26.8.9 Armoured cables having an over-sheath of polyvinyl chloride (PVC) or oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring
- 26.9 Plugs, socket-outlets and couplers:
- 26.9.1 The contractor shall ensure plugs, socket-outlets, and couplers available in the construction site as "splash proof" type. The minimum degree of Ingress Protection should be of IP44 in accordance with BS EN 60529.
- 26.9.2 Only plugs and fittings of the weatherproof type shall be used and they should be colour coded in accordance with the internationally recognized standards for example as detailed as follows:
- (a) 110 volts: Yellow.
 - (b) 240 volts: Blue.
 - (c) 415 volts: Red.
- 26.10 Connections

- 26.10.1 Every joint and connection in a system shall be mechanically and electrically suitable for use to prevent danger. Proper cable connectors as per national/international standards shall only be used to connect cables.
- 26.10.2 No loose connections or tapped joints shall be allowed anywhere in the work site, office area, stores and other areas. Penalty as per relevant clause shall be put in case of observation of any tapped joints.
- 26.11 Portable and hand-held equipments:
 - 26.11.1 The contractor shall ensure the use of double insulated or all-insulated portable electrical hand equipment may be used without earthing (i.e. two core cables), but they shall still be used only on 110V because of the risk of damage to trailing leads.
- 26.12 Other equipments:
 - 26.12.1 All equipment shall have the provision for major switch/cut-off switch in the equipment itself.
 - 26.12.2 All non-current carrying metal parts of electrical equipment shall be earthed through insulated cable
 - 26.12.3 Isolate exposed high-voltage (over 415 Volts) equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts and prevent unauthorised access.
 - 26.12.4 Approved perimeter markings shall be used to isolate restricted areas from designated work areas and entryways and shall be erected before work begins and maintained for entire duration of work. Approved perimeter marking shall be installed with either red barrier tape printed with the words "DANGER—HIGH VOLTAGE" or a barrier of yellow or orange synthetic rope, approximately 1 to 1.5 meter above the floor or work surface.
- 26.13 Work on or near live conductors
 - 26.13.1 No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless-
 - a) it is unreasonable in all the circumstances for it to be dead; and
 - b) it is reasonable in all the circumstances for him to be at work on or near it while it is live; and
 - c) Suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.
- 26.14 Inspection and Maintenance

- 26.14.1 All electrical equipment should be permanently numbered and a record kept of the date of issue, date of last inspection and recommended inspection period.
- 26.14.2 Fixed installations shall be inspected at least at three monthly intervals; routine maintenance being carried out in accordance with equipment manufactures recommendations.
- 26.14.3 25 KV AC 50 Hz single phase Traction:
- a) Induction effect of 25 KV AC 50 Hz single phase Traction
- I. The attention of all staff is drawn to the fact that under 25 kv ac 50 Hz single phase traction, there is heavy induction on all metallic structures and conductors in the vicinity of the track. The induction is two – fold.
 - Electro- static, which results from the high potential of 25 kv on the OHE system.
 - Electro- magnetic, which is proportional to the currents passing from the sub – station to the OHE to the locomotives /EMUs and back partly through the earth.
 - II. The voltage induced is quite appreciable on overhead conductors running parallel to the tracks depending on the length of parallelism.
This explains why most of the overhead telecommunication's lines are replaced by underground cables. Special protective measures are required to reduce the adverse effects of induction.
 - III. In a railway yard, voltage of the order of 200 volts may be induced on yard lighting mains situated 8 m away from the centre of a double line track, of it runs parallel to the 25 KV lines for a distance of about 270 m; it could be several thousand volts when parallelism is much longer. In such a case, a dangerous voltage due to induction will exist even after power supply to the line has been switched off. No one shall therefore attempt to work on any overhead line running alongside the electrified tracks without taking special precautions of earthing on both sides of the work. Before a section is electrified, the necessary modifications to distribution lines in all stations and yards should be carried out, so as to limit the induced voltage within permissible values, but this by no means limits the need for earthing the lines on both the sides of the working party. Earthing should be done individually by each working party as close to the work spot as possible. The distance between the two earths shall not exceed 1 km.
 - IV. Such inductive effects occur on large metallic structures such as fencings, structural steelwork of platforms running parallel to the track. They will therefore, have to be earthed suitably to afford safety.

- V. Inductive effects also show themselves on any metallic conductor, such as metallic clothes-lines, power lines and lines belonging to private parties running parallel and close to the electrified tracks.

Wide publicity should be given to the effects of induction so that special precautions are taken by the private parties.

b) General Precautions

The precautions laid down below must be followed under all circumstances in sections equipped for 25 kv as single phase, 50 Hz traction.

- i. No work shall be done above or within a distance of 2 m from the live OHE without a “permit-to-work.”
 - ii. No part of a tree shall be nearer than 4 m from the nearest live conductor. Any tree or branches likely to fall on live conductor should be cut or trimmed periodically to maintain this clearance. Cutting or trimming should be done by the OHE staff themselves or through an agency manage and supervised by them.
 - iii. Work for trimming of trees should also be done in the presence of authorized OHE staff or supervisor to maintain the safe clearance of 4mt. Any dispute regarding cutting of trees may be done on contract basis or departmentally of the terms & conditions of concerning department.
 - iv. No fallen wire or wires shall be touched unless power is switched off and the wire or wires suitably earthed. In case the wires drop at a level crossing, the Gate-keeper shall immediately make arrangements to stop all road traffic and keep the public away.
 - v. As far as possible closed wagons shall be used for material trains. In case open or hopper wagons are used, loading and unloading or such wagons in electrified tracks shall be done under the supervision of an Engineering Official not below the rank of a APM who shall personally ensure that no tool or any part of the body of the worker comes within the ‘danger zone’ i.e. within 2 m of the OHE.
 - vi. Permanent Way staff should keep clear of the tracks and avoid contact with the rails either when approaching or reaching the work-spot when an electrically hauled train is within 250m.
 - vii. When unloading rails alongside the tracks, it should be ensured that rails do not touch each other to form a continuous metallic mass of length greater than 300m.
- c) Safety precautions on Electrified Sections (Chapter-IV), Electrical Accidents (Chapter-V) Fire Pre cautions (Chapter-VI) of Indian Railways AC Traction Manual Volume – I, as applicable may be followed.
- d) The Training and Competency Certificates (Chapter XII) of Volume-II, part-I of Indian Railway AC Traction Manual may be followed.

- e) Power Blocks and Permit to Work are required to be taken in case of construction work going on in the vicinity of electrified line as per applicable Para of Chapter –VI of volume-II, part – I of Indian Railway AC Traction Manual

27.0 LIGHTING

27.1 The contractor shall provide sufficient site lighting, of the right type and at the right place for it to be properly effective. Lighting ought not to introduce the risk of electric shock. Therefore, 230V supplies should be used for those fittings, which are robustly installed, and well out of reach e.g. flood lighting or high-pressure discharge lamps.

27.2 Selection of Luminaries:

The contractor shall select the luminaries as per the area requirement indicated below:

Sl. No.	Type of Lighting	Area of Requirement	Luminaries
1.	Area Lighting	Workmen and vehicles to move about in safely.	Shovel type: non-symmetrical Symmetrical or non-symmetrical tungsten halogen
2.	Beam flood lighting	Concentrated light over an area from a relatively great distance.	Portable flood light (Conical beam) Wide angle flood (fan shaped beam) Medium or narrow angle flood (Conical beam)
3.	Dispersive lighting	Lighting for indoor	Dispersive (Mercury florescent) Cargo cluster Florescent trough
4.	Walkway lighting	Lighting for stairways, ladder ways, corrido scaffold access routes, etc.	Well glass unit Bulkhead unit (tungste filament) Bulk head unit (Florescent)
5.	Local lighting	Lighting on sites and fittings are generally accessible to operatives	PAR (Parabolic Aluminised Reflector) lamp cluster

			Festoons (with or without shades) Adjustable florescent work lamp Portable flood lamp (mounted on own cable drum)
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27.3 The contractor shall ensure that luminaries should always be placed so that no person is required to work in their own shadow and so that the local light for one person is not a source of glare for the others. Strongly made clamps should be available for attaching luminaries to poles and other convenient supports.

27.4 Luminaries should be robust, resistant to corrosion and rain proof especially at the point of the cable entry.

27.5 The correct type of lamp for each luminary should always be used and when lamps need to be replaced it shall be in accordance with the supply voltage.

27.6 Lamp holders not fitted with a lamp should be capped off.

28.0 HAND TOOLS AND POWER TOOLS

28.1 General

28.1.1 The contractor is wholly responsible for the safe condition of tools and equipment used by his employees and that of his sub-contractors.

28.1.2 Use of short / damaged hand tools shall be avoided and the contractor shall ensure all his hand tools used at his worksite are safe to work with or stored and shall also train his employees (including his sub-contractors) for proper use thereby.

28.1.3 All hand tools and power tools shall be duly inspected before use for safe operation.

28.1.4 All hand tools and power tools shall have sufficient grip and the design specification on par with national/international standards on anthropometrics.

28.2 Hand tools

28.2.1 Hand tools shall include saws, chisels, axes and hatches, hammers, hand planes, screw drivers, crow bars, and nail pullers.

28.2.2 The contractor shall ensure that,

- i) For crosscutting of hardwood, saws with larger teeth points (no. of points per inch) shall be preferred to avoid the saw jumping out of the job.
- ii) Mushroom headed chisels shall not be used in the worksite where the fragments of the head may cause injury.
- iii) Unless hatchet has a striking face, it shall be used as a hammer.
- iv) Only knives of retractable blades shall be used in the worksite.
- v) No screwdrivers shall be used for scraping, chiselling or punching holes.
- vi) A pilot hole shall always be driven before driving a screw.
- vii) Wherever necessary, usage of proper PPEs shall be used by his employees.

28.3 Power tools

28.3.1 Power tools include drills, planes, routers, saws, jackhammers, grinders, sprayers, chipping hammers, air nozzles and drills.

28.3.2 The contractor shall ensure that

- i) Electric tools are properly grounded or / and double insulated.
- ii) GFCIs/ RCCBs shall be used with all portable electric tool operated especially outdoors or in wet condition.
- iii) Before making any adjustments or changing attachments, his workers shall disconnect the tool from the power source.
- iv) When operating in confined spaces or for prolonged periods, hearing protection shall be required. The same shall also apply to working with equipments, which gives out more noise as mentioned in clause **43.0** of this contract document.
- v) Tool is held firmly and the material is properly secured before turning on the tool.
- vi) All drills shall have suitable attachments respective of the operations and powerful for ease of operation.
- vii) When any work / operation need to be performed repeatedly or continuously, tools specifically designed for that work shall be used. The same is applicable to detachable tool bit also.
- viii) Size of the drill shall be determined by the maximum opening of the chuck n case of drill bit.
- ix) Attachments such as speed reducing screwdrivers and buffers shall be provided to prevent fatigue and undue muscle strain to his workers.

- x) Stock should be clamped or otherwise secured firmly to prevent it from moving.
- xi) Workers shall never stand on the top of the ladder to drill holes in walls / ceilings, which can be hazardous, instead standing on the fourth or fifth rung shall be recommended.
- xii) Electric plane shall not be operated with loose clothing or long scarf or open jacket.
- xiii) Safety guards used on right angle head or vertical portable grinders must cover a minimum of 180° of the wheel and the spindle / wheel specifications shall be checked.
- xiv) All power tools / hand tools shall have guards at their nip points.
- xv) Low profile safety chain shall be used in case of wood working machines and the saw shall run at high rpm when cutting and also correct chain tension shall be ensured to avoid “kickback”.
- xvi) Leather aprons and gloves shall be used as an additional personal protection auxiliary to withstand kickback.
- xvii) Push sticks shall be provided and properly used to hold the job down on the table while the heels moves the stock forward and thus preventing kickbacks.
- xviii) Air pressure is set at a suitable level for air actuated tool or equipment being used. Before changing or adjusting pneumatic tools, air pressure shall be turned off.
- xix) Only trained employees shall use explosive actuated tools and the tool shall also be unloaded when not in use.
- xx) Usage of such explosive actuated tools shall be avoided in case of places where explosive/flammable vapours or gases may be present.
- xxi) Explosive actuated tools and their explosives shall be stored separately and be taken out and loaded only before the time of immediate use.
- xxii) Misfired cartridges of explosive actuated tools must be placed in a container of water and be removed safely from the project.
- xxiii) No worker shall point any power operated / hand tool to any other person especially during loading / unloading.

29.0 WELDING, GOUGING AND CUTTING

- 29.1 Gas cylinders in use shall be kept upright on a custom-built stand or trolley fitted with a bracket to accommodate the hoses and equipment or otherwise secured. The metal cap shall be kept in place to protect the valve when the cylinder is not connected for use.
- 29.2 Hose clamp or clip shall be used to connect hoses firmly in both sides of cylinders and torches.
- 29.3 All gas cylinders shall be fixed with pressure regulator and dial gauges
- 29.4 Non-return valve and Flashback arrester shall be fixed at both end of cylinder and torch.
- 29.5 Domestic LPG cylinders shall not be used for Gas welding and Cutting purpose.

- 29.6 DCP or CO₂ type Fire Extinguisher not less than 5 kg shall be fixed at or near to welding process zone in an easily accessible location. Fire Extinguisher should confirm to IS 2190: 1992.
- 29.7 Use firewatchers if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads).
- 29.8 Oxygen cylinders and flammable gas cylinders shall be stored separately, at least 6.6 meters (20 feet) apart or separated by a fire proof, 1.5 meters (5 feet) high partition. Flammable substances shall not be stored within 15 meters of cylinder storage areas.
- 29.9 Transformer used for electrical arc welding shall be fixed with Ammeter and Voltmeter and also fixed with separate main power switch.
- 29.10 Welding grounds and returns should be securely attached to the work by cable lugs, by clamps in the case of stranded conductors, or by bolts for strip conductors. The ground cable will not be attached to equipment or existing installations or apparatus.
- 29.11 Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.
- 29.12 Take precautions against the risk of increased fume hazards when welding with chrome containing fluxed consumables or high current metal inert gas (MIG) or tungsten inert gas (TIG) processes.
- 29.13 Avoid being in contact with water or wet floors when welding. Use duckboards or rubber protection.
- 29.14 All electrical installations shall meet the IS: 5571: 1997 and NFPA 70 for gas cylinder storage area and other hazardous areas.
- 29.15 The current for Electric arc welding shall not exceed 300 A on a hand welding operation.

30.0 DANGEROUS AND HARMFUL ENVIRONMENT

As per Rule 40 of BOCWR,

- a) When internal combustion engines are to be used into a confined space or excavation or tunnel or any other workplace where neither natural or artificial ventilation system is inadequate to keep carbon monoxide below 50ppm, exposure of building workers shall be avoided unless suitable measures are taken and provided by the contractor.
- b) No worker shall be allowed into any confined space or tank or trench or excavation wherein there is given off any dust, fumes / vapours or other impurities which is likely to be injurious or offensive to the worker, or in which explosive or poisonous or noxious or gaseous material or other harmful articles have been carried or stored or in which dry ice has been used as a refrigerant, which has been fumigated or in which there is a possibility of oxygen deficiency,

unless all practical steps have been taken to remove such dust, fumes, other impurities and dangers which may be present and to prevent any further ingress thereof, and such work place or tank or trench or excavation shall be certified by the responsible person to be safe and fit for the entry of such workers.

31.0 FIRE PREVENTION, PROTECTION AND FIGHTING SYSTEM

- 31.1 The contractor shall ensure that construction site is provided with fire extinguishing equipment sufficient to extinguish any probable fire at construction site. An adequate water supply is provided at ample pressure as per national standard.
- 31.2 Recharging of fire extinguishers and their proper maintenance should be ensured and as a minimum should meet Indian National Standards
- 31.3 All drivers of vehicles, foreman, supervisors and managers shall be trained on operating the fire extinguishers and firefighting equipment.
- 31.4 The contractor shall also give consideration to the provision of adequate firefighting arrangements within the underground and tunnelling operations including the provision of Fire Service compatible hose connections and emergency lighting
- 31.5 As per Rule 79 (A (7) of The Building and Other Contract Workers (Regulation of Employment and conditions of service) (Karnataka) Rules 2006, all lifting appliances operators shall be provided a cabin which shall be equipped a suitable portable fire extinguisher.
- 31.6 Combustible scrap and other construction debris should be disposed off site on a regular basis. If scrap is to be burnt on site, the burning site should be specified and located at a distance no less than 12 metres from any construction work or any other combustible material.
- 31.7 Every fire, including those extinguished by contractor personnel, shall be reported to the Employer representatives.
- 31.8 Emergency plans and Fire Evacuation plans shall be prepared and issued. Mock drills should be held on a regular basis to ensure the effectiveness of the arrangements and as a part of the programme, the Telephone Number of the local fire brigade should be prominently displayed near each telephone on site.

32.0 CORROSIVE SUBSTANCES

- 32.1 As per Rule 44 of BOCWR, corrosive substances including alkalis and acids shall be stored and used by a person dealing with such substances at a building / construction site in a manner that it does not endanger the building worker and suitable PPE shall be provided by the contractor to

the worker during such handling and work. In case of spillage of such substances on building worker, the contractor shall take immediate remedial measures.

33.0 **DEMOLOTION**

33.1 The Contractor shall ensure that

- i) All demolition works be carried out in a controlled manner under the management of experienced and competent supervision.
- ii) The concerned department of the Government or local authority is informed and permission obtained wherever required. Media shall also be informed regarding this concern.
- iii) All glass or similar materials or articles in exterior openings are removed before commencing any demolition work and all water, steam, electric, gas and other similar supply lines are put-off and such lines so located or capped with substantial coverings so as to protect it from damage and to afford safety to the building workers and public.
- iv) Examine the walls of all structures adjacent to the structure to be demolished to determine thickness, method of support to such adjacent structures.
- v) No demolishing work be performed if the adjacent structure seems to be unsafe unless and until remedial measures like sheet piling, shoring, bracing or similar means be ensured for safety and stability for adjacent structure from collapsing.
- vi) Debris / bricks and other materials or articles shall be removed by means of
 - a) chutes
 - b) buckets or hoists
 - c) through openings through floors or
 - d) any other safe means
- vii) No person other than building workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition and the area be provided with substantial barricades.

34.0 **EXCAVATION AND TUNNELLING**

34.1 Excavation

34.1.1 The contractor shall ensure

- i) Where any construction building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than one 1.5 m above his footing, such worker is protected by adequate piling and bracing against such bank or side.
- ii) Where banks of an excavation are undercut, adequate shoring is provided to support the material or article overhanging such bank.

- iii) excavated material is not stored at least 0.65 m from the edge of an open excavation or trench and banks of such excavation or trench are stripped of loose rocks and the banks of such excavation or trench are stripped of loose rocks and other materials which may slide, roll or fall upon a construction building worker working below such bank
- iv) metal ladders and staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where, the depth of such excavation exceeds 1.5 m and such ladders, staircases or ramps comply with the IS 3696 Part 1&2 and other relevant national standards.
- v) Trench and excavation is protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 m and such protection is an improved protection in accordance with the design and drawing of a professional engineer, where such depth exceeds 4m.

34.2 Tunnelling

34.2.1 The contractor shall inform in writing to the Director General within 30 days, prior to the commencement of any tunnelling work.

34.2.2 The contractor shall appoint a responsible person for safe operation for tunnelling work as per Rule 121 & 125 of BOCWR.

34.2.3 The contractor shall ensure

- i) every compressed air system in a tunnel is provided with emergency power supply for maintained continued supply of compressed air as per Rule 155 of BOCWR
- ii) Watertight bulkhead doors are installed at the entrance of a tunnel to prevent flooding.
- iii) Reliable and effective means of communication such as telephone or walkie-talkie are provided and maintained for arranging better effective communication at an excavation or tunnelling work as per Rule 136 of BOCWR.
- iv) All portable electrical hand tools and inspection lamp used in underground and confined space at an excavation or tunnelling work is operated at a voltage not exceeding 24V.
- v) only flame proof equipment of appropriate type as per IS:5571:2000 and or other relevant national standard is used inside the tunnel
- vi) petrol or LPG of any other flammable substances are not used, stored inside the tunnel except with prior approval from Employer, and also no oxy-acetylene gas is used in a compressed air environment in excavation or tunnelling
- vii) Adequate number of water outlets provided for fire fighting purpose, an audible fire alarm and adequate number and types of fire extinguishers are provided and maintained.

- viii) Temperature in any working chamber in an excavation or tunnelling work where workers employed does not exceed 29°C as per Rule 165 of BOCWR.
- ix) All working areas in a free air tunnel are provided with ventilation system as approved by the Director General and the fresh air supplied in such tunnel is not less than 6 m³/ min for each worker employed in tunnel as per Rule 153 of BOCWR.

34.3 Warning signs and notices:

34.3.1 The contractor shall ensure that

- i) suitable warning signs or notices, required for the safety of building workers carrying out the work of an excavation or tunnelling, shall be displayed or erected at conspicuous places in Hindi and in a language understood by majority of such building workers at such building such excavation or tunnelling work
- ii) such warning signs and notices with regard to compressed air working shall include
 - a) the danger involved in such compressed air work
 - b) fire and explosion hazard
 - c) The emergency procedures for rescue from such danger or hazards.

35.0 WORK PERMIT SYSTEM

35.1 The Contractor shall develop a Work Permit system, which is a formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken. Work Permits form an essential part of safe systems of work for many construction activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

35.2 A permit is needed when construction work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work. Examples of high-risk activities include but are not limited to

- i) Entry into confined spaces
- ii) Work in close proximity to overhead power lines and telecommunication cables.
- iii) Hot work.
- iv) To dig—where underground services may be located.
- v) Work with heavy moving machinery.
- vi) Working on electrical equipment
- vii) Work with radioactive isotopes.
- viii) Heavy lifting operations and lifting operations closer to live power line

- 35.3 The permit-to-work system should be fully documented, laying down:
- i. How the system works;
 - ii. The jobs it is to be used for;
 - iii. The responsibilities and training of those involved; and
 - iv. How to check its operation;
- 35.4 A Work Permit authorisation form shall be completed with the maximum duration period not exceeding 12 hours.
- 35.5 A copy of each Permit to Work shall be displayed, during its validity, in a conspicuous location in close proximity to the actual works location to which it applies.
- 35.6 Format of Work Permits i.e., Cold Permit (for all works other than Hot or Excavation/ tunneling and Electrical Isolation), Hot Work, Electrical Isolation are given at the end of this document as **Form No SF 003, SF 004 & SF 005** respectively. These are indicative and can be suitably modified depending upon site condition.

36.0 TRAFFIC MANAGEMENT

- 36.1 The basic objective of the following guidelines is to lay down procedures to be adopted by contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen at construction sites.
- 36.2 All construction workers should be provided with high visibility jackets with reflective tapes as most of viaduct /tunnelling and station works or either above or under right-of-way. The conspicuity of workmen at all times shall be increased so as to protect from speeding vehicular traffic.
- 36.3 The guiding principles to be adopted for safety in construction zone are to
- i) Warn the road user clearly and sufficiently in advance.
 - ii) Provide safe and clearly marked lanes for guiding road users.
 - iii) Provide safe and clearly marked buffer and work zones
 - iv) Provide adequate measures that control driver behaviour through construction zones.
- 36.4 Legal permission

- 36.4.1 In all cases, the contractor shall employ proper precautions. Wherever operations undertaken are likely to interfere with public traffic, specific traffic management plans shall be drawn up and implemented by the contractor in consultation with the approval of local police authorities and/or the concerned metropolitan/civil authorities as the case may be.
- 36.4.2 Such traffic management plans shall include provision for traffic diversion and selection of alternative routes for transport of equipment. If necessary, the contractor shall carry out road widening before commencement of works to accommodate the extra load
- 36.5 The primary traffic control devices used in work zones shall include signs, delineators, barricades, cones, pylons, pavement markings and flashing lights.
- 36.6 The road construction and maintenance signs which fall into the same three major categories as do other traffic signs, that are Regulatory Signs, Warning Signs and Direction (or guidelines) Signs shall only be used. The IRC: 67 (Code of Practice for Road Signs) provide a list of traffic signs. The size, colours and placement of sign shall confirm to IRC: 67.
- 36.7 Regulatory signs
- 36.7.1 Regulatory signs impose legal restriction on all traffic. It is essential, therefore, that they are used only after consulting the local police and traffic authorities.
- 36.8 Warning signs
- 36.8.1 Warning signs in the traffic control zone shall be utilised to warn the drivers of specific hazards that may be encountered.
- 36.8.2 The contractor shall place detour signage at strategic locations and install appropriate warning signs. In order to minimize disruption of access to residences and business, the contractor shall maintain at least one entrance to a property where multiple entrances exist.
- 36.8.3 Materials hanging over / protruded from the chassis / body of any vehicle especially during material handling shall be indicated by red indicator (red light/flag) to indicate the caution to the road users.
- 36.9 Delineators
- The delineators are the elements of a total system of traffic control and have two distinct purposes:

- i) To delineate and guide the driver to and along a safe path
 - ii) As a taper to move traffic from one lane to another.
- 36.9.1 These channelizing devices such as cones, traffic cylinders, tapes and drums shall be placed in or adjacent to the roadway to control the flow of traffic. These should normally be retro-reflectors complying with IRC: 79 - Recommended Practice for Road Delineators.
- 36.9.2 Traffic cones and cylinders
- 36.9.2.1 Traffic cones of 500mm, 750mm and 1000mm high and 300mm to 500mm in diameter or in square shape at base and are often made of plastic or rubber and normally have retro-reflectorised red and white band shall be used wherever required.
- 36.9.3 Drums
- 36.9.3.1 Drums about 800mm to 1000mm high and 300mm in diameter can be used either as channelising or warning devices. These are highly visible, give the appearance of being formidable objects and therefore command the respect of drivers.
- 36.9.4 Barricades
- 36.9.4.1 Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the working area from the risk of accidents due to speedy vehicular movement. Same the way barricades protect the road users from the danger due to construction equipment and other temporary structures.
- 36.9.4.2 The structure dimension of the barricade, material and composition, its colour scheme, K-RIDE logo and other details shall be in accordance with specifications laid down in tender document.
- 36.9.4.3 All barricades shall be erected as per the design requirements of the Employer, numbered, painted and maintained in good condition and also Barricade in-charge maintains a barricade register in site.
- 36.9.4.4 All barricades shall be conspicuously seen in the dark/night time by the road users so that no vehicle hits the barricade. Conspicuity. Shall be ensured by affixing retro reflective stripes of required size and shape at appropriate angle at the bottom and middle portion of the barricade at a minimum gap of 1000mm. In addition, minimum one red light or red light blinker should be placed at the top of each barricade.

36.9.5 The contractor shall ensure that all his construction vehicles plying on public roads (like dump trucks, trailers, etc.) have proper license to ply on public roads from the State Transport Authority. Drivers holding proper valid license as per the requirements of Motor Vehicles Act shall drive these vehicles

36.9.6 The contractor shall not undertake loading and unloading at carriageways obstructing the free flow of vehicular traffic and encroachment of existing roads by the contractor applying the excuse of work execution.

36.9.7 Safety Fencing:

Before commencing any work close to the running track, the Contractor shall provide safety fencing and obtain the specific permission of Engineer to commence the work in that stretch. The fencing shall be for a as per relevant scheduled item. The Contractor shall maintain the safety fencing in good working condition throughout the period until the work in a given stretch is completed. The Contractor will be paid for providing safety fencing along the track as per the relevant scheduled item.

36.9.8 Tow away vehicle

36.9.8.1 The contractor shall make arrangements keeping tow away van / manpower to tow away any breakdown vehicle in the traffic flow without losing any time at his cost.

36.9.9 Cleaning of road

36.9.9.1 The contractor shall ensure the cleanliness of roads and footpaths by deploying proper manpower for the same. The contractor shall have to ensure proper brooming, cleaning washing of roads and footpaths on all the time throughout the entire stretch till the currency of the contract including disposal of seepage.

37.0 WORK TO ADJACENT RAILWAYS

37.1 Whenever work is to be conducted in close proximity to the live railways then the following measures shall need to be addressed:

- a. Provision of IRPWM (Indian Railways Permanent Way Manual) related to block protection; safety precaution for protection of track must be followed.
- b. Works which is executed within 3.5 mtr from center line of existing Indian Railway track should be executed under block protection and with permit to work from concerned railway
- c. For works to be executed between 3.5 mtr to 6 mtr from center line of existing Indian Railway track work to be executed after erection of fencing as per approved plan.

- d. For works to be executed beyond 6 mtr from center line of existing Indian Railway track, it must be ensured that no vehicle / construction equipment infringes demarcation line marked at 3.5 mtr from center of existing railway track.
- e. All utilities, signaling cables, signaling equipment, pipelines, gate lodges, staff quarters etc., coming in the alignment must be shifted / relocated as per approved plan before undertaking earth-work Program .
- f. During earth-work if any signaling cable not identified earlier got damaged it should be immediately reported to Railway and immediate action should be taken for repair of the same to avoid interruption to traffic.
- g. Any material unloaded along the track should be kept clear of moving dimensions and stacked at minimum 3.5 mtr from track center of running track.
- h. Movement of vehicle / working of machineries should not be permitted during night. In case night working is to be adopted proper fencing at 3.5 mtr from track center of running track should be erected to ensure that no infringement of moving dimension takes place. Suitable lighting arrangements should also be done.
- i. Working in existing railway station area for modification of existing siding / line must be done after approval of plan and with permit to work from Railway.
- j. Modification to road surface at existing level crossings which may cause interruption to road traffic should be executed as per approved plan with the approval of concerned local authorities.
- k. Launching of girders for construction of ROB / rail flyover / modification to existing ROBs should be done as per approved plan and scheme with permission to work from Railway / road authorities.
- l. For construction of new bridge over canal / extension of existing bridge over canal approval of respective authorities should be taken before undertaking work.

37.2 The work of formation in banks and cuttings throughout the length of doubling is adjacent to track under running traffic. Many of the bridges on the proposed double line are to be constructed either as extensions or just adjacent to the existing bridges under running traffic. The work of Installation of Track throughout the length of doubling is adjacent to track under running traffic. The work of Installation of Track and Signals in the Station yards including alterations to the existing Track and Signals has to be done adjacent to or in replacement of the existing Track and Signals which are under running traffic. The contractor shall ensure that the safety of the running lines and running traffic is not endangered, because of his work.

37.2.1 Any traffic/traction blocks, temporary speed restrictions and caution orders required in this connection shall also be got sanctioned from the Railway authorities well in advance, through the Engineer. The Railways may sanction the same for specific sites within the overall recovery time available in the Railway's time table. The contractor shall have to schedule his programme according to the convenience of the Railways. No claim from the contractor for any delay/inconvenience/loss on this account shall be entertained by the Employer.

37.2.2 The contractor shall provide at site at his own cost, all protection measures including exhibition and lighting of all Temporary Engineering Signals as per Railway rules, instructions and norms. All lights provided by the contractor shall be screened so as not to interfere with any signal light on the Railways or with any traffic or signal lights of any local or other authority.

37.3 Ancillary and Temporary works

- (a) The Contractor's proposals for erection of all ancillary and temporary works shall be in conformity with the proposals submitted along with the tender and modifications thereto as approved by the Engineer.
- (b) The Contractor shall submit drawings, supporting design calculations where called for by the Engineer and other relevant details of all such works to the Engineer for approval at least one month before he desires to commence such works. Approval by the Engineer of any such proposal shall not relieve the contractor of his responsibility for the sufficiency of such works.
- (c) The contractor shall, at his own cost, design and provide any temporary arrangements including relieving/service girders required in connection with the above said works and remove the same, when no longer required. These arrangements shall conform to Railway norms. The contractor shall obtain all necessary approvals and sanctions of the concerned Railway authorities including Commissioner of Railway Safety through the Engineer/ Employer in advance and well in time.
- (d) The contractor shall ensure and be entirely responsible for proper design, fabrication, provision and upkeep of all temporary arrangements and all associated activities so as not to endanger safety of any assets, running track, traffic and traveling public and for following all extent instructions, norms, practice and procedures laid down by Railway authorities in this respect, which may be ascertained from the Railways through the Engineer.
- (e) If required, Railways may, in order to ensure the safety of the running track, post at site Regular Railway staff to watch the efficacy and safety of temporary arrangements and protection measures round the clock for the period the same exist in the running line and till the running line is restored back to normal. Railways may also supervise the insertion, maintenance and removal of the temporary arrangements. The cost of such staff shall be borne by the Employer.
- (f) Notwithstanding the above, the contractor shall not, however, be relieved of his responsibility and obligation as aforesaid.
- (g) Save as provided in (e) above, the contractor shall bear the cost of complying with all safety requirements. No extra payment will be made for complying with the safety provisions under this chapter and the cost of all such elements to meet the safety requirements shall be deemed to be included in the Bill of Quantities.

37.3.1 The contractor remains fully responsible for ensuring safety. In case of any accident, the Contractor shall bear cost of all damages to his equipment and men and also damages to Railway and its passengers.

Suitable barricading to forewarn road vehicle driver shall be provided by the contractor. The luminous tape, strung on bamboo or steel poles can be considered for such barricading. Barricading arrangement should be got approved by the Engineer.

37.4 Indemnity by Contractor

The Contractor shall indemnify and save harmless the Railway/Employer/Engineer from and against all actions, suit proceedings, losses, costs, damages, claims, and demands of every nature and description brought or recovered against the Railways/ Employer/Engineer by reason of any act or omission of the contractor, his agents or employees, in the execution of the works or in his guarding the same. All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the actual loss or damage sustained, and whether or not any damage shall have been sustained.

38.0 BATCHING PLANT AND CASTING YARD LAYOUT

- i) The batching plant / casting yard shall be effectively planned for smooth flow of unloading and stacking the aggregates reinforcements and cement, batching plant, transport of concrete, casting the segment, stacking the segment and loading the segments to the trucks. As far as possible the conflicts should be avoided.
- ii) The batching plant / casting yard shall be barricaded and made as a compulsory PPE zone
- iii) If in case of material unloading area is not maintainable as PPE zone, the same shall be segregated properly and made as a non-PPE zone with appropriate barrications.
- iv) Electrical system shall also be suitably planned so that location of diesel generator, if any, location of DBs, routing of cables and positioning of area lighting poles/masts does not infringe on any other utility and pose danger.
- v) Drainage shall be effectively provided and waste water shall be disposed after proper treatment
- vi) Time office, canteen, drinking water, toilet and rest place shall be suitably located for the easy access to workers. All the facilities shall be properly cleaned and maintained during the entire period of operation.
- vii) Manual handling of cement shall be avoided to a larger extent. Whenever it is absolutely necessary the workmen shall be given full body protection, hand protection and respiratory protection as a basic measure of ensuring better health.
- viii) The PPEs provided to cement handling workmen shall conform to international standards.
- ix) Access roads and internal circulation roads shall be well laid and maintained properly at all time.
- x) Non-adherence to any of the above provision shall be penalised as per relevant penalty clause.

39.0 PERSONAL PROTECTIVE EQUIPMENTS (PPEs)

39.1 The contractor shall provide required PPEs to workmen to protect against safety and / or health hazards. Primarily PPEs are required for the following protection

- a) Head Protection (Safety helmets)
- b) Foot Protection (Safety footwear, Gumboot, etc)
- c) Body Protection (High visibility clothing (waistcoat/jacket), Apron, etc)
- d) Personal fall protection (Full body harness, Rope-grap fall arrester, etc)
- e) Eye Protection (Goggles, Welders glasses, etc)
- f) Hand Protection (Gloves, Finger coats, etc)
- g) Respiratory Protection. (Nose mask, SCBAs, etc)
- h) Hearing Protection (Ear plugs, Ear muffs, etc)

39.2 The PPEs and safety appliances provided by the contractor shall be of the standard as prescribed by Bureau of Indian Standards (BIS). If materials conforming to BIS standards are not available, the contractor as approved by the Employer shall procure PPE and safety appliances.

39.3 All construction workers should be provided with high visibility jackets with reflective tapes confirming to the requirement specified under BS EN 471: 1994 as most of viaduct / tunneling and station works are executed either above or under right-of-way. The conspicuity of workmen at all times shall be increased so as to protect them from speeding vehicular traffic.

39.4 The contractor shall provide **safety helmet, safety shoe and high visibility clothing** for all employees including workmen, traffic marshal and other employees who are engaged for any work under this contract as per the following requirement.

All employees of the Contractor including workmen	Traffic marshals
i) Hard hat with company Logo ii) Safety boots iii) Hi-visibility waistcoat covering upper body and meeting the following requirement as per BS EN 471:1994: a. Background in fluorescent orange-red in colour b. Two vertical green strips of 5cm wide on front side, covering the torso at least 500 cm ²	i) Hard hat with reflective tape ii) Safety boots iii) Hi-visibility jacket covering upper body and meeting the following requirements as per BS EN 471:1994: a. Background in fluorescent orange-red in colour b. Jackets with full-length sleeves with two bands of retro reflective material, which shall be placed at

<p>c. Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 570cm²</p> <p>d. Horizontal strips not less than 5cm wide running around the bottom of the vertical Strip in front and 'X' pattern at back.</p> <p>e. The bottom strip shall be at a distance of 5cm From the bottom of the vest.</p> <p>f. Strips must be retro reflective and fluorescent</p> <p>g. Waistcoat shall have a side adjustable fit and a side and front tear-away feature on Vests made of nylon.</p>	<p>the same height on the garment as those of the torso. The upper band shall encircle the upper part of the sleeves between the elbow and the shoulder; the bottom of the lower band shall not be less than 5cm from the bottom of the sleeve.</p> <p>c. Two vertical green strips of 5cm wide on front side, covering the torso at least 500 cm²</p> <p>d. Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 570cm²</p> <p>e. Horizontal strips not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back.</p> <p>f. The bottom strip shall be at a distance of 5cm from the bottom of the vest.</p> <p>g. Strips must be retro reflective and Fluorescent.</p>
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39.4.1 Color coding for helmets

Safety Helmet Colour Code (Every Helmet should have the LOGO* affixed /painted)	Person to use
White	K-RIDE staffs
Grey	All Designers, Architect, Consultants, etc.
Violet	Main Contractors (Engineers / Supervisors)
Blue	All Sub-contractors (Engineers / Supervisors)
Red	Electricians (Both Contractor and Sub-contractor)
Green	Safety Professionals (Both Contractor and Sub-contractor)
Orange	Security Guards / Traffic marshals
Yellow	All workmen

White (with "VISITOR" sticker)	Visitors
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Note: LOGO*

- 1) Logo shall have its outer dimension 2"X2" and shall be conspicuous
- 2) Logo shall be either painted or affixed
- 3) No words shall come either on Top / Bottom of Logo

Logo of the corresponding main contracting company for their employees and sub-contracting company for their employees shall only be used.

- 39.5 In addition to the above any other PPE required for any specific jobs like, welding and cutting, working at height, tunnelling etc shall also be provided to all workmen and also ensure that all workmen use the PPEs properly while on the job.
- 39.6 The contractor shall not pay any cash amount in lieu of PPE to the workers/sub-contractors and expect them to buy and use during work.
- 39.7 The contractor shall at all time maintain a minimum of 10% spare PPEs and safety appliances and properly record and show to the Employer during the inspections. Failing to do so shall invite appropriate penalty as per the provisions of the contract.
- 39.8 It is always the duty of the contractor to provide required PPEs for all visitors. Towards this required quantity of PPEs shall be kept always at the security post.
- 39.9 Damage to Railway Property or Life or Private Property
- 39.9.1 The contractor shall be responsible for all risks to the works and for the trespass and shall make good at his own expense all loss or damage whether to the works themselves or to any other property of the Railway or the lives of persons or property of others from whatsoever cause in connection with the works until they are taken over by the Employer and this although all reasonable and proper precautions may have been taken by the Contractor, and in case the Railway/Employer/Engineer shall be called upon to make good any costs, loss or damages, or to pay any compensation, including that payable under the provisions of Workmen's compensation act or any statutory amendments thereof to any person or persons sustaining damages as aforesaid, by reason of any act, or any negligence or any omissions on the part of the contractor, the amount of any costs or charges including costs and charges in connection with legal proceedings, which the Railway/Employer/Engineer may incur in reference thereto, shall be charged to the contractor. The Railway/Employer/Engineer shall have the power and right to pay or to defend or compromise any claim of threatened legal proceedings or in anticipation of legal proceedings being instituted consequent on the action or default of the contractor, to take such steps as may be considered necessary or desirable to ward off or mitigate the effect of such proceedings, charging to Contractor, as aforesaid, any sum or sums of money which may be paid

and any expenses whether for reinstatement or otherwise which may be incurred and the propriety of any such payment, defence or compromise, and the incurring of any such expense shall not be called in question by the Contractor.

39.9.2 Safety of Public

- i. The Contractor shall be responsible to take all precautions to ensure the safety of the Public whether on Public or Railway property and shall post such look out men as may in the opinion of the Engineer be required to comply with regulations pertaining to the work.
- ii. The Contractor shall provide effective barricading using G.I. corrugated sheets around foundation pits, trenches, erection sites, demolition sites etc., to prevent accidents and injuries to the public. He shall erect barricading duly leaving safe passage for the movement of the public as per the directions of Engineer.
- iii. No payment will be made for providing such barricading and the rates quoted by the Contractor shall be inclusive of such safety measures.

39.9.3 Reporting of Accidents

The Contractor shall report to the Engineer details of any accidents as soon as possible after its occurrence. In the case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer and the Employer immediately by the quickest available means.

39.9.4 Life-saving Appliances and First-aid Equipment

The Contractor shall provide and maintain upon the Works sufficient, proper and efficient life-saving appliances and first-aid equipment to the approval of the Engineer and in accordance with the requirements of ILO Convention No. 62. The appliances and equipment shall be available for use at all time

39.9.5 Security Measure

- i. Security arrangements for the work shall be in accordance with general requirements and the contractor shall conform to such requirements and shall be held responsible for the action or inaction on the part of his staff, employees and the staff and employees of his subcontractors.
- ii. Contractor's as well as Sub Contractor's employees and representatives shall wear identification Badges (cards), uniforms, helmets, gum boots and other safety/protection gadgets/accessories provided by the Contractor. Badges shall identify the Contractor and show the employee's name and number and shall be worn at all times while at site.

- iii. All vehicles used by the contractor shall be clearly marked with the Contractor's name or identification mark.
- iv. The contractor shall be responsible for security of works for the duration of the contract and shall provide and maintain continuously adequate security personnel to fulfill these obligations. The requirements of security measures shall include, but not be limited to, maintenance of Law and Order at site, provision of all lighting, guard, flagmen, and all other measures necessary for protection of works within the colonies, camps and elsewhere at site, all materials delivered to the site and all persons employed in connection with the works continuously throughout working and non-working periods including nights, Sundays and holidays, for the duration of the contract. However, at work sites in close proximity of traffic corridors where public and traffic are likely to come close to the work area, suitable barricading as proposed by contractor and approved by Engineer shall be provided.
- v. No separate payment will be made for providing security measures and will be deemed included in the quoted lumpsum price.

39.9.6 Contractor will have to comply the instructions circulated for Safety on Worksites Specially Doubling Works being implemented on Indian Railways as per relevant letters and any subsequent instructions on this issue.

It is presumed that bidders have gone through the Indian Railway's policies including any subsequent instructions on this issue if any, before quoting the rates.

39.9.7 Ensuring Safety at work site

Ensuring safety at work site while carrying out of doubling works is of paramount importance.

39.9.8 Following measures must be ensure:

1. Fencing as per specification lay down along the track at specified distance from centerline of existing track. The fencing should be maintained until the track is handed over to Railways. Accordingly, at locations where it has been broken/stolen away, the same should be restored expeditiously.
2. Contractors to ensure patrolling by Cycle/ Motor Cycle to prevent damage to fencing and to rectify as soon as it is detected.
3. In the stretch where new formation is likely to be used by unauthorized vehicles and likely to create potential unsafe condition, lifting barriers under lock & key at points where contractor's vehicles are required to enter should be provided and the same should be manned to allow entry to only contractor's vehicles and prevent entry of unauthorized vehicles.
4. Other likely entry points on the new formation must be suitably blocked by providing physical obstructions by stacking sleepers or by cross trenches or by erecting fence to prevent entry of unauthorized vehicles. Frequent check exercised to ensure that unauthorized vehicles do not ply.

5. Reducing number and length of such stretches by providing cross-barricades should be done.
 6. PMC should be advised to educate his supervisor for each stretch to ensure Safety who should be well conversant safety instructions and should see that the same are not violated. PMC has to be made accountable for lapses on the safety aspects.
 7. Periodical formal counseling of all contractor's staff and PMC officials regarding safety instructions and review violations coming to light and taking appropriate action.
 8. Counseling of drivers and operators of machinery regarding safety aspect during routine inspection of PMC official's contractors Engineers.
 9. All the drivers/machine operators should have competency certificate issued by PMC after examining their knowledge about safety. Only authorized drivers can ply within 6.6 m of the existing track will have to be proposed as found necessary.
 10. Necessary caution orders to Drivers of trains wherever required in terms of Railway Board's instructions/PCE circulars.
 11. In case work is required to be carried out within 3.5 M of existing running line, K-RIDE should be advised well in time and requested to provide look out men and Railway Supervisors for the site. At such locations, close supervision must be ensured.
- In terms of contract conditions, preventing entry of outsiders at the worksites is the responsibility of contractor and this has to be ensured.

40.0 VISITORS TO THE SITE

- 40.1 No visitor is allowed to enter the site without the permission of the Employer. All authorised visitors should report at the site office. Contractor shall provide visitor's helmet (White helmet with visitor sticker) and other PPEs like Safety Shoe, reflective jacket, respiratory protection etc. as per requirement of the site.
- 40.2 All Visitors shall be accompanied at all times by a responsible member of the site personnel.
- 40.3 The contractor shall be fully responsible for all visitors' safety and health within the site.
- 40.4 As indicated earlier in this Manual, the Engineer shall undertake regular audits at quarterly intervals, of the Contractor's onsite practices and procedures as a means of assessing the ongoing performance of the Contractor.
- 40.5 The criteria against which the audits will be undertaken shall be derived from the clauses within the Environment Protection Requirements (Appendix III herein above), contract-specific Site Environmental Plan and previous site inspection results.
- 40.6 In addition to the quarterly audits by the Engineer, site inspection shall be undertaken by the Contractor's staff to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control measures are properly followed and implemented.
- 40.7 The frequency of site inspection shall be at least once a week.

- 40.8 The Contractor shall prepare an 'Environmental Inspection and Action Reporting System' and submit to the Engineer for approval and make amendments as suggested. It shall contain a contract specific comprehensive Environment Inspection checklist as requirement of Site Environmental Plan.
- 40.9 The area of inspection shall not be limited to environmental compliance within the site but areas outside the site which are likely to be affected, directly or indirectly by activities at site.
- 40.10 Results of inspection shall be discussed with Engineer and his recommendations on better environmental protection shall be notified to the Contractor for taking immediate action and rapid resolution of identified non-compliance.
- 40.11 If significant environmental problems are identified or if there is an environmental complaint or as a part of investigation work, then the Engineer shall also carry out Ad hoc site inspection which shall be attended by Contractor's Representative.
- 40.12 Reporting system
- 40.12.1 Reporting under the Environmental Management System will contain results of monitoring and inspection programs.
- 40.12.2 In Site Environmental Plan, the Contractor shall prepare and submit monthly Environmental Quality Management Reports in accordance with Requirements as per Contract.
- 40.12.3 The monthly report shall include (but not limited to) the following:
- i) Executive Summary
 - ii) Brief mention of construction activities
 - iii) Monitoring results under AMCP, and NMCP
 - iv) Interpretation of monitoring results, significance and influencing factors
 - v) Graphical representation of monitored results over past four reporting periods.
 - vi) Measures to control spill under SPCP.
 - vii) Action taken on recommendations under site inspection programme or specific directions.
 - viii) Summary of complaints, results of investigations and follow-up action
 - ix) Future key issues.
- 40.13 Complaint Response Process
- 40.13.1 Inquiries, complaints and requests for information can be expected from a wide range of individuals and organizations both private and government. The majority of complaints is likely

to be received by K-RIDE, although the site offices are also likely to be contacted.

- 40.13.2 The objective of complaint process is to ensure that public and agency complaints are addressed and resolved consistently and expeditiously.
- 40.13.3 The Contractor's Site Manager will be notified immediately on receipt of complaint that may relate to environmental impacts. The Site Manager will immediately inform the Engineer and through him the K-RIDE.
- 40.13.4 Field investigation should determine whether the complaint has merit, and if so action should be taken to address the impact.
- 40.13.5 The outcome of the investigation and the action taken shall be documented on a complaint Performa prepared by the Contractor and approved by the Engineer in advance of the works.
- 40.13.6 Where possible, a formal response to each complaint received shall be prepared by the Contractor within seven days in order to notify the concerned person(s) that action has been taken.
- 40.14 Completion of the EQM Programme
 - 40.14.1 The construction of Bangalore Suburban rail project will be undertaken as a series of individual construction contracts with necessarily different construction program and completion dates.
 - 40.14.2 The Engineer shall maintain an overview of the 'impact causing potential' of each site or contract and monitoring parameter with a view to maintaining the most cost-effective use of the environmental resources dedicated to the Project.
 - 40.14.3 Termination of EQM should focus on the percentage contract completion status and on the basis of a history of environmental impact arising from the site over a representative period of monitoring.
 - 40.14.4 Justifiable application for termination of EQM shall be put forward by the Contractor to the Engineer, as necessary throughout the construction period.
- 40.15 Working near running line
 - 40.15.1 The contractor shall not allow any road vehicle belonging to him or his suppliers etc. to ply in railway land next to the running line. If for execution of certain works viz. earth work for parallel railway line and supply of ballast for new or existing rail line, gauge conversion etc, road vehicles are necessary to be used in railway land next to the railway line, the contractor shall apply to the Engineer for permission giving the type & no. of individual vehicles, names & license particulars of the drivers, location, duration & timings for such work/movement. The Railways/Employer/Engineer or his authorized representative will personally counsel, examine & certify, the road vehicle drivers, contractor's flag men & supervisor and will give written permission giving names of road vehicle drivers, contractor's flag men and supervisor to be deployed on the work, location, period and timing of the work. This permission will be subject to the following obligatory conditions:

- 40.15.2 Road vehicles can ply along the track after suitable cordoning of track with minimum distance of 6 meters from the centre of the nearest track. For working of machinery close to the running tracks or plying of road vehicles during night hours, the contractor shall apply to the Engineer in writing for permission, duly indicating the site details in a neat sketch and safety measures proposed to be taken. Subject to the approval of concerned Railway authorities, the Engineer or his authorized representative will communicate permission to the contractor/contractor's representative. The contractor and his men shall strictly adhere to the instructions given along with such permissions.
- 40.15.3 Nominated vehicles and drivers shall be utilized for work in the presence of at least one flag man and one supervisor certified for such work. In order to monitor the activities during night hours, additional staff may have to be posted based on the need of the individual site.
- 40.15.4 The Contractor's machinery, equipment and vehicles shall normally operate 6 m clear of track. Any movement/work at less than 6m and upto a minimum of 3.5m clear of track centre, shall be carried out only in the presence of a person (including any railway employee) authorized by the Engineer. No part of the road vehicle shall be allowed at less than 3.5m from track centre. Cost of such railway employee shall be borne by the Employer.
- 40.15.5 The Contractor's machinery and equipment like Cranes, Flash Butt Welders, Ballasting machinery, Compactors, Track Laying Systems etc. are required to operate close to the existing line carrying traffic. Contractor is fully responsible for operating these machineries without endangering the safety of the running line and traffic.
- 40.15.6 Safety Fencing:
- i) Before commencing any work close to the running track, the Contractor shall provide safety fencing and obtain the specific permission of Engineer to commence the work in that stretch.
 - ii) The fencing shall be for a as per relevant scheduled item.
 - iii) The Contractor shall maintain the safety fencing in good working condition throughout the period till the work in a given stretch is completed.
 - iv) The Contractor will be paid for providing safety fencing along the track as per the relevant item in the Price schedule.
- 40.16 The contractor's special attention is drawn to Para 826 of Indian Railways Permanent Way Manual introduced under Advance Correction Slip no. 69 dated 23.05.2001, reproduced below which should invariably be complied with "826 Safe working of Contractors -- A large number of men and machinery are deployed by the contractors for track renewals, gauge conversions, doublings, bridge rebuilding etc. It is therefore essential that adequate safety measures are taken for safety of the trains as well as the work force.

The following measures should invariably be adopted:

- a) The contractor shall not start any work without the presence of Railway supervisor at site.
- b) Wherever the road vehicles and/or machinery are required to work in the close vicinity of railway line, the work shall be so carried out that there is no infringement to the railway's schedule of dimensions. For this purpose the area where road vehicles and/or Machinery are required to ply, shall be demarcated and acknowledged by the contractor. Special

care shall be taken for turning/reversal of road vehicles/machinery without infringing the running track. Barricading shall be provided wherever justified and feasible as per site conditions.

- c) The “look out and whistle” caution orders shall be issued to the trains and speed restrictions imposed where considered necessary. Suitable flag men/detonators shall be provided where necessary for protection of trains.
- d) The supervisors/workmen should be counseled about safety measures. A competency certificate to the contractor’s supervisor as per proforma annexed shall be issued by AEN which will be valid only for the work for which it has been issued.
- e) The unloaded ballast/rails/sleepers/other P.Way materials after unloading along track should be kept clear off moving dimensions and stacked as per the specified heights and distance from the running track.
- f) Supplementary site-specific instructions, wherever considered necessary, shall be issued by the Engineer.

COMPETENCY CERTIFICATE

“Certified that Shri _____ P. Way supervisor of M/S _____ has been examined regarding P. Way working on _____ work. His knowledge has been found satisfactory and he is capable of supervising the work safely.

Authorized Representative / K-RIDE

- 40.17 The work of formation in banks and cuttings throughout the length of doubling is adjacent to track under running traffic. Many of the bridges on the proposed double line are to be constructed either as extensions or just adjacent to the existing bridges under running traffic. The work of Installation of Track throughout the length of doubling is adjacent to track under running traffic. The work of Installation of Track and Signals in the Station yards including alterations to the existing Track and Signals has to be done adjacent to or in replacement of the existing Track and Signals which are under running traffic. The contractor shall ensure that the safety of the running lines and running traffic is not endangered, because of his work.
- 40.18 Any traffic/traction blocks, temporary speed restrictions and caution orders required in this connection shall also be got sanctioned from the Railway authorities well in advance, through the Engineer. The Railways may sanction the same for specific sites within the overall recovery time available in the Railway’s time table. The contractor shall have to schedule his programme according to the convenience of the Railways. No claim from the contractor for any delay/inconvenience/loss on this account shall be entertained by the Employer.

- 40.19 The contractor shall provide at site at his own cost, all protection measures including exhibition and lighting of all Temporary Engineering Signals as per Railway rules, instructions and norms. All lights provided by the contractor shall be screened so as not to interfere with any signal light on the Railways or with any traffic or signal lights of any local or other authority.
- 40.20 Ancillary and Temporary works
- (a) The Contractor's proposals for erection of all ancillary and temporary works shall be in conformity with the proposals submitted along with the tender and modifications thereto as approved by the Engineer.
 - (b) The Contractor shall submit drawings, supporting design calculations where called for by the Engineer and other relevant details of all such works to the Engineer for approval at least one month before he desires to commence such works. Approval by the Engineer of any such proposal shall not relieve the contractor of his responsibility for the sufficiency of such works.
 - (c) The contractor shall, at his own cost, design and provide any temporary arrangements including relieving/service girders required in connection with the above said works and remove the same, when no longer required. These arrangements shall conform to Railway norms. The contractor shall obtain all necessary approvals and sanctions of the concerned Railway authorities including Commissioner of Railway Safety through the Engineer/ Employer in advance and well in time.
 - (d) The contractor shall ensure and be entirely responsible for proper design, fabrication, provision and upkeep of all temporary arrangements and all associated activities so as not to endanger safety of any assets, running track, traffic and traveling public and for following all extent instructions, norms, practice and procedures laid down by Railway authorities in this respect, which may be ascertained from the Railways through the Engineer.
 - (e) If required, Railways may, in order to ensure the safety of the running track, post at site Regular Railway staff to watch the efficacy and safety of temporary arrangements and protection measures round the clock for the period the same exist in the running line and till the running line is restored back to normal. Railways may also supervise the insertion, maintenance and removal of the temporary arrangements. The cost of such staff shall be borne by the Employer.
 - (f) Notwithstanding the above, the contractor shall not, however, be relieved of his responsibility and obligation as aforesaid.
 - (g) Save as provided in Para 7 (e) above, the contractor shall bear the cost of complying with all safety requirements. No extra payment will be made for complying with the safety provisions under this chapter and the cost of all such elements to meet the safety requirements shall be deemed to be included in the Bill of Quantities.
- 40.21 The contractor remains fully responsible for ensuring safety. In case of any accident, the Contractor shall bear cost of all damages to his equipment and men and also damages to Railway and its passengers.
- 40.22 Suitable barricading to forewarn road vehicle driver shall be provided by the contractor. The luminous tape, strung on bamboo or steel poles can be considered for such barricading. Barricading arrangement should be got approved by the Engineer.

40.23 Indemnity by Contractor

The Contractor shall indemnify and save harmless the Railway/Employer/Engineer from and against all actions, suit proceedings, losses, costs, damages, claims, and demands of every nature and description brought or recovered against the Railways/ Employer/Engineer by reason of any act or omission of the contractor, his agents or employees, in the execution of the works or in his guarding the same. All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the actual loss or damage sustained, and whether or not any damage shall have been sustained.

40.24 Damage to Railway Property or Life or Private Property

40.24.1 The contractor shall be responsible for all risks to the works and for the trespass and shall make good at his own expense all loss or damage whether to the works themselves or to any other property of the Railway or the lives of persons or property of others from whatsoever cause in connection with the works until they are taken over by the Employer and this although all reasonable and proper precautions may have been taken by the Contractor, and in case the Railway/Employer/Engineer shall be called upon to make good any costs, loss or damages, or to pay any compensation, including that payable under the provisions of Workmen's compensation act or any statutory amendments thereof to any person or persons sustaining damages as aforesaid, by reason of any act, or any negligence or any omissions on the part of the contractor, the amount of any costs or charges including costs and charges in connection with legal proceedings, which the Railway/Employer/Engineer may incur in reference thereto, shall be charged to the contractor. The Railway/Employer/Engineer shall have the power and right to pay or to defend or compromise any claim of threatened legal proceedings or in anticipation of legal proceedings being instituted consequent on the action or default of the contractor, to take such steps as may be considered necessary or desirable to ward off or mitigate the effect of such proceedings, charging to Contractor, as aforesaid, any sum or sums of money which may be paid and any expenses whether for reinstatement or otherwise which may be incurred and the propriety of any such payment, defence or compromise, and the incurring of any such expense shall not be called in question by the Contractor.

40.25 Safety of Public

- i. The Contractor shall be responsible to take all precautions to ensure the safety of the Public whether on Public or Railway property and shall post such look out men as may in the opinion of the Engineer be required to comply with regulations pertaining to the work.
- ii. The Contractor shall provide effective barricading using G.I. corrugated sheets around foundation pits, trenches, erection sites, demolition sites etc., to prevent accidents and injuries to the public. He shall erect barricading duly leaving safe passage for the movement of the public as per the directions of Engineer.
- iii. No payment will be made for providing such barricading and the rates quoted by the Contractor shall be inclusive of such safety measures. The quoted lumpsum price is inclusive for all the above items of work.

40.26 Reporting of Accidents

The Contractor shall report to the Engineer details of any accidents as soon as possible after its occurrence. In the case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer and the Employer immediately by the quickest available means

40.27 Life-saving Appliances and First-aid Equipment: The Contractor shall provide and maintain upon the Works sufficient, proper and efficient life-saving appliances and first-aid equipment to the approval of the Engineer and in accordance with the requirements of ILO Convention No. 62. The appliances and equipment shall be available for use at all time

40.28 Security Measure

- i. Security arrangements for the work shall be in accordance with general requirements and the contractor shall conform to such requirements and shall be held responsible for the action or inaction on the part of his staff, employees and the staff and employees of his subcontractors.
- ii. Contractor's as well as Sub Contractor's employees and representatives shall wear identification Badges (cards), uniforms, helmets, gum boots and other safety/protection gadgets/accessories provided by the Contractor. Badges shall identify the Contractor and show the employee's name and number and shall be worn at all times while at site.
- iii. All vehicles used by the contractor shall be clearly marked with the Contractor's name or identification mark.
- iv. The contractor shall be responsible for security of works for the duration of the contract and shall provide and maintain continuously adequate security personnel to fulfill these obligations. The requirements of security measures shall include, but not be limited to, maintenance of Law and Order at site, provision of all lighting, guard, flagmen, and all other measures necessary for protection of works within the colonies, camps and elsewhere at site, all materials delivered to the site and all persons employed in connection with the works continuously throughout working and non-working periods including nights, Sundays and holidays, for the duration of the contract. However, at work sites in close proximity of traffic corridors where public and traffic are likely to come close to the work area, suitable barricading as proposed by contractor and approved by Engineer shall be provided.
- v. No separate payment will be made for providing security measures and will be deemed to be included in the quoted lumpsum price.

40.29 Contractor will have to comply the instructions circulated for Safety on Worksites Specially Doubling Works being implemented on Indian Railways as per relevant letters and any subsequent instructions on this issue.

It is presumed that bidders have gone through the Indian Railway's policies including any subsequent instructions on this issue if any, before quoting the rates

40.30 Ensuring Safety at work site

Ensuring safety at work site while carrying out of doubling works is of paramount importance.

Following measures must be ensured: -

1. Fencing as per specification laid down along the track at specified distance from centre line of existing track. The fencing should be maintained till the track is handed over to Railways. Accordingly, at locations where it has been broken/stolen away, the same should be restored expeditiously.
2. Contractors to ensure patrolling by Cycle/ Motor Cycle to prevent damage to fencing and to rectify as soon as it is detected.
3. In the stretch where new formation is likely to be used by unauthorized vehicles and likely to create potential unsafe condition, lifting barriers under lock & key at points where contractor's vehicles are required to enter should be provided and the same should be manned to allow entry to only contractor's vehicles and prevent entry of unauthorized vehicles.
4. Other likely entry points on the new formation must be suitably blocked by providing physical obstructions by stacking sleepers or by cross trenches or by erecting fence to prevent entry of unauthorized vehicles. Frequent check should be exercised to ensure that unauthorized vehicles do not ply.
5. Reducing number and length of such stretches by providing cross barricades should be done.
6. PMC should be advised to educate his supervisor for each stretch to ensure Safety who should be well conversant safety instructions and should see that the same are not violated. PMC has to be made accountable for lapses on the safety aspects.
7. Periodical formal counseling of all contractor's staff and PMC officials regarding safety instructions and review violations coming to light and taking appropriate action.
8. Counseling of drivers and operators of machinery regarding safety aspect during routine inspection of PMC officials contractors Engineers.
9. All the drivers/machine operators should have competency certificate issued by PMC after examining their knowledge about safety. Only authorized drivers can ply within 6.6 m of the existing track will have to be proposed as found necessary.
10. Necessary caution orders to Drivers of trains wherever required in terms of Railway Board's instructions/PCE circulars.
11. In case work is required to be carried out within 3.5 M of existing running line, K-RIDE should be advised well in time and requested to provide look out men and Railway Supervisors for the site. At such locations close supervision must be ensured.

In terms of contract conditions, preventing entry of outsiders at the worksites is the responsibility of contractor and this has to be ensured

40.31 **Additional Conditions to Safety at Work Spot**

To ensure safety at all the work sites all the time, a dedicated Safety officer duly trained as per the provisions of the contract shall be posted by the contractor for each project. Following works will in general be assigned to safety officer.

1. The Safety officer (in charge) shall be from the permanent rolls of the contractor. He will work under the administrative control of the Project Manager of the contractor.
2. The person from any sub-contractor deputed by the main contractor shall not be designated as Safety officer.
3. The Safety officer shall be overall in charge of the safety methods being undertaken at various work sites. He shall not be given any other task related to the project planning and execution.
4. The Safety officer should be well versed with the safety aspects related to worksites in the vicinity of running railway lines and should impart training to the officials assisting him.
5. The Safety officer shall be given suitable means of transport (depending on the requirement) by the contractor to approach all the work sites frequently and ensure that adequate precautions to ensure safety have been taken. Following items shall be specifically done by the Safety officer.
 - a) Ensuring the provision of the safety fencing. Any shortfall shall be made good immediately.
 - b) Availability of suitable lookout men at each working site. The lookout men shall be in possession of hooters, safety helmet and retro-reflective jacket to warn the site engineer/supervisor and operators/drivers of the equipments/vehicles working near the running track.
 - c) Arranging issuance of competency certificates by Employer/Engineer with the operator/driver of each equipment/vehicle before deputing for work.
 - d) Take assurance from the contractor officials at regular interval of complying with the safety instructions.
 - e) Any safety violation to be advised to all concerned and remedial action taken thereof.
6. The Safety officer will frequently counsel the contractor engineers/supervisors/operators/drivers/lookout men about safety provisions during his day to day inspections and keep a record of the same. The Safety officer will prepare a monthly report of the safety inspections carried out and remedial action taken thereof and send it to the Project Manager of the contractor and the employer/engineer.

7. The contractor should open new sites only after discussing the safety measures to be undertaken with his Safety officer and obtaining the permission from Employer/ Engineer.
8. It shall be the duty of the Project Manager and Safety officer of the contractor that the instructions contained in the agreement related to safety and the same issued by the Railway/Employer/Engineer from time to time are strictly complied with.

Based on the above, it is advised that a thorough review of the safety provisions may be undertaken and it should be ensured that competent safety officers are available at all the work spots

PART III : OCCUPATIONAL HEALTH AND WELFARE

41.0 PHYSICAL FITNESS OF WORKMEN

- 41.1 The contractor shall ensure that his employees/workmen subject themselves to such medical examination as required under the law or under the contract provision and keep a record of the same.
- 41.2 The contractor shall not permit any employee/workmen to enter the work area under the influence of alcohol or any drugs.

42.0 MEDICAL FACILITIES

42.1 Medical Examination

42.1.1 The contractor shall arrange a medical examination of all his employees including his sub-contractor employees employed as drivers, operators of lifting appliances and transport equipment before employing, after illness or injury, if it appears that the illness or injury might have affected his fitness and, thereafter, once in every two years up to the age of 40 and once in a year, thereafter.

- i) The Contractor shall maintain the confidential records of medical examination or the physician authorized by the Employer.
- ii) No building or other construction worker is charged for the medical examination and the cost of such examination is borne by contractor employing such building worker.
- iii) The medical examination shall include: -
 - a) Full medical and occupational history.
 - b) Clinical examination with particular reference to
 - i) General Physique;

- ii) Vision:- Total visual performance using standard orthorator like Titmus Vision Tester should be estimated and suitability for placement ascertained in accordance with the prescribed job standards.
- iii) Hearing: - Persons with normal must be able to hear a forced whisper at twenty-four feet. Persons using hearing aids must be able to hear a warning shout under noisy working conditions.
- iv) Breathing:- Peak flow rate using standard peak flow meter and the average peak flow rate determined out of these readings of the test performed. The results recorded at pre-placement medical examination could be used as a standard for the same individual at the same altitude for reference during subsequent examination.
- v) Upper Limbs: - Adequate arm function and grip
- vi) Spine: - Adequately flexible for the job concerned.
- vii) Lower Limbs: - Adequate leg and foot concerned.
- viii) General: - Mental alertness and stability with good eye, hand and foot coordination.

c) Any other tests which the examining doctor considers necessary

42.1.2. If the contractor fails to get the medical examination conducted as mentioned above, the employer will have the right to get the same conducted by through an agency with intimation to the contractor and deduct the cost and overhead charges.

42.2 Occupational Health Centre

42.2.1 The contractor shall ensure at a construction site an occupational health centre, mobile or static is provided and maintained in good order. Services and facilities shall be provided in the manner laid down in Schedule X of BOCWR. A construction medical officer appointed in an occupational health centre, shall possess the qualification as laid down in Schedule XI of BOCWR.

42.3 Ambulance van and room

42.3.1 The Contractor shall ensure at a construction site of a building or other construction work that an ambulance van and room are provided at such construction site or an arrangement is made with a nearby hospital for providing such ambulance van for transportation of serious cases of accident or sickness of workers to hospital promptly and such ambulance room and van are maintained in good repair and is equipped with standard facilities specified in Schedule IV and Schedule V of BOCWR, respectively.

42.4 First-aid boxes

42.4.1 The contractor shall ensure at a construction site one First-aid box for 100 workers provided and maintained for providing First-aid to the building workers. Every First-aid box is distinctly marked "First-aid" and is equipped with the articles specified in Schedule III of BOCWR.

42.5 HIV/ AIDS prevention and control

42.5.1 The contractor shall adopt the Employer's Policy on "HIV / AIDS Prevention and Control for Workmen Engaged by Contractors" and the copy of the policy is given in **Appendix No: 4**.

42.5.2 The Employer will engage a professional agency for implementing the guidelines laid down in the policy and communicate to the contractor.

42.5.3 The Contractor shall extend necessary support to the appointed agency by deputing the workmen to attend the awareness creation programmes.

42.5.4 The contractor shall also extend necessary organizational support to the appointed agency for the effective implementation of the Employers' workplace policy on HIV/AIDS for workmen of the Contractors.

42.5.5 As laid down in the policy the contractor shall identify peer educators (1 for every 100 workers) and refer them for professional training to the Employers' appointed agency for the purpose.

42.5.6 The peer educators on completion of the training shall serve as the focal point for any information, education and awareness campaign among the workmen throughout the contract period.

42.5.7 The peer educators will be paid a monthly honorarium as fixed by the Employer for rendering his services in addition to his regular duty.

42.5.8 The total number of peer educators (1 for 100 workers) shall always be maintained by the contractor.

42.5.9 In case if these peer educators leave the contractor by creating vacancy, then the contractor at his own expense train the new replacement peer educator from the Employers' appointed agency for the purpose.

42.5.10 It is suggested to the contractor that due care should be taken to select the peer educators from among the group of workmen so that they remain with the contractor throughout the contract period.

42.6 Prevention of mosquito breeding

- 42.6.1 Measures shall be taken to prevent mosquito breeding at site. The measures to be taken shall include:
- i) Empty cans, oil drums, packing and other receptacles, which may retain water shall be deposited at a central collection point and shall be removed from the site regularly.
 - ii) Still waters shall be treated at least once every week with oil in order to prevent mosquito breeding.
 - iii) Contractor's equipment and other items on the site, which may retain water, shall be stored, covered or treated in such a manner that water could not be retained.
 - iv) Water storage tanks shall be provided.
- 42.6.2 Posters in both Hindi, English and local language which draw attention to the dangers of permitting mosquito breeding, shall be displayed prominently on the site.
- 42.6.3 The contractor at periodic interval shall arrange to prevent mosquito breeding by fumigation / spraying of insecticides. Most effective insecticides shall include SOLFAC WP 10 or Baytex, The Ideal Larvicide etc.

42.7 Alcohol and drugs

- 42.7.1 The contractor shall ensure at all times that no employee is working under the influence of alcohol / drugs which are punishable under Govt. regulations.
- 42.7.2 Smoking at public worksites by any employee is also prohibited as per Govt. regulations.

43.0 NOISE

- 43.1 The Contractor shall consider noise as an environmental constraint in his design, planning and execution of the Works and provide demonstrable evidence of the same on Employer's request.

The Contractor shall, at his own expense, take all appropriate measures to ensure that work carried out by the Contractor and by his sub-Contractors, whether on or off the Site, will not cause any unnecessary or excessive noise which may disturb the occupants of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise.

- 43.1.1 Without prejudice to the generality of the foregoing, noise level reduction measures shall include the following:

- i) The Contractor shall ensure that all powered mechanical equipment used in the Works shall be effectively sound reduced using the most modern techniques available including but not limited to silencers and mufflers.
 - ii) The Contractor shall construct acoustic screens or enclosures around any parts of the Works from which excessive noise may be generated.
- 43.1.2 The Contractor shall ensure that noise generated by work carried out by the Contractor and his sub-Contractors during daytime and night time shall not exceed the maximum permissible noise limits, whether continuously or intermittently, as given in the project SHE Manual. The same may be varied from time to time by and at the sole discretion of the Employer, In the event of a breach of this requirement, the Contractor shall immediately re-deploy or adjust the relevant equipment or take other appropriate measures to reduce the noise levels and thereafter maintain them at levels which do not exceed the said limits. Such measures may include without limitation the temporary or permanent cessation of use of certain items of equipment.
- 43.1.3 The noise monitoring requirements including monitoring locations are given in the project SHE Manual.
- 43.2 Noise Monitoring
- 43.2.1 The activities which are expected to cause noise during the construction of Bangalore metro, include noise from construction equipment, construction activities such as portal construction, boring for piling, earthwork excavation, concreting, viaduct construction (including shifting of launching truss / girder) and removal of spoil and movement of construction vehicles and delivery vehicles, traveling to and from the construction and disposal sites.
- 43.2.2 The level of impact of these noise sources depends upon the noise characteristics of the equipment and activities involved the construction schedule, and the distance from noise sensitive receptors.
- 43.2.3 The Noise Monitoring and Control Plan (NMCP) in contract specific site Environmental Quality Management Plan prepared by the Contractor shall establish procedures to monitor construction noise and determine when to apply measures to control noise pollution due to construction activities at work sites.
- 43.2.4 The NMCP will provide site description, define acceptable noise monitoring equipment, provide siting and operating procedures for noise equipment, and indicate reports and record keeping on noise monitoring data.
- 43.2.5 The NMCP will provide guidance for construction activity. It shall also address noise performance criteria used in the selection of construction equipment.
- 43.2.6 The Noise Monitoring and Control Plan shall provide for:
- a) Definition of noise-sensitive uses in the zones affected by construction.
 - b) Calculation of future noise levels at the closest noise-sensitive receptors to the construction activity based on construction activity and ambient noise levels.

- c) Evaluation and specification of the noise abatement measures that can be applied to meet the noise objectives.
 - d) Monitoring construction activity and providing adjustments to noise abatement controls that may be required to increase their effectiveness.
 - e) regular reporting
 - f) Requirements of NMCP:
 - (i) It shall specify the nighttime and daytime construction activities, monitoring locations, equipment, procedures, and schedule of measurements and reporting methods to be used.
 - (ii) It shall contain a scaled plan indicating monitoring location, including measurements to be taken at construction site boundaries and at nearby residential zones.
 - (iii) a record of the noise characteristics of powered mechanical equipment proposed to be used during day time and night time and of proposed working methods and of potential noise level reduction measures.
 - (iv) Provisions for immediate notification when measured noise levels exceed allowable limits,
 - (v) Provide a reporting procedure whereby noise-monitoring data is furnished to the Engineer on a weekly basis.
- 43.2.7 In defining the requirements of the NMCP, available measures for noise control, such as, the use of equipment with special exhaust silencers or enclosures, and the construction of temporary enclosures or noise barriers around specific construction site activity areas shall be considered. It should also specify the measures to be adopted to counter the impact of noise pollution for public and workers working at site during construction.
- 43.2.8 If the measured noise levels exceed the noise limits, the noise levels shall be reduced by appropriate abatement measures.
- 43.2.9 The NMCP will be reviewed on a regular basis and updated as necessary to assure current construction activities are addressed.
- 43.2.10 The Engineer shall monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures related to the control of noise.
- 43.2.11 Impact monitoring shall be carried out at noise sensitive receptor locations within 200 feet of the construction site once each week and after a change in construction activity. Construction noise measurements shall coincide with daytime and night time periods of maximum noise generating construction activities.
- 43.2.12 Noise Monitoring data will be submitted in a Noise Measurement Report Form. It will contain the type of measurement, duration of measurement, distance of monitoring from construction site, and construction equipment working during monitoring period.
- 43.2.13 appropriate parameter for measuring construction noise impacts shall be the equivalent A-weighted sound pressure level (L_{eq}) measured in decibels (dB). The two statistical sound levels

L_{10} and L_{90} ; the level exceeded for 10 and 90 percent of the time respectively, shall also be recorded during monitoring. The L_{90} may be considered as the ambient level into which the L_{10} as average peak level intrudes. The L_{max} , L_{eq} , L_{10} and L_{90} values will be reported in the noise measurement form along with allowable noise limit. The duration of monitoring shall be for a minimum of 30 minutes.

- 43.2.14 In no case shall the Contractor expose the public to construction noise levels exceeding 90dBA (slow) or to impulsive noise levels with a peak sound pressure level exceeding 140dB as measured on an impulse sound level meter.
- 43.2.15 Limit for construction noise is based on the existing ambient noise levels in areas adjoining the construction sites.
- 43.2.16 The noise levels emanating from any source during construction, shall not exceed 5 dB(A) or more above existing ambient pre-construction noise levels when measured at a point outside the premises of the location of source. The same may be varied from time to time by and at the sole discretion of the Engineer.
- 43.2.17 Where there are no ambient noise measurements, the construction activities shall be limited to levels measured at a distance of 200 feet from the construction limits or at the nearest affected building, whichever is closer, as given in **Table-2**.

TABLE-2

ALLOWABLE CONSTRUCTION NOISE

LAND USE	MAXIMUM NOISE LEVELS- L _{max} dB (A)	
	Day Time	Night Time
Residential	75	65
Commercial		85
Industrial		90

43.2.18 At the surface of the construction site during night time hours, the Contractor shall use only equipment that operating under full load meets the noise limits specified in **Table-3**, if a sensitive receptor would be affected.

TABLE-3

**NOISE EMISSION LIMITS FOR CONSTRUCTION EQUIPMENT USED DURING NIGHTTIME HOURS;
MEASURED AT 50 FEET FROM CONSTRUCTION EQUIPMENT***

Equipment Category	L _{max} Level dB(A)
Backhoe	80
Bar Bender	75
Chain Saw	81
Compactor	80
Compressor	80
Concrete Mixer	85
Concrete Pump	82
Crane	85
Dozer	85
Front End Loader	80
Generator	82
Gradall	85
Grader	85
Paver	85
Pneumatic Tools	85
Scraper	85
Tractor	84

Noise emission limits apply to equipment used at surface of the construction site during Night time hours

of 9 p.m. to 6 a.m.

- 43.2.19 The adjustments for close in equipment noise measurement shall be made in accordance with **Table-4.**

TABLE – 4
ADJUSTMENTS FOR CLOSE-IN EQUIPMENT NOISE MEASUREMENTS
(Measurement Values to be subtracted from Measured Sound)

<u>Distance (Feet)</u>	<u>Level to Estimate Sound Level at 50 Feet dB</u>
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

TABLE- 5
CONSTRUCTION VIBRATION LIMITS
VIBRATION TYPE AND PERMISSIBL

<u>AGGREGATE DURATION</u>	<u>LIMIT</u>
Sustained (1 hr/day)	0.01 in/sec (80 VdB re 10 ⁻⁶ in/sec)
Transient (<1 hr/day)	0.03 in/sec (90 VdB re 10 ⁻⁶ in/sec)
Transient (<10 min/day)	0.10 in/sec (100 VdB re 10 ⁻⁶ in/sec)

- 43.2.20 When Diesel Generator (DG) Sets are used for operation of equipment and machinery, then 'Standards and Guidelines for control of Noise Pollution from Stationery DG Sets', under Environment (Protection) Act, 1986 shall apply.

- 43.2.21 Should the impact monitoring record noise levels which are:
- Indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
 - When in the opinion of the Engineer additional measurements are required in view of deteriorating noise environment, then, the Engineer may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of noise.

- 43.2.22 The Contractor shall submit a copy of monitoring results. The results should represent a

statistical evaluation of data for evaluation of trends and comparison with noise emission standards.

43.2.23 Where the Engineer determines that the recorded Noise level is significantly greater than the acceptable levels, the Engineer may direct the Contractor to take effective remedial measures including, but not limited to, reviewing noise sources and modifying working procedures.

43.2.24 The Contractor shall inform the Engineer of all steps taken to investigate cause of exceedance and immediate action taken to avoid further exceedance through written reports and proposals for action under an Event Contingency Plan.

43.3 Control Requirements

43.3.1 Construction material should be operated and transported in such a manner as not to create unnecessary noise as outlined below:

- i) Perform Work within the procedures outlined herein and comply with applicable codes, regulations, and standards established by the Central and State Government and their agencies.
- ii) Keep noise to the lowest reasonably practicable level. Appropriate measures will be taken to ensure that construction works will not cause any unnecessary or excessive noise, which may disturb the occupants of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise. Use equipment with effective noise-suppression devices and employ other noise control measures as to protect the public.
- iii) Schedule and conduct operations in a manner that will minimize, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.
- iv) The Contractor shall submit to the Employer a Noise Monitoring and Control Plan (NMCP) under contract specific Site Environmental Plan. It shall include full and comprehensive details of all powered mechanical equipment, which he proposes to use during daytime and night - time, and of his proposed working methods and noise level reduction measures. The NMCP shall include detailed noise calculations and vibration levels to demonstrate the anticipated noise generation and vibrations by the Contractor.
- v) The NMCP prepared by the Contractor shall guide the implementation of construction activity. The NMCP will be reviewed on a regular basis and updated as necessary to assure that current construction activities are addressed. It may appear as a regular agenda item in project coordination meetings, if noise is an issue at any location in the contract.

43.3.2 Dust Control and Silicosis Exposure Reduction Strategy:

The Contractor shall ensure proper dust handling at work site as described in the project specific Environment Management Plan and follow Silicosis Exposure Reduction Strategy as described at **Annexure-I** at the end of this document.

43.4 Occupational Noise

- i) Protection against the effects of occupational noise exposure should be provided when the sound level exceeds the threshold values as provided in Project SHE Manual.
- ii) When employees are subjected to sound levels exceeding those listed in the Table, feasible administrative or engineering controls should be utilized as given in this document and K-RIDE's Project SHE Manual.
- iii) If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.
- iv) When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. Exposure to different levels for various periods of time shall be computed according to the formula and sample computations, as given in project SHE Manual.

43.4 Vibration Level

43.4.1 In locations where the alignment is close to historical / heritage structures, the contractor shall prepare a monitoring scheme prior to construction at such locations. This scheme for monitoring vibration level at such historical / heritage sites shall be submitted to Employer for his approval. This scheme shall include:

- i) Monitoring requirements for vibrations at regular intervals throughout the construction period.
- ii) Pre-construction structural integrity inspections of historic and sensitive structures in project activity.
- iii) Information dissemination about the construction method, probable effects, quality control measures and precautions to be used.
- iv) The vibration level limits at work sites adjacent to the alignment shall conform to the permitted values of peak p velocity as given in article project SHE Manual.

44.0 VENTILATION AND ILLUMINATION

44.1 Ventilation

44.1.1 The contractor shall ensure at a construction site of a building or other construction work that all working areas in a free tunnel are provided with ventilation system as approved by the DG and

the fresh air supply in such tunnel is not less than 6m³/min for each building worker employed underground in such tunnel and the free air flow movement inside such tunnel is not less than 9m/min.

44.1.2 The oxygen level shall not be less than 19.5% in the working environment.

44.2 Illumination

44.2.1 The contractor shall take every effort to illuminate the work site as per the Employer's requirement illustrated in general instruction **K-RIDE/SHE/CEO/011**.

44.2.2 The contractor shall conduct a monthly illumination monitoring by lux meter for all the locations and the report shall be sent to the Employer within 7th of the next month and the same shall be reviewed during the monthly SHE committee meeting.

45.0 RADIATION

45.1 The use of radioactive substances and radiating apparatus shall comply with the Govt. regulatory requirements and all applicable legislations.

45.2 Operations involving ionizing radiation shall only be carried out after having been reviewed without objection by the Employers representative and shall be carried out in accordance with a method statement.

45.3 Each area containing irradiated apparatus shall have warning notices and barriers, as required by the Regulations, conspicuously posted at or near the area.

45.4 Radioactive substances will be stored, used or disposed shall be strictly in accordance with the Govt. Enactments.

45.5 The contractor shall ensure that all site personnel and members of the public are not exposed to radiation.

46.0 WELFARE MEASURES FOR WORKERS

46.1 Latrine and Urinal Accommodation

46.1.1 The contractor shall provide one latrine seat for every 20 workers up to 100 workers and thereafter one for every additional 50 workers. In addition one urinal accommodation shall be provided for every 100 workers.

46.1.2 When women are employed, separate latrine and urinals accommodation shall be provided on the same scale as mentioned above.

- 46.1.3 Latrine and urinals shall be provided as per Section 33 of BOCWA and maintained as per Rule 243 of BOCWR and shall also comply with the requirements of public health authorities
- 46.1.4 Moving sites
- 46.1.4.1 In case of works like track laying, the zone of work is constantly moving at elevated level or at underground level. In such cases mobile toilets with proper facility to drain the sullage shall be provided at reasonably accessible distance.
- 46.1.5 In case if the contractor fail to provide required number of urinals and latrines or fail to maintain it as per the requirements of Public Health laws, the Employer shall have the right to provide/maintain through renowned external agencies like “Sulabh” at the cost of the contractor.
- 46.2 Canteen
- 46.2.1 In every workplace wherein not less than 250 workers are ordinarily employed the contractor shall provide an adequate canteen conforming to Section 37 of BOCWA, read with Rule 244 of BOCWR and as stipulated in Rule 247 of BOCWR the changes for food stuff shall be based on ‘no profit no loss’ basis. The price list of all items shall be conspicuously displayed in such canteen.
- 46.3 Serving of tea and snacks at the workplace
- 46.3.1 As per Rule 246 of BOCWR, at a building or other construction work where a workplace is situated at a distance of more than 200 m from the canteen provided under Rule 244(1) of BOCWR, the contractor employing building works shall make suitable arrangement for serving tea and light refreshment to such building works at such place.
- 46.4 Drinking water
- 46.4.1 As per Section 32 of BOCWA the contractor shall make in every worksite, effective arrangements to provide sufficient supply of wholesome drinking water with minimum quantity of 5 litres per workman per day. Quality of the drinking water shall conform to the requirements of national standards on Public Health
- 46.4.2 While locating these drinking water facilities due care shall be taken so that these are easily accessible within a distance of 200m from the place of work for all workers at all location of work sites.

- 46.4.3 All such points shall be legible marked "Drinking Water" in a language understood by a majority of the workmen employed in such place and such point shall be situated within six metres of any washing places, urinals or latrines.
- 46.5 Labour Accommodation
- 46.5.1 The contractor shall provide free of charges as near as possible, temporary living accommodation to all workers conforming to provisions of Section 34 of BOCWA. These accommodations shall have cooking place, bathing, washing and lavatory facilities
- 46.6 Crèche
- 46.6.1 In every workplace where in more than 50 female workers are ordinarily employed, there shall be provided and maintained a suitable room for use of children under age of 6 yrs, conforming to the provisions of Section 35 of BOCWA.

PART IV : ENVIRONMENTAL MANAGEMENT

47.0 ENVIRONMENTAL MANAGEMENT

Environment Management during construction shall include implementation of Environment Management plan and compliance of pollution control measures at work sites.

Major Statutory Environmental Acts, Rules, Standards, for the time being enforce and as may be amended or substituted from time to time, are listed below:

- i. Environment (Protection) Act, 1986 and Rules therein
- ii. EIA Notification, 2020
- iii. Air (Prevention and Control of Pollution) Act, 1981
- iv. Water (Prevention and Control of Pollution) Act, 1974
- v. Wildlife (Protection) Act, 1972
- vi. Forests (Conservation) Act, 1980
- vii. Coastal Regulation Zone Notification, 2011
- viii. The Wetlands (Conservation and Management) Rules, 2010
- ix. Karnataka Preservation of tress Act 1976
- x. Noise Pollution (Regulation and Control) Rules, 2000
- xi. Public Liability Insurance Act, 1991
- xii. Explosive Act, 1884
- xiii. Hazardous and other Wastes (Management and Transboundary Movement) Rules, 2016

- xiv. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- xv. The Petroleum Rules, 2002
- xvi. Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and National Monuments Authority (Condition of Service of Chairman and Members of the Authority and Conduct of Business) Rules, 2011
- xvii. Mineral Concession Rules, 1960
- xviii. National Green Tribunal Act, 2010 and National Green Tribunal (Prevention and Protection) Rules, 2011

47.1 Environmental Monitoring

- 47.1.1 The Contractor's Environmental Team shall carry out the monitoring of environmental impacts during construction. Representative sensitive receivers in the vicinity of the works shall be monitored for noise and air quality impacts.
- 47.1.2 For carrying out impact monitoring for noise and air, equipment shall be provided, operated and maintained by the Contractor. The equipment shall be kept in a good state of repair in accordance with the manufacturer's recommendations and maintained in proper working order with sufficient spare equipment available in the event of breakdown to maintain the planned monitoring program.
 - 47.1.2 The calibration of monitoring instruments and their respective calibrators shall be carried out in accordance with the manufacturer's requirements to ensure they perform to the same level of accuracy as stated in the manufacturer's specifications.
 - 47.1.3 Suspended Particulate Matter (SPM) levels shall be measured by following the standard high volume sampling method as set out in High Volume Method for Suspended Particulate, BIS: 5182-1981
 - 47.1.4 24-hour average SPM concentration shall be measured by drawing air through a High Volume Sampler (HVS) fitted with pre-weighted Glass Fiber filter paper at an average flow rate not less than 1.1m³ per minute.
 - 47.1.5 The minimum requirements to the specifications of sound level meter should be as given in IS: 9779-1981
 - 47.1.6 Engineer will undertake baseline monitoring to establish background levels. Action Level of the Contractor shall be based on the results of baseline monitoring program, which will be made available to him prior to start of construction.

47.1.7 The Contractor's monitoring program is summarized in **Table –1**.

TABLE-1
SUMMARY OF CONTRACTOR'S MONITORING PROGRAMME

Parameter	Noise	Air
Sampling	Day Time (6.00 to 22.00 hrs): L _{max} , L _{eq} , L ₁₀ , L ₉₀ , L ₅₀ Night Time (9 PM – 6AM): L _{max} , L _{eq} , L ₁₀ , L ₉₀ , L ₅₀ , L _{dn}	RSPM, SPM 24-hours of the day CO: 12 hrs from 8.00 to 20.00 hrs.
Frequency At each location	Once a week (when noise generating activities are underway).	Two 24-hour Samples every fifteen days at uniform intervals.
Locations	To be determined by the Contractor based on noise sensitive receptors.	To be determined by the Contractor based on air sensitive receptors.
Number of Locations	4 Locations	2 Locations
Duration of Monitoring by Contractor	During Civil Construction	During Civil Construction
Additional Requirements	Adhoc monitoring as required.	Ad hoc monitoring as required

47.2 Event Contingency Plan

The Contractor shall prepare an Event Contingency Plan under his Site Environmental Plan. The purpose is to provide, in addition to monitoring activities, procedures for ensuring that if any environmental exceedance of limiting values (either accidental or through inadequate implementation of mitigation measures on part of the Contractor) does occur, the cause is quickly identified and remedied, and that the risk of a similar event recurring is reduced.

47.3 Air Quality

47.3.1 The Contractor shall take all necessary precautions to minimise fugitive dust emissions from operations involving excavation, grading, and clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, construction or storage activity to remain visible in atmosphere beyond the property line of emission source for any prolonged period of time without notification to the Employer.

- 47.3.2 The Contractor shall use construction equipment designed and equipped to minimise or control air pollution. He shall maintain evidence of such design and equipment and make these available for inspection by Employer.
- 47.3.3 If after commencement of construction activity, Employer believes that the Contractor's equipment or methods of working are causing unacceptable air pollution impacts then these shall be inspected and remedial proposals shall be drawn up by the Contractor, submitted for review to the Employer and implemented.
- 47.3.4 In developing these remedial measures, the Contractor shall inspect and review all dust sources that may be contributing to air pollution. Remedial measures include use of additional / alternative equipment by the Contractor or maintenance / modification of existing equipment of the Contractor.
In the event that approved remedial measures are not being implemented and serious impacts persist, the Employer may direct the Contractor to suspend work until the measures are implemented, as required under the Contract.
- 47.3.5 Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India or the State Government from time to time. The Contractor shall carry out periodical checks and undertake remedial measures including replacement, if required, so as to operate within permissible norms.
- 47.3.6 The Contractor shall establish and maintain records of routine maintenance program for internal combustion engine powered vehicles and equipment used on this project. He shall keep records available for inspection by Employer.
- 47.3.7 The Contractor shall cover loads of dust generating materials like debris and soil being transported from construction sites. All trucks carrying loose material should be covered and loaded with sufficient free-board to avoid spills through the tailboard or sideboards.
- 47.3.8 The Contractor shall promptly transport all excavation disposal materials of whatever kind so as not to delay work on the project. Stockpiling of materials will only be allowed at sites designated by the Employer. The Contractor shall place excavation materials in the dumping/disposal areas designated in the plans as given in the specifications.
- 47.3.9 The temporary dumping areas shall be maintained by the Contractor at all times until the excavate is re-utilised for backfilling or as directed by Employer. Dust control activities shall continue even during any work stoppage.
- 47.3.10 The Contractor shall place material in a manner that will minimize dust production. Material shall be minimized each day and wetted, to minimize dust production. During dry weather, dust

control methods must be used daily especially on windy, dry days to prevent any dust from blowing across the site perimeter.

- 47.3.11 The Contractor shall water down construction sites as required suppressing dust, during handling of excavation soil or debris or during demolition. The Contractor will make water sprinklers, water supply and water delivering equipment available at any time that it is required for dust control use. Dust screens will be used, as feasible when additional dust control measures are needed especially where the work is near sensitive receptors.
- 47.3.12 The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. At such facility, high-pressure water jets will be directed at the wheels of vehicles to remove all spoil and dirt.
- 47.3.13 The Contractor shall design and implement his blasting techniques so as to minimise dust, noise, vibration generation and prevention fly rock.
- 47.3.14 Blasting technique should be consistent not only with nature and quantity of rock to be blasted but also the location of blasting.
- 47.3.15 The contractor shall give preference to explosives with better environmental characteristics.
- 47.3.16 The Contractor shall protect structures, utilities, pavements roads and other facilities from disfiguration and damage as a result of his activities. Where this is not possible, the contractor shall restore the structures, utilities, pavements, roads and other facilities to their original or better, failing which the rectification/restoration work shall be carried out at the risk and cost of the contractor.
- 47.3.17 The Contractor shall submit to the Employer an Air Monitoring and Control Plan (AMCP) under contract specific Site Environmental Plan to guide construction activity insofar as it relates to monitoring, controlling and mitigating air pollution.

47.4 Air Monitoring

- 47.4.1 Construction activities that will generate dust impacts include excavation (including related activities), material handling and stockpiling, vehicular movement, and wind erosion of unpaved work areas.
- 47.4.2 The impact of fugitive dust on ambient air pollution depends on the quantity generated, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and smaller particles are likely to undergo dispersal over greater distance from the sources and impeded settling. SPM levels will be monitored to evaluate the dust impact during the construction phase of the Project.
- 47.4.3 The Air Quality Monitoring and Control Plan (AMCP) in contract-specific Site Environmental Plan

prepared by the Contractor shall establish procedures to monitor impact air quality and measures to control air pollution including dust suppression due to construction activities at work sites. This plan shall contain description of activities that will cause degradation in air quality, environmental procedures to manage pollutants to minimize the air pollution, monitoring program, record keeping and reporting.

47.4.4 The Engineer shall monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures related to the control of air quality given in AMCP.

47.4.5 Information gathered during the AMCP will be catalogued and maintained by the Contractor and shall be available for review by the Engineer.

47.4.6 The exact location of the air monitoring stations located near air sensitive receptors adjoining the construction sites, such as residences, schools, hotels and hospitals and placement of monitoring equipment thereat shall be agreed with the Engineer prior to commencement of air monitoring program.

47.4.7 Impact monitoring during the course of the Works shall be carried out at the monitoring stations for two days (continuous twenty-four hours) every fifteen days and where there is a perceived air quality problem.

47.4.8 The Contractor shall construct suitable fence, lockable gate, 220V AC power point and suitable access at each air monitoring station. Monitoring stations shall be free from local obstructions or sheltering.

47.4.9 Should impact monitoring record dust levels which are:

- i) Indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
- ii) When in the opinion of the Engineer additional measurements are required in view of deteriorating air quality,

Then the Engineer may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of air quality.

47.4.10 The Contractor shall keep records of air quality monitoring (including location, date, time). The Contractor shall submit a copy of monitoring results to the Engineer. The results should represent a statistical evaluation of data by calculating maximum, minimum, mean, standard deviation, geometric mean and percentile calculations for evaluation of frequency distribution, trends, and comparison with emission standards.

47.4.11 The National Ambient Air Quality Standards given in Air (Prevention and Control of Pollution) Act, 1981 may be referred by the Contractor for Limit Levels of SPM in ambient air which may be followed in estimating the pollution level caused by Contractor's activities.

47.4.12 Where the Engineer determines that the recorded dust (TSP) level is significantly greater than

the Limit levels, the Engineer may direct the Contractor to take effective remedial measures including, but not limited to, reviewing dust sources and modifying working procedures.

- 47.4.13 Where the recorded baseline levels exceed the ambient air quality standards, then at such locations the action level is the recorded base line. Contractor shall take all effective remedial measures to contain the levels to their baseline value as a result of his activities. The action level may be varied by and at the sole discretion of the Engineer.
- 47.4.14 The Contractor shall inform the Engineer of all steps taken to investigate cause of exceedance and immediate action taken to avoid further exceedance through written reports and proposals for action under an Event Contingency Plan.

48.0 WATER QUALITY

- 48.1 The Contractor shall comply with the Indian Government legislation and the State regulations in existence insofar as they relate to water pollution control and monitoring. A drainage system should be constructed at the commencement of the Works, to drain off all surface water from the work site into suitable drain outlet.
- 48.2 The Contractor shall provide adequate precautions to ensure that no spoil or debris of any kind is pushed, washed, falls or deposited on land adjacent to the site perimeter including public roads or existing stream courses and drains within or adjacent to the site. In the event of any spoil or debris from construction works being deposited or any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Employer.
- 48.3 Due to lowering of potable water supplies in Bangalore and subsequent contamination of ground water, the Contractor is not allowed to discharge water from the site without the approval of the Employer. The Contractor must comply with the requirements of the Local Ground Water Board for discharge of water arising from dewatering. Any water obtained from dewatering systems installed in the works must be either re-used for construction purposes and this water may subsequently be discharged to the drainage system or, if not re-used, recharged to the ground water at suitable aquifer levels. The Contractor must submit his proposals for approval of Employer, on his proposed locations of dewatering of excavation and collection of water for either construction re-use or recharge directly to aquifers.

The Contractor's recharge proposals must be sufficient for recharging of the quantity of water remaining after deduction of water re-used for construction. During dewatering, the contractor shall monitor ground water levels from wells to ensure that draw down levels do not exceed allowable limits. The Contractor will not be permitted to directly discharge, to the drainage system, unused ground water obtaining from the excavation without obtaining approval of Employer or the Agency controlling the system.

- 48.4 The Contractor shall ensure that earth, bentonite, chemicals and concrete agitator washings etc. are not deposited in the watercourses but are suitably collected and residue disposed of in a manner approved by local authorities.
- 48.5 All water and waste products (surface runoff and wastewater) arising on the site shall be collected and removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance.
- 48.6 Any mud slurry from drilling, tunnelling, diaphragm wall construction or grouting etc. shall not be discharged into the drainage system unless treatment is carried out that will remove silt, mud particles, bentonite etc. The Contractor shall provide treatment facilities as necessary to prevent the discharge of contaminated ground water.
- 48.7 The Contractor shall discharge wastewater arising out of site office, canteen or toilet facilities constructed by him into sewers after obtaining prior approval of agency controlling the system. A wastewater drainage system shall be provided to drain wastewater into the sewerage system.
- 48.8 The bentonite mixing, treatment and handling system shall be established by the contractor giving due regard to its environmental impacts. The disposal of redundant bentonite shall be carefully considered whether in bulk or liquid form. The disposal location will be advised and agreed with the relevant authorities.
- 48.9 The Contractor shall take measures to prevent discharge of oil and grease during spillage from reaching drainage system or any water body. Oil removal / interceptors shall be provided to treat oil waste from workshop areas etc.
- 48.10 The Contractor shall apply to the appropriate authority for installing bore wells for water supply at site.

49.0 ARCHAEOLOGICAL AND HISTORICAL PREVENTION

- 49.1 The contractor shall seek to accommodate archaeological and historical preservation concerns that may arise due to the construction of the project especially in close vicinity of such areas where such monuments may be located.
- 49.2 The contractor shall consult the Archaeological Survey of India (ASI) and other parties, on the advice of the Employer, to identify and assess construction effects and seek ways to avoid, minimize or mitigate adverse effects on such monuments.

- 49.3 Adverse effects may include reasonably foreseeable effects caused by the construction that may occur later in time, be farther removed in distance or those that alter, howsoever temporarily, the significance of the structure.

50.0 LANDSCAPE AND GREENERY

- 50.1 As far as is reasonably practicable, the Contractor shall maintain ecological balance by preventing deforestation and defacing of natural landscape. In respect of ecological balance, the Contractor shall observe the following instructions.
- 50.2 The Contractor shall, so conduct his construction operations, as to prevent any avoidable destruction, scarring or defacing of natural surroundings in the vicinity of work.
- 50.3 Where destruction, scarring, damage or defacing may occur as a result of operations relating to Permanent or Temporary works, the same shall be repaired, replanted or otherwise corrected at Contractor's expense. All work areas shall be smoothed and graded in a manner to conform to natural appearance of the landscape as directed by the Employer.
- 50.4 A suggested list of trees / shrubs suitable for planting and landscaping is found in Employer's Project SHE Manual.

51.0 FEELING OF TREES

- 51.1 The contractor shall identify the number and type of trees that are require to be felled as a result of construction of works and facilities related to Bangalore Sub Urban Rail Project and inform the Employer.
- 51.2 All trees and shrubbery, which are not specifically require to be cleared or removed for construction purposes, shall be preserved and shall be protected from any damage that may be caused by Contractor's construction operations and equipment. The contractor shall not fell, remove or dispose of any tree or forest produce in any land handed over to him for the construction of works and facilities related to Bangalore Sub Urban Rail Project except with the previous permission obtained from the Forest Department.
- 51.3 The Employer shall arrange permission from the forest department for trees to be felled or transplanted. The Employer will permit the removal of trees or shrubs only after prior approval.
- 51.4 Special care shall be exercised where trees or shrubs are exposed to injuries by construction equipment, blasting, excavating, dumping, chemical damage or other operation and the Contractor shall adequately protect such trees by used of protective barriers or other methods approved by the Employer. Trees shall not be used for anchorage.

52.0 FLY ASH

- 52.1 The Employer may require the contractor to use fly ash as a percentage substitution of cement, in concrete for certain structures and works.
- 52.2 In all such uses of Fly Ash, the contractor shall maintain a detailed record of usage of Fly Ash. The contractor shall also collect related details and provide to the Employer.
- 52.3 The reporting details on consumption of Fly Ash are found in Employer's SHE Manual.

53.0 WASTE

- 53.1 The contractor is required to develop, institute and maintain a Waste Management Programme (WMP) during the construction of the project for his works, which may include:
- i) Identification of disposal sites.
 - ii) Identification of quantities to be excavated and disposed of.
 - iii) Identification of split between waste and inert material
 - iv) Identification of amounts intended to be stored temporarily on site location of such storage.
 - v) Identification of intended transport means and route.
 - vi) Obtaining permission, where required, for disposal.
- 53.2 Such a mechanism is intended to ensure that the designation of areas for the segregation and temporary storage of reusable and recyclable materials are incorporate into the WMP. The WMP should be prepared and submitted to the Engineer for approval.
- 53.3 The Contractor shall handle waste in a manner that ensures they are held securely without loss or leakage thus minimizing potential for pollution. The Contractor shall maintain and clean waste storage areas regularly.
- 53.4 The Contractor shall remove waste in a timely manner and disposed of at landfill sites after obtaining approval of the competent authorities namely BBMP, BDA, BMRDA, BWSSB.
- 53.5 Burning of wastes is prohibited. The Contractor shall not burn debris or vegetation or construction waste on the site but remove it in accordance with **50.1** above.
- 53.6 The Contractor shall make arrangement to dispose of metal scrap and other saleable waste to authorized dealer and make available to the Employer on request, records of such sales.

54.0 HAZARDOUS WASTE MANAGEMENT

- 54.1 If encountered or generated as a result of Contractor's activity, then waste classified as hazardous under the "Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016, as amended from time to time shall be disposed of in a manner in compliance with the procedure given in the rules under the aforesaid act.
- 54.2 Chemicals classified as hazardous chemicals under "Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 incorporated under the provisions of Environment (Protection) Act, 1986 shall be disposed of in a manner in compliance with the procedure given in the rules under the aforesaid act.
- 54.3 The contractor shall identify the nature and quantity of hazardous waste generated as a result of his activities and shall file a 'Request for Authorisation' with Bangalore Pollution Control Board along with a map showing the location of storage area.
- 54.4 Outside the storage area, the contractor shall place a 'display board', which will display quantity and nature of hazardous waste, on date. Hazardous Waste needs to be stored in a secure place
- 54.5 It shall be the responsibility of the contractor to ensure that hazardous wastes are stored, based on the composition, in a manner suitable for handling, storage and transport. The labelling and packaging is required to be easily visible and be able to withstand physical conditions and climatic factors.
- 54.6 The contractor shall approach only Authorised Recyclers of Hazardous Waste for disposal of Hazardous Waste, under intimation to the Employer.
- 54.7 Submittal of all environment related documents and records pertaining to monitoring and trend analysis on key parameters such as but not limited to consumption/efficient use of resources such as energy, water, material such as cement, fly ash, iron and steel, recycle/reuse of waste etc that shall have demonstrated continual improvement in the implementation of Environmental management System. Failure to do so the employer shall impose appropriate penalty as indicated under penalty clause.

55.0 ENERGY MANAGEMENT

- 55.1 The contractor shall use and maintain equipment so as to conserve energy and shall be able to produce demonstrable evidence of the same upon Employer's request.
- 55.2 Measures to conserve energy include but not limited to the following:

- i) Use of energy efficient motors and pumps
- ii) Use of energy efficient lighting, which uses energy efficient luminaries
- iii) Adequate and uniform illumination level at construction sites suitable for the task
- iv) Proper size and length of cables and wires to match the rating of equipment
- v) Use of energy efficient air conditioners

55.3 The contractor shall design site offices maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible.

K-RIDE

PART –V : PENALTY AND AWARDS**56.0 CHARGES TO BE RECOVERED FROM CONTRACTOR FOR UNSAFE ACT OR CONDITION**

56.1 K-RIDE is safety conscious organisation. Any reportable accident (fatality / injury) results in loss of life and/or property damage. These accidents not only result in loss of life but also damage the reputation of K-RIDE. Most of the accidents are avoidable and caused preliminary due to contractors' negligence. Hence K-RIDE shall recover the cost of damages from the contractors for every reportable incident (fatality / injury).

56.2 In addition every K-RIDE work site is exposed to public scrutiny as the work is executed just on the right-of-way. Any unsafe act / unsafe condition observed by public further damage our reputation. Because of the non-voluntary compliance of contractors to the condition of contract on SHE and project SHE manual, K-RIDE has been forced to establish safety-enforcing organisation. The cost of established such organisation is to be recovered from contractors for all observed safety violations at sites.

56.3 The following table indicates the Safety, Health and Environment violation (unsafe act / unsafe condition) and charges to be recovered from contractors.

SL. NO	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
1	SHE Policy & Plan	i) SHE policy non-compliance of clause 4.1	Rs.5,000 per single violation, compounded to a maximum of Rs.25,000 at any single instance.
		SHE plan: I. Not as per Employers' content and coverage (clause 4.2, 4.7) II. Delay in submission (clause 4.2, 4.4) III. Not updated as per employer's instruction as per clause 4.4 IV. Copies not provided to all required supervisors / engineers (clause 4.6)	Rs.1,00,000 per single violation, compounded to a maximum of Rs.2,00,000 at any single instance.
2	SHE Organisation	I. Not complying to the minimum manpower requirements as mentioned in General Instruction K-RIDE /SHE/CEO/ 001(clause 6.1.1)	Rs.1,00,000 per month for first month and Rs.2,00,000 for subsequent months
		II. Not filling up the vacancies created due to SHE personnel leaving the contractor within 14 days.(clause 6.7)	Rs.50,000 per month for first month and Rs.1,00,000 for subsequent months
		III. SHE organization not provided with	

		<p>required Audio-visual and other equipment's as per General Instruction K-RIDE /SHE/CEO/03 (clause 6.9.2)</p> <p>IV. Employing through outsourcing agencies and SHE personal are not in the payroll of the main contractor (clause 6.5.1)</p> <p>V. Disobedience / Improper conduct of any SHE personnel. (clause 6.2)</p> <p>VI. Chief SHE Manager not reporting directly to CPM of contractor. (clause 6.6)</p>	<p>For items iii), iv), v) and vi)</p> <p>Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations</p>
3	SHE committee	<p>I. Failed to formulate or conduct SHE Committee meeting for any month (clause 7.4)</p> <p>II. Contractor and Sub-contractor representatives not attending SHE Committee meetings (clause 7.10)</p> <p>III. Failed to conduct Site inspection before conducting SHE Committee meeting (clause 7.2.1 (viii))</p> <p>IV. Failed to send SHE Committee Meeting minutes or Agenda to Employer in time (clause 7.8.1, 7.9.1)</p> <p>V. Non-adherence of clause 7.7.1</p> <p>VI. Non-adherence of clause 7.9</p>	<p>Rs.1,00,000 for the first violation and Rs.5,00,000 for the subsequent violations</p> <p>Rs.5, 000 to the contractor of the member who had not attended the meeting for first violation and Rs.25,000 for subsequent violations.</p> <p>For item iii), iv), v) and vi)</p> <p>Rs.25,000 for first violation and Rs.50,000 for subsequent violations</p>
4	ID card	Non-adherence of clause 8.1, 8.2 and 8.3	<p>Rs.1,00,000 for first violation and Rs.2,00,000 for subsequent violations</p>
5	SHE Training	<p>I. not complying to the requirements as mentioned in conditions of contract on SHE and project SHE manual with regard to:</p> <p>II. Induction training not given (clause 8.1)</p> <p>III. Supervisor/engineer/manager training not conducted as per clause 9.6</p> <p>IV. Refresher training as per clause 9.7 and 9.11 not conducted</p> <p>V. Tool-box talk not conducted as per clause 9.8</p> <p>VI. Skill development training not conducted as clause 9.9</p>	<p>For item 1 a) to g)</p> <p>Rs.50,000 for first violation on and Rs.1,00,000 for subsequent violations</p>

		VII. Daily Safety Oath not conducted as per clause 9.10 VIII. Top management behaviour based SHE training conducted (clause 9.4)	
6	SHE Inspection	I. Not complying to the requirements as mentioned in conditions of contract on SHE and project SHE manual as per clause 10.0 II. Noncompliance of clause 10.3.6	Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations
7	SHE audit	I. Internal Audit: MARS II. Not conducted as per SHE Plan (clause 11.2.1) III. Report not sent to Employer (clause 11.2.6) IV. Action not taken for any month (clause 11.2.4)	For item i) to iii) Rs.50, 000 for first violation and Rs.1,00,000 for subsequent violations.
		I. External Audit II. Not conducted as per SHE Plan (clause 11.4.3) III. Report not sent to employer (clause 11.4.7) IV. Action not taken for any quarter (clause 11.4.9)	For item iv) to vi) Rs.1,00,000 for first violation and Rs.2,00,000 for subsequent violations.
8	SHE Communication	Important days to be observed for SHE awareness as furnished by employer not observed (clause 12.2) Posters as furnished by Employer not printed and displayed (clause 12.2)	Rs.10,000 for first violation and Rs.50,000 for subsequent violations 2,00,000 per contract
9	SHE Submittals	I. noncompliance of clause 13.1 II. Noncompliance of clause 13.2 III. Noncompliance of clause 13.3	For item i) Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations For item ii) and iii) Rs.1,00,000 for first violation and Rs.2,00,000 for subsequent violations
10	Injury and Incidence reporting	I. Fatal accidents II. Injury accident III. Abnormal delay in reporting accidents or willful suppression of information about any accidents / dangerous occurrence as per clause 14.1.4 IV. Non-compliance of the clause 14.4	Rs.5,00,000 for first fatality and Rs.10,00,000 for every subsequent fatality. Rs.1,00,000 for first grievously injured person and Rs.2,00,000 for every subsequent grievously injured person

			(Grievous Injury as defined by Workmen Compensation Act) Rs.1,00,000 for first violation and Rs.2,00,000 for subsequent violations For items iv) and v) Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations
11	Emergency preparedness Plan	Non-compliance of the clause 15.1,15.2, 15.3, 15.4, 15.5 and 15.6	Rs.1,00,000 for non-compliance of any of the clauses
12	Housekeeping	<ul style="list-style-type: none"> I. Housekeeping maintenance register not properly maintained up to date (clause 17.4) II. Surrounding areas of drinking water tanks / taps not hygienically cleaned / maintained (clause 17.4) III. Office, stores, toilet / urinals not properly cleaned and maintained. (Clause 17.4) IV. Required dustbins at appropriate places not provided / not cleaned. (Clause 17.6) V. Stairways, gangways, passageways blocked. (Clause 17.9) VI. Lumber with protruding nails left as such (clause 17.10) VII. Openings unprotected (clause 17.7) VIII. Excavated earth not removed within a reasonable time. (Clause 17.15, 47.8) IX. Truck carrying excavated earth not covered / tyres not cleaned. (Clause 17.11) X. Vehicles / equipment's parked / placed on roads obstructing free flow of traffic (clause 17.13) XI. Unused surplus cables / steel scraps lying scattered (clause 17.17) XII. Wooden scraps, empty wooden cable drums lying scattered (clause 17.18) XIII. Water stagnation leading to mosquito breeding (clause 42.6.1) 	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
13	Working at Height	I. Not using or anchoring Safety Belt (clause 18.9)	Rs.10,000 per single violation Compounded to a maximum of

	/ Ladders and Scaffolds	<ul style="list-style-type: none"> II. Not using Safety Net (clause 18.18) III. Absence of life line or anchorage point to anchor safety belt (clause 18.19) IV. Non-compliance of clause 18.17 V. Using Bamboo ladders (clause 18.20) VI. Painting of ladders VII. Improper usage (less than 1m extension above landing point, not maintaining 1:4 ratio) (clause 18.20) VIII. Aluminum ladders without base rubber bush (clause 18.20) IX. Usage of broken / weak ladders (clause 18.20) X. Usage of re-bar welded ladders (clause 18.20) XI. Improper guardrail, toe board, barriers and other means of collective protection (clause 18.16) XII. Improper working platform (clause 18.17) XIII. Working at unprotected fragile surface (clause 18.9) XIV. Working at unprotected edges (clause 20.0) 	Rs.1,00,000 at any single instance
14	Lifting appliances and gear	<ul style="list-style-type: none"> I. Non availability of fitness certificate as per clause 21.3 II. Documents not displayed on the machine or not available with the operator as per clause 21.4 III. Maximum Safe Working Load not written on the machine as per clause 21.5 IV. Non-compliance of 21.6 V. Non-compliance of 21.7 VI. Automatic safe load indicator not provided or not in working condition as per clause 21.8 VII. Age of the operator less than 21 years or without any licence and non-compliance of other item as per clause 21.9 VIII. Non-compliance of 21.10 IX. Non-compliance of any of the items mentioned regarding rigging 	Rs.50,000 per single violation Compounded to a maximum of Rs.5,00,000 at any single instance

		<p>requirements as per clause 21.11</p> <p>X. Failure to submit method statement in case of all critical lifting (clause 21.3)</p> <p>XI. Person riding on crane. (clause 23.4)</p> <p>XII. Creating more noise and smoke (clause 43.1.1)</p> <p>XIII. Absence of portable fire extinguisher in driver cabin (clause 31.5)</p> <p>XIV. Fail to guard hoist platform (clause 24.0)</p> <p>XV. No fencing of hoist rope movement area (clause 24.0)</p> <p>XVI. Hoist platform not in the horizontal position (clause 21.2)</p>	
15	Launching Operation / Erection	Non-adherence of any of the provisions mentioned in clause 22.2	Rs. 50,000 for first violation and Rs.1,00,000 for subsequent violations
16	Site Electrical safety	<p>I. Non-compliance of clause 26.1.1</p> <p>II. Non-compliance of clause 26.2.3, 26.2.4 & 26.2.5</p> <p>III. Non-compliance of clause 26.3.1</p> <p>IV. Non-compliance of clause 26.7, 26.8 and 26.9.1</p> <p>V. Non-compliance of clause 26.10 and 26.13</p> <p>VI. Non-compliance of clause 28.3.2</p> <p>VII. Exposed electric lines (fermentative damage) and circuits in the workplace. (clause 26.5.1)</p> <p>VIII. Inserting of wires directly into the socket</p> <p>IX. Improper grounding for the electrical appliances (clause 26.7.1)</p> <p>X. Electrical cables running on the ground (clause 26.8.5 & 26.8.6)</p> <p>XI. Non-compliance clause 27.0</p>	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
17	Hand tools and Power tools	Non-compliance of clause 28.0	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
18	Gas Cutting	<p>I. Wrong color coding of cylinder.</p> <p>II. Cylinders not stored in upright</p>	Rs.10,000 per single violation Compounded

		<p>position. (clause 29.1)</p> <p>III. Flash back arrester, non-return valve and regulator not present or not in working condition. (clause 29.3 & 29.4)</p> <p>IV. Fail to put cylinders in a cylinder trolley. (clause 29.1)</p> <p>V. Damaged hose and fail to use hose clamps (clause 29.2)</p> <p>VI. Using domestic LPG cylinders (clause 29.5)</p> <p>VII. Fail to store cylinder 6.6m away from fire prone materials (clause 29.8)</p> <p>VIII. Fire extinguisher not placed in the vicinity during operation (clause 29.6)</p>	to a maximum of Rs.50,000 at any single instance
19	Welding	<p>I. Voltmeter and Ammeter not working (clause 29.9)</p> <p>II. Non-availability of separate switch in the transformer (clause 29.9)</p> <p>III. Improper grounding and return path. (clause 29.10)</p> <p>IV. Damaged and bare openings in the welding cable. (clause 29.10)</p> <p>V. Damaged holder (clause 29.10)</p> <p>VI. Fire extinguisher not placed in the vicinity during operation (clause 29.6)</p>	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance
20	Fire precaution	<p>I. Smoking and open flames in fire prone area (clause 31.6)</p> <p>II. Using more than 24V portable electrical appliances in the fire prone area (clause 34.2.3)</p> <p>III. Not proper ventilation in cylinder storage area. (clause 29.8)</p> <p>IV. Absence of fire extinguishers (clause 31.1)</p> <p>V. Fire extinguishers not refilled once in a year. (clause 31.2)</p> <p>VI. Fire extinguisher placed in a not easily accessible location</p>	Rs.5,000 per single violation Compounded to a maximum of Rs.25,000 at any single instance.
21	Excavation, Tunneling and confined space	<p>I. Non-compliance of clause 34.1.1</p> <p>II. Non-compliance of clause 34.2.3</p> <p>III. Non-compliance of clause 34.3</p>	For any item from i) and ii) Rs.10,000 per single violation Compounded to a maximum of

			Rs.50,000 at any single instance. For item iii) Rs.10,000 per first violation and Rs.50,000 for subsequent violations
22	Work permit system	I. Non-compliance of clause 35.2 II. Non-compliance of clause 21.11.9	For item i) and ii) Rs.50,000 per first violation and Rs.1,00,000 for subsequent violations
23	Traffic Management	I. Non-compliance of clause 36.4.1 II. Non-compliance of clause 36.8.3 III. Non-compliance of clause 36.9.2 IV. Non-compliance of clause 36.9.3 V. Non-compliance of clause 36.9.7 VI. Non-compliance of clause 36.9.8	Rs.1,00,000 per first violation and Rs.2,00,000 for subsequent violations
		a) Barricades (clause 36.9.4) I. Not Cleaned II. Not in alignment III. Not numbered IV. Not painted V. Red lights / reflectors not working VI. Damages not repaired VII. Not secured properly VIII. Barricade inspector not employed IX. Protruding parts / portions repaired X. Barricades maintaining register not properly maintained up to date	Rs.25,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
		b) Contractor Vehicles (clause 36.9.5 & 36.9.6) I. Over loading of vehicles II. Unfit drivers or operators III. Unlicensed vehicles IV. Absence of traffic marshals V. Absence of reversing alarm VI. Absence of fog light (at winter) VII. Power / hand brakes not in working VIII. Condition.	Rs.25,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
		I. Splashing of Bentonite on roads / non-cleaning of tyres of dumpers and transit mixers (clause 17.11 &	For item i) and ii) Rs.1,00,000 on first observation.

		<p>17.14)</p> <p>II. Mishandling of bentonite like splashing of bentonite outside specified width of barricading</p> <p>III. Non-cleaning of tyres of dumpers and transit mixers before leaving the site and thereby creating a traffic safety hazard to road users.</p>	<p>Rs. 2,00,000 on second observation</p> <p>Rs. 3,00,000 on third and subsequent observations</p>
24	Batching plant / Casting yard	Non-adherence of any of the provisions mentioned in clause 38.0.	Rs. 10,000 for single violation compounded to a maximum of Rs.1,00,000 at any single instant.
25	PPE	<p>I. Not having (clause 39.1)</p> <p>II. Not wearing (or) using and kept it elsewhere (clause 39.1)</p> <p>III. Using damaged one (clause 39.2)</p> <p>IV. Using wrong type (clause 39.5)</p> <p>V. Using wrong color helmet or helmet without logo (clause 39.4.1)</p> <p>VI. Using for other operation (e.g. Using safety helmet for storing materials or carrying water from one place to other) (clause 39.5)</p> <p>VII. Not conforming to BIS standard (clause 39.2)</p> <p>VIII. Non-compliance of clause 39.6, 39.7 and 39.8</p>	<p>From item i) to vi).</p> <p>Rs.200 per single violation</p> <p>For item vii)</p> <p>Rs.10,000 for first violation and Rs.50,000 for subsequent violations</p> <p>For item viii)</p> <p>Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations</p>
26	Occupational Health	<p>I. Fail to conduct medical examination to workers (clause 42.1)</p> <p>II. Absence of ambulance van & room (clause 42.3)</p> <p>III. Workers not having ID card (clause 8.2)</p> <p>IV. Absence of first-aid person in work site. (Clause 42.4)</p> <p>V. Absence or inadequacy of first-aid box. (Clause 42.4)</p> <p>VI. Misuse of first-aid box. (Clause 42.4)</p> <p>VII. First-aid box not satisfy the minimum Indian standard. (Clause 42.4)</p> <p>VIII. Smoking inside the construction site (clause 42.7.2)</p> <p>IX. Drink and drive or work (clause</p>	<p>Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance</p>

		<p>42.7.1)</p> <p>X. Fumigation / insecticides not sprayed to prevent Mosquito breeding (clause 42.6.3)</p> <p>XI. Non-compliance of clause 44.1 and 44.2</p>	
27	Labour Welfare measures	<p>I. Inadequate number of toilets (clause 46.1.1)</p> <p>II. Toilets not cleaned properly (clause 46.1.3)</p> <p>III. Absence of water facilities for toilets and washing places (clause 46.1.3)</p> <p>IV. Toilet placed more than 500m from the work site (clause 46.1.3)</p> <p>V. Accommodation not provided as per BOCWA (clause 46.5.1)</p> <p>VI. Absence of drinking water (clause 46.4)</p> <p>VII. Excessive noise and vibration (clause 43.0)</p> <p>VIII. Canteen not provided (clause 46.2)</p> <p>IX. Food stuff not served on no loss no profit basis (clause 46.3)</p> <p>X. Creche not provided (clause 46.6)</p> <p>XI. Non adherence of Labour welfare provisions of BOCWA (clause 3.3.1.2)</p> <p>XII. Fail to register establishment and display the registration certificate at workplace (clause 3.3.1.2)</p> <p>XIII. Absence of workers register and records (clause 3.3.1.2)</p> <p>XIV. Absence of muster roll and wages register (clause 3.3.1.2)</p> <p>XV. Fail to display an abstract of BOCWA and BOCWR (clause 3.3.1.2)</p>	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance
28	Environmental Management	<p>I. Tyre wash facility not provided (clause 47.12)</p> <p>II. Spillage from vehicles not arrest (clause 48.9)</p> <p>III. Air monitoring not practiced (clause 47.17)</p> <p>IV. Noise monitoring not practiced (clause 43.2.1)</p> <p>V. The values of air monitoring and</p>	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance

		<p>noise monitoring not within acceptable limits (clause 47.17, 43.2.1)</p> <p>VI. Dust control measures at sites not practiced (clause 47.13)</p> <p>VII. Improper disposal of debris / residues</p> <p>VIII. Noncompliance of clause 53.0 & 54.0</p>	
29	Working near existing railway track	<p>I. To start work without erecting barricading as per requirement.</p> <p>II. To start work in station area without permit to work or without approved plan.</p> <p>III. To launch girder for RFO/ROB without approved plan and work permit.</p> <p>IV. Infringement of moving dimension by any vehicle / construction equipment with running train causing disruption of traffic, injury to passenger / fatal incidence.</p>	Rs. 500000 for first violation and Rs. 1000000 for Subsequent violation.

56.4 Without limiting to the unsafe acts and or conditions mentioned above in clause 56.3 the Employer shall have the right to deduct charges for any other unsafe act and or condition depending upon the gravity of the situation on a case-to-case basis. The charges shall be in comparison with that of the similar offence indicated in clause 56.3.

57.0 STOPPAGE OF WORK

57.1 The Employer shall have the right to stop the work at his sole discretion, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipment's. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident.

57.2 The contractor shall not proceed with the work until he has complied with each direction to the satisfaction of Employer.

57.3 The Contractor shall not be entitled for any damages / compensation for stoppage of work, due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

58.0 AWARDS

The following categories will be considered for awards as per the scheme in practice of Employer

- i) For every safe million man hour working without any reportable incidents
- ii) Zero fatality contracts
- iii) 100% adherence to voluntary reporting of all accidents throughout the currency of contract
- iv) Safest project team of the year.
- v) Best SHE team of the year.
- vi) Safest Contractor of the year.

K-RIDE

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited
APPENDIX NO 1

Memorandum of Understanding between Karnataka Rail Infrastructure Development Company Ltd. (K-RIDE) and the Contractor for safe execution of contract work

This Memorandum of Understanding is made and executed by and between Rail Infrastructure Development Company (Karnataka) Limited - "K-RIDE" a Company registered under the Companies Act 1956 and having its registered office at Rail Infrastructure Development Company(Karnataka) Limited – 'K-RIDE', 'Samparka Soudha', 1st Floor, (Opp. Orion Mall), Dr. Rajkumar Road, Rajajinagar 1st Block, Bangalore - 560010 or their authorized representative(s), hereinafter referred to as "EMPLOYER" (which expression shall wherever the context so requires or admits be deemed to mean and include its successors in business and assigns) of the one party

AND

M/s _____ having its registered office at _____ hereinafter referred to as the "CONTRACTOR" (which expression shall wherever the context so requires or admits be deemed to mean and include its successors in business and assigns) of the other party

WITNESSETH THAT

WHEREAS the EMPLOYER gives highest importance to the occupational safety, health and environment during execution of work, seeks cooperation from the CONTRACTOR in this endeavour.

Thus, this Memorandum of Understanding is for promoting the safety, health and environment aspects required to be followed at workplace/site and will be applicable to any site job to be done by the CONTRACTOR

AND

WHEREAS the CONTRACTOR has read all the terms and conditions of the EMPLOYER and whereas the CONTRACTOR has studied the following documents:

- (a) Tender Documents, including Notice Inviting Tender, General Conditions, Special Conditions,
- (b) Conditions of Contract on Safety, Health and Environment and Project Safety, Health and Environment Manual.
- (c) Building and Other Construction Workers (Regulations of Employment and Conditions of Service) Act 1996, Central Rules 1998 and subsequent Karnataka Government Rules 2006, Building and Other Construction Workers Welfare Cess Act 1996 and Rules 1998 and notification [Central & State] Collection of cess.
- (d) Indian Electricity Act 2003 and Rules 1956.
- (e) Corresponding International / Bureau of Indian Standard Codes.

The amendments to any of the above rules and any other rules & regulations or procedures, circulars, notices & advices lay down by the EMPLOYER from time to time.

Now it is hereby AGREED AND DECLARED by and between the EMPLOYER and the CONTRACTOR as follows:

- Clause - I The CONTRACTOR shall abide by the terms and conditions stipulated in Condition of Contract on Safety, Health & Environment and Project Safety, Health & Environment Manual.
- Clause - II The CONTRACTOR shall undertake full responsibility for safe execution of job at work place/site and safety of his personnel and adjoining road users during work.
- Clause - III Without giving any prior notice, the EMPLOYER shall from time to time be entitled to add/or amend any or all terms and conditions with a view to improving safety and occupational health of personnel and safety of work, with immediate effect and the same shall be binding on the CONTRACTOR. The contractor agrees to implement all such amendments, which shall be laid down by the EMPLOYER.
- Clause - IV Besides following the guidelines, safety rules and regulations, safety codes given in various safety procedures/documents mentioned above, the CONTRACTOR shall also prepare detailed method statement which includes job safety analysis wherever there are complicated and hazardous/high risk working involved and get it approved from Employer before execution of work.
- Clause - V Any negligence or violation in implementing any of the provision of the conditions of contract on Safety, Health & Environment and K-RIDE project Safety, Health & Environment Manual shall be viewed seriously and the contractor is liable to compensate the employer for the loss of reputation. The cost of damage shall be fixed on case-to-case basis.

In witness thereof the Parties hereto by representatives duly authorised have executed this Memorandum of Understanding on _____ day of _____ 20____.

Signed on
For and on behalf of K-RIDE

Signed on
For and on behalf of (Contractor)

Signature:

Signature:

Name:

Name:

Title:

Title:

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited
APPENDIX NO 2

Safety, Welfare and Occupational Health requirements as per BOCW Act 1996 and Rules 1998 and BOCWKR Rules 2006.

(This list has been prepared in chronological order with primary importance to Section of Act and secondary importance to Rules)

S - Refers relevant Sections in BOCWA

R - Refers relevant Rules in BOCWR

C - Refers relevant Chapter No. in BOCWR

P - Refers to relevant rules in BOCWWCR 1998

K - Refers to relevant rules in BOCWKR 2006

Sl. No	Items	Relevant Sections / Rules in BOCWA and BOCWR and BOCWKR 2006
1.	Registration of establishment	S – 7, R – 23 to 27
2.	Display of registration certification at workplace	R – 26 (5)
3.	Hours of work	S – 28 R – 234 to 237
4.	Register of overtime	S – 28; S – 29 R – 241(1) Form XXII
5.	Weekly rest and payment at rest	R – 235
6.	Night shift	R – 236
7.	Maintenance of workers registers and records	S – 30 R – 238
8.	Notice of commencement and completion	S – 46 R – 239
9.	Register of persons employed as building workers	R – 240
10.	Muster roll and wages register	R – 241(1) (a); Form XVI and XVII
11.	Payment of wages	R – 248
12.	Display of notice of wages regarding	R – 249

13.	Register of damage or loss	R – 241(1)(a); Form XIX, XX, XXI
14.	Issue of wages book	R – 241(2)(a); Form XXIII
15.	Service certificate for each workers	R – 241(2)(b); Form XXIV
16.	Display an abstract of BOCWA and BOCWR	R – 241(5)
17.	Deduction of welfare cess by the government agency	P – 4(3)
18.	Annual return	R – 242; Form XXV
19.	Drinking water	S – 32
20.	Latrines and Urinals	S – 33 R – 243
21.	Accommodation	S – 34
22.	Creches	S – 35
23.	First-aid boxes	S – 36 R – 231 and Schedule III
24.	Canteens	S – 37 R – 244
25.	Food stuff and other items served in the canteens	R – 245
26.	Supply of tea and snacks in work place	R – 246
27.	Food charges on no loss no profit basis	R – 247
28.	BOCWKR 2006 welfare Board Rules	K – 261 to 267
29.	Safety committee	S – 38 R – 208
30.	Safety officer	S – 38 R – 209 and Schedule VII
31.	Reporting of accidents and dangerous occurrences	S – 39 R – 210
32.	Procedure for inquiry in to the causes of accidents	R – 211
33.	Responsibility of employer	S - 44 R – 5
34.	Responsibility of Architects, Project engineer and Designers	R – 6
35.	Responsibility of workmen	R – 8
36.	Responsibility for payment of wages and compensation	S – 45
37.	Penalties and Procedures	S – 47; S – 55

38.	Excessive noise, vibration etc.	R – 34
39.	Fire Protection	R – 35
40.	Emergency action plan	R – 36
41.	Fencing of motors	R – 37
42.	Lifting of carrying of excessive weight	R – 38
43.	Health, Safety and Environmental Policy	R – 39
44.	Dangerous and Harmful Environment	R – 40
45.	Overhead protection	R – 41
46.	Slipping, Tripping, Cutting, Drowning and Falling Hazards	R – 42
47.	Dust, Gases, Fumes, etc	R – 43
48.	Corrosive substance	R – 49
49.	Eye Protection	R – 45
50.	Head Protection and other protection apparel	R – 46; R – 54
51.	Electrical Hazards	R – 47
52.	Vehicular traffic	R – 48
53.	Stability of structure	R – 49
54.	Illumination	R – 50; R – 124
55.	Stacking of materials	R – 51
56.	Disposal of debris	R – 52
57.	Numbering and marking of floors	R – 53
58.	Lifting appliances and gears	C – VII; R – 55 to 81
59.	Runways and Ramps	C – VIII; R – 82 to 85
60.	Working on or adjacent to water	C – IX; R – 86 & 87
61.	Transport and earthmoving equipment's	C – X; R – 88 to 95
62.	Concrete work	C – XI; R – 96 to 107
63.	Demolition	C – XII; R – 108 to 118
64.	Excavation and Tunneling works	C – XIII; R – 119 to 168
65.	Ventilation	R – 153
66.	Construction, repair and maintenance of step roof	C – XIV; R – 169 to 171
67.	Ladders and Step ladders	C – XV; R – 172 to 174
68.	Catch platform and hoardings, chutes, safety belts &	C – XVI; R – 175 to 180

	nets	
69.	Structural frame and formworks	C – XVII; R – 181 to 185
70.	Stacking and unstacking	C – XVIII; R – 186 & 187
71.	Scaffold	C – XIX; R – 188 to 205
72.	Cofferdams and Caissons	C – XX; R – 206 to 211
73.	Explosives	C – XXI; R – 212 & 213
74.	Piling	C – XXII; R – 214 to 222
75.	Medical Examination for building and other construction worker, Crane operator an Transport vehicle drivers	R – 81; R – 223(a)(iii) and Schedule XII
76.	Medical examination for occupational health hazards	R – 223(a)(iv)
77.	Charging of workers for Medical Examination	R – 223(b)
78.	Occupational health centers and Medical officers	R – 225 and Schedule X & XI
79.	Ambulance van & room	R – 226 & 227 and Schedule IV & V
80.	Stretchers	R – 228
81.	Occupational health service for building workers	R – 229
82.	Medical examination for occupational health hazards	R – 223(a)(iv)
83.	Emergency care services and emergency treatment	R – 232
84.	Panel of experts and agencies	Central Rule 250
85.	Power of inspectors	Central rule 251 Karnataka Rules 268

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited.**APPENDIX NO 3****SITE SHE PLAN**

Contract No	
Contractor Name	
Project Name	
1	<p>Project Highlights</p> <ul style="list-style-type: none"> i) Title of the content ii) Contractor Number iii) Brief scope of work iv) Location map/ key plan v) Period of the project
2	SHE Policy
3	<p>Site Organisation Chart</p> <p>Chart indicating reporting of SHE personnel</p>
4	<p>Roles & Responsibility</p> <p>Individual responsibility of the</p> <ul style="list-style-type: none"> i) Project Manager ii) Construction Manager iii) Construction Supervisors iv) SHE Committee Members v) SHE In charge vi) Site Engineers vii) First Line Supervisors viii) Sub-contractors
5	<p>SHE Committee</p> <ul style="list-style-type: none"> i) Details - Chairman, Members, Secretary and Employer's representative, ii) Procedures for effective conduct of meeting
6	SHE Training
7	Subcontractor Evaluation, Selection and Control
8	SHE Inspection
9	SHE Audit

10	Accident Investigation And Reporting Procedures
11	Occupational Health Measures
12	Labour Welfare Measures
13	Risk assessment and mitigation procedures
14	<p>Safe work procedures</p> <ul style="list-style-type: none"> i) Work at Height ii) Structural Steel Erection iii) Launching of segments iv) Floor, Wall Openings and Stairways v) Welding, Cutting and Bracing vi) Lifting appliances vii) Work Permit Systems viii) Electrical Equipment's ix) Mechanical Equipment's x) Excavation xi) Fire Prevention xii) Hazardous Chemicals and Solvents xiii) Ionizing Radiation xiv) Lighting xv) Abrasive Blasting
15	Work Permit System
16	List of standard job specific PPEs to be used in the site
17	Maintenance of Regime for construction Equipment and Machinery
18	Traffic management
19	Housekeeping
20	Environmental Management
21	Emergency Management
22	Visitors and Security arrangement

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited.
APPENDIX NO 4

WORKPLACE POLICY ON HIV/AIDS PREVENTION & CONTROL FOR WORKMEN ENGAGED BY CONTRACTORS

“Being mobile in and of itself is not a risk factor for HIV infection. It is the situations encountered and the behaviours possibly engaged in during mobility or migration that increase vulnerability and risk regarding HIV / AIDS.” *UNAIDS, Technical update on ‘Population, Mobility and AIDS’, February 2001, p.5*

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited recognizes HIV / AIDS as a developmental challenge and realizes the need to respond to it by implementing regular HIV / AIDS prevention programmes and creating a non-discriminatory work environment for HIV infected workmen engaged by contractors. For the purpose of making conscientious, sensitive and compassionate decision in addressing the realities of HIV / AIDS, K-RIDE has established these guidelines based on ILO code of practice on HIV / AIDS.

- ▶ Creating awareness through professional agency using IEC (Information, Education and Communication) package specially designed for migrant workers.
- ▶ Institutional capacity building by training the project implementation team, Safety, Health & Environment (SHE) Managers, establishing linkages for efficient diagnosis and treatment of the affected workers, effective monitoring of implementation and documentation for further learning.
- ▶ Establishing peer educators by selecting them in consultation with contractors and training them through professional agencies so that they become focal point for any information, education and awareness campaigns among the workmen throughout the contract period.
- ▶ Promotion of social marketing of condoms through State Aids Control Society.

K-RIDE : Rail Infrastructure Development Company (Karnataka) Limited.

General Instruction: K-RIDE/SHE/CEO/001

SUGGESTIVE MANPOWER REQUIREMENTS OF SHE ORGANIZATION BASED ON CONTRACT VALUE

	1	2	3	4	5	6
Awarded Contract value (in Cr.)	Chief SHE Manager	Senior SHE Manager	Junior SHE Manager	Safety Steward	Senior SHE (Electrical) Engineer	Junior SHE (Electrical) Engineer
Up to 2	-	-	1	Refer Note 1	-	1
Up to 10	-	1	Refer Note 1		1	Refer Note 2
Up to 25	1	Refer Note 1			1	
Up to 100	1				1	
Up to 250	1				1	
More than 250	1				1	

	7	8	9	10	11	12	13
Awarded Contract value (in Cr.)	*Junior SHE (Fire) Manager / **Senior SHE (Fire) Manager	Occupational Health officer with Necessary Nursing Assistants (Refer Note 3)	Environmental Manager	Senior SHE (Traffic) Engineer (Refer Note 4)	Barricade Maintenance Squad (Refer Note 4)	House Keeping Squad	Labour Welfare Officer
Up to 2	-	-	-	-	Refer Note 5	Refer Note 6	-
Up to 10	-	1 (PT)	1	1			1
Up to 25	1*	1 (PT)	1	1			1
Up to 100	1*	1 (FT)	1	1			1
Up to 250	1**	2(FT)	1	1			1 with support staff
More than 250	2**	2(FT)	1 with support staff	1			1 with support staff

Note 1: Adequate, qualified and trained SHE Professionals with required support staff to be deployed at each worksite at each shift.

Note 2: Adequate, qualified and trained Electrical Engineers / supervisors to be deployed at each worksite at each shift.

Note 3: (PT) means Part-Time and (FT) means Full-time.

Note 4: Senior SHE (Traffic) Engineer Post and Barricade Manager (including the staff) Posts are applicable to contracts where the work has to be executed either below or over the right-of-way like Viaduct, Tunnel Contracts wherein erection and maintenance of barricades are paramount important.

Note 5: One Barricade Manager supported by required supervisors and workmen

Note 6: One Housekeeping Manager supported by required supervisors and workmen

K-RIDE

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited.

General Instruction: K-RIDE/SHE/CEO/002

**MINIMUM QUALIFICATION AND EXPERIENCE FOR (SHE) SAFETY, ELECTRICAL,
ENVIRONMENTAL, TRAFFIC ENGG. AND OCCUPATIONAL HEALTH PROFESSIONAL**

Sl. No	Designation	Qualification	Experience (in years)
1	Chief SHE Manager	<p>The Chief SHE Manager shall have qualified in any of the following degree/diploma:</p> <ul style="list-style-type: none"> i) Post Graduate Diploma in Industrial Safety & Environmental Management (PGDISEM) from National Institute of Industrial Engineering, Mumbai ii) M.E. in Industrial Safety from NIT, Trichy, Tamil Nadu iii) M.E. in Industrial Safety from Mepco Schlenk Engineering College, Sivakasi, Tamil Nadu iv) B.E. in Fire and Safety Engg. From Cochin University of Science and Engg. Cochin, Kerala v) B.E. with advanced Safety Management Diploma from CLI / RLI Mumbai / Chennai / Kolkata and Kanpur. vi) B.E / B.Arch., with one-year <u>Full Time</u> advanced Safety diploma from NICMAR, Hyderabad. vii) B.E / B.Tech with any other equivalent State and Central Govt. recognized full time Degree / Diploma in Safety. viii) International qualifications like CSP (Certified Safety Professional), NEBOSH, MIOSH, MSISO etc. 	2 {for all category except (iv) and 5yrs for category (iv)}
2	Senior SHE Manager	<p>As stated in Sl. No:1 and in addition the following categories:</p> <ul style="list-style-type: none"> i) B.Sc.(Physics/Chemistry/Math) with one year Full Time advanced Safety diploma from NICMAR, Hyderabad ii) B.Sc. / Diploma in Engg. With advanced Safety Management Diploma from CLI / RLI / Mumbai / Chennai / Kolkata and Kanpur. iii) B.Sc. (Physics/Chemistry/Math) with One year Full Time diploma in Safety Engineering offered by West Bengal State Technical Education Departments and similar courses by other states. iv) Any Graduate or diploma holder with 7 years of work experience in full-fledged SHE department of any 	2 {for category (i), (ii) and (iii) only}

		Public Sector / Leading Private Sector / MNC / with prior approval of employer on a case to case basis	
3	Junior SHE Manager	i) Degree in Science / Diploma in Engineering with Govt. recognized safety diplomas from Correspondence course of NICMAR, Annamalai University, National and State Productivity Councils, Other State Technical Education Boards etc. ii) Any Graduate or diploma holder with 5 years of work experience in full-fledged SHE department of any Public Sector / Leading Private Sector / MNC / with prior approval of employer on a case to case basis	2 (for category (i) only)
4	Safety Steward	Any basic qualification with any SHE related certificate courses.	2
5	Senior SHE (Electrical) Manager	Degree in Electrical Engineering + Govt. recognized Electrical Licence holder	2
6	Junior SHE (Electrical) Manager	Diploma in Electrical Engineering + Govt. recognized Electrical Licence holder	1
7	Senior SHE (Fire) Manager	i) B.E. (Fire) from National Fire Service College, Nagpur ii) B.E (Fire & Safety) from Cochin University iii) Graduate with any Govt. recognized diploma in Fire Safety with 5 years of experience	2 (for category (i) and (ii) only)
8	Junior SHE (Fire) Manager	Any Diploma holder with any Govt. recognized diploma in Industrial Fire Safety.	1
9	Occupational Health Officer	MBBS with Govt. recognized degree/diploma in Industrial/ occupational health	1
10	Environment Manager	Govt. recognized PG Degree / PG Diploma / Degree in Environmental Engineering / Science	2
11	Senior SHE (Traffic) Engineer	Govt. recognized PG Degree / Degree / Diploma in Traffic/Transportation Engineering or Planning	1
12.	House Keeping Squad Manager	Any Diploma in Engineering	1
13	Barricade Manager	Any Diploma in Engineering	1
14	Labour Welfare Officer	Any Degree with Govt. Recognized Degree / Diploma / P G Diploma in Labour Welfare related fields like Law, Personnel / Industrial Relations etc.	2

Note 1: In some extraordinary cases where the candidate had earlier worked in K-RIDE or other MRTS Projects they can be considered for the following posts:

- i) Senior SHE Manager
- ii) Junior SHE Manager
- iii) Safety Steward

Depending upon the qualification and no. of years of experience on a case-to-case basis even if they do not possess the prescribed qualification as listed above.

Note 2: In all other cases other than listed under **Note 1** irrespective their earlier experience with MRTS projects the candidates shall qualify as specified above.

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K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited.**General Instruction: K-RIDE /SHE/CEO/003****SUGGESTIVE REQUIREMENTS OF SHE MONITORING AND AUDIO-VISUAL EQUIPMENTS**

1. For the purpose of minimum requirements of Audio-visual and Other equipment the contracts are categorized into the following groups:

Contract Value (Initial awarded value of contract)	Group
Upto 25 Cr	A
Upto 100 Cr	B
Upto 250 Cr	C
More than 250 Cr	D

2. Every contractor falling into the above groups shall provide the following minimum required audio visual aids for conducting weekly review, monthly safety committee and other post review meeting of all fatal and major incidences effectively. These audio-visual equipments are a must for conducting periodical in-house safety presentations in the training programmes.
3. In addition to the above portable hand held digital sound level meter (SLM) and portable hand held digital lux meter are also to be provided.

Sl. No	SHE monitoring and Audio-Visual Equipment details	SHE monitoring and Audio-Visual equipment required for			
		Group A Contract	Group B Contract	Group C Contract	Group D Contract
1.	Portable hand held Digital Sound Level Meter (SLM)	1	1	1	1
2.	Portable hand held Digital Lux Meter	1	1	1	1
3.	Laptop Computer with standard configuration including multimedia facilities	1	1	1	1
4.	Colour Printer	1	1	1	1
5.	Computer projector with screen	-	1	1	1

6.	Overhead projector	1			
7.	35mm Camera (For taking accident investigation photos in which case the images cannot be easily altered)	1	1	1	1
8.	Digital camera with flash of minimum 4 mega pixel and video facility	1	1	1	2
9.	Digital still camera with flash of minimum 4 mega pixel	1	2	4	6
10.	Portable loudspeaker (for tool-box talk and emergency purpose)	1	1	2	6
11.	Communication facility like mobile phone, walky-talky etc	For all supervisors and managers/engineers working in Safety, Health & Environment			
12.	Accident investigation Kit containing the following:	1	1	1	2
a)	Chalk piece for marking				
b)	Measuring tape for measuring i) Flexible tape – 2m length ii) Metal Foot long scale and iii) Metal tape – 30m				
c)	Equipment tags				
d)	Multipurpose Flash light				
e)	Barrier tape of 20m length				
f)	Accident investigation Forms and checklists				
g)	Enough Paper for witness recording and other noting				
h)	Emergency Phone Numbers list				

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited.

General Instruction: K-RIDE/SHE/CEO/004

Topics for First day at work SHE orientation training of Workmen

1. Hazard Identification Procedure

Hazards on site:

- i) Falls
- ii) Earthing work
- iii) Electricity
- iv) Machinery
- v) Handling materials
- vi) Transport
- vii) Site housekeeping
- viii) Fire

2. Personal Protective Equipment

- i) What is available?
- ii) How to obtain it?
- iii) Correct use and care

3. Health

- i) Site welfare facilities
- ii) Potential health hazards
- iii) First Aid/CPR

4. Duties of the contractor

- i) Brief outline of the responsibilities of the Contractor by law
- ii) Details of Contractor's accident prevention policy
- iii) K-RIDE's SHE manual
- iv) Building and other Constructions Welfare Law

5. Employee's Duties

- i. Brief outline of responsibilities of employee under law
- ii. Explanation of how new employees fit into the Contractor's plan for accident prevention. (Induction and orientation).

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited.
General Instruction: K-RIDE/SHE/CEO/005

ID card Format

(85 mm x 55mm)

Front side of ID card:

Company Logo

Name & Address of Main / Sub / Labour contractor

Name:

Designation:

Photo

Authorised Signatory

Backside of ID Card:

Employee Address: _____

1 This card is the property of "XX" (Main / Sub / Labour Contractor) and must be returned on demand and on transfer / cancellation of employment.
2 A charge will be levied for replacement of the card due to loss or theft

Main contractors' Address

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited

General Instruction: K-RIDE/SHE/CEO/006

SHE Training details for Managers and Supervisors

1. The Law and Safety	2. Policy and Administration
<ul style="list-style-type: none"> i) Statutory requirement ii) Appropriate regulations iii) Duties of employer and employee 	<ul style="list-style-type: none"> i) Effect of incentive on accident prevention ii) Human relations iii) Consultation iv) Safety Officer: duties, aims, objectives
3. Safety and the Supervisor	4. Principles of Accident Prevention
<ul style="list-style-type: none"> i) Safety and efficient production go together ii) Accidents affect morale and public relations 	<ul style="list-style-type: none"> i) Attitudes of management, supervision & operations ii) Methods of achieving safe operations iii) Accident and injury causes
5. Site Inspection	6. Human Behavior
<ul style="list-style-type: none"> i) The role of management ii) Hazard Identification Procedure iii) Records results iv) Follow-up procedures v) Feedback 	<ul style="list-style-type: none"> i) Motivating agencies ii) Individual behavior iii) Environmental effects iv) Techniques of persuasion
7. Site housekeeping	8. Health
<ul style="list-style-type: none"> i) Site organization ii) Relationship of site housekeeping to accident occurrence iii) Site access iv) Equipment storage v) Material stacking vi) Materials handling 	<ul style="list-style-type: none"> i) Medical examination ii) Hazard to health on site iii) Sanitation and welfare iv) Protective clothing v) First Aid/CPR
9. Personal Protective Equipment	10. Electricity
<ul style="list-style-type: none"> i) Eye, face, hands, feet and legs ii) Respiratory protective equipment iii) Protection against ionizing radiation 	<ul style="list-style-type: none"> i) Appreciation of electrical hazards ii) Power tools iii) Arc welding iv) Low voltage system v) Lighting and power system on sites vi) ELCB, RRCB, Grounding/Ground fault circuit interrupters (GFCIs)

11. Oxygen and Acetylene Equipment	12. Equipment
<ul style="list-style-type: none"> i) Cylinder storage and maintenance ii) Condition and maintenance of valves, regulators and gauges iii) Condition and maintenance of hoses and fittings iv) Pressures 	<ul style="list-style-type: none"> i) Accidents related to moving parts of machines ii) Appreciation of principles of guarding iii) Importance of regular maintenance
13. Transportation	14. Excavations
<ul style="list-style-type: none"> i) Transport to and from site ii) Hazard connected with site transport iii) Competent drivers iv) Dumpers v) Tipping trucks vi) Movement near excavations 	<ul style="list-style-type: none"> i) Method of shoring ii) Precautions while shoring iii) Precautions at edge of excavations iv) Removal of shoring v) Sheet steel piling
15. Working platforms, Ladders & Scaffolding	16. Cranes and other Lifting Machines
<ul style="list-style-type: none"> i) Hazards connected with the use of ladders ii) Maintenance and inspection iii) Type of scaffold iv) Overloading v) Work on roofs vi) Fragile material vii) Openings in walls and floors viii) Use of safety belts and nets 	<ul style="list-style-type: none"> i) Licensing, certification and training required for operation of cranes ii) Slinging methods iii) Signaling iv) Access to crane(s) v) Maintenance and examination vi) Ground conditions vii) Hazards and accident prevention methods connected with the use of different types of cranes/heavy equipment viii) Crane Lift Plan for all lifts
17. Lifting Tackle	18. Fire Prevention and Control
<ul style="list-style-type: none"> i) Slings - single and multi-legged ii) Safe working loads (SWLs) iii) Safety hooks and eyebolts iv) Cause of failure v) Maintenance and examination 	<ul style="list-style-type: none"> i) Principle causes determining fire ii) Understanding fire chemistry iii) Firefighting equipment iv) Firefighting training
19. Communications	20. Manual Handling
<ul style="list-style-type: none"> i) Effective methods of communication (particular interest to non-English speaking workers) ii) Method and preparation of reports iii) Safety committees iv) Safety meeting 	<ul style="list-style-type: none"> i) Body posture and procedure for lifting, pushing, pulling, dragging, sitting and walking ii) Ergonomics iii) Stretching exercises

K-RIDE : Rail Infrastructure Development Company (Karnataka) Limited
General Instruction: K-RIDE/SHE/CEO/008

DAYS TO BE OBSERVED FOR CREATING SHE AWARENESS

1 st Monday to Sunday of January	Road Safety Week (Subjected to confirmation from Ministry of Road Transport, Govt. of India every year.)
16 th February	Kyoto Protocol Day
March	Red Cross Month
4 th March	National Safety Day
7 th April	World Health Day
14 th April	Fire Safety Day
April 18 to 22	Earth Week
20 th April	Earth Day
20 th April	Noise Awareness Day
28 th April	ILO World Day for Safety and Health at Work
May 1 to 7	Emergency Preparedness Week
5 th June	World Environmental Day
12 th June	World Day against Child Labors
9 th July	Occupational Health Day
17 th October	World Trauma Day
1 st December	World AIDS Day

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited
General Instruction: K-RIDE/SHE/CEO/009

Minimum Requirements of SHE Communication Posters / Signage's / Video

1. For the purpose of Minimum requirements of SHE Communication Posters / Signage's / Video the contracts are categorized into the following groups:

Contract Value (Initial awarded value of contract)	Group
Up to 25 Cr	A
Up to 100 Cr	B
Up to 250 Cr	C
More than 250 Cr	D

2. Every contractor falling into the above groups shall prepare a SHE Communication Plan as a part of site specific SHE Plan and shall include the following minimum requirement of Posters / Signage's / Video as applicable. In case readymade posters are available in any of the category from National Safety Council, Loss Prevention Association of India or any other safety related organizations they may procure the same and display it. In case the same is not available then the contractors' shall make necessary arrangements to get the posters designed and printed on their own.

All the above are to be detailed in the Site SHE Plan and get an approval from the Employer before displaying the posters.

Table No 1 - Minimum No. of Posters

Sl. No	SHE Poster Title	Minimum No. of concepts in each title	No. of Posters / Signage / Video			
			Group A Contract	Group B Contract	Group C Contract	Group D Contract
1.	Safety Culture	5	Each 10	Each 50	Each 75	Each 100
2.	Daily Safety Oath	1 English & 1 Hindi	Each 100	Each 200	Each 500	Each 1000
3.	Mandatory PPE Usage					
a)	Signage's to display the messages like PPE ZONE, NO PPE ZONE, HARD HAT AREA etc.	2 types of sizes made up of metal sheet to be mounted at different locations	Each 25	Each 50	Each 75	Each 200
b)	Helmet	5	Each 25	Each 50	Each 75	Each 200
c)	Shoe	5	Each 25	Each 50	Each 75	Each 200
d)	Goggles & Ear Protection	5	Each 25	Each 50	Each 75	Each 200
e)	Full Body Harness	5	Each 25	Each 50	Each 75	Each 200
f)	Hi-Vi Jacket	5	Each 25	Each 50	Each 75	Each 200
4.	Emergency Management Plan	5	Each 25	Each 50	Each 75	Each 200
5.	Working at Heights	10	Each 25	Each 50	Each 75	Each 200
a)	Ladder, Stairway, Scaffold - Signage's to display the messages like SAFE, UNSAFE, FIT FOR USE, AVOID USE etc.	5 types of sizes made up of metal sheet to be mounted at different locations	Each 25	Each 50	Each 75	Each 200
6.	Site Electricity	5	Each 25	Each 50	Each 75	Each 200
7.	Fire and Explosion	5	Each 25	Each 50	Each 75	Each 200
8.	Crane Safety	5	Each 25	Each 50	Each 75	Each 200
9.	Slings	5	Each 25	Each 50	Each 75	Each 200
10.	Rigging Procedures	5	Each 25	Each 50	Each 75	Each 200
11.	Excavation	5	Each 25	Each 50	Each 75	Each 200

Section 8C: Safety, Health and Environment (SHE) Manual

12.	Occupational Health (Mosquito Control, HIV/AIDS awareness, Dust Control, Noise Control, No Smoking/Spitting, etc.)	10	Each 25	Each 50	Each 75	Each 200
13.	First – Aid	3	Each 25	Each 50	Each 75	Each 200
14.	Labor Welfare Measures (Payment of Minimum Wages, Avoidance of Child labor, Signing in the Muster Roll, In case of accidents-what to do? etc.	5	Each 25	Each 50	Each 75	Each 200
15.	Importance of “Safety Handbook”	1	25	50	75	200
16.	Traffic Safety (Speed limit, safe crossing and working within barricaded area etc.)	5	Each 25	Each 50	Each 75	Each 200
17.	Environmental Monitoring (Spillage of Muck, hazardous material, Improper drainage, water spray for dust containment etc.)	5	Each 25	Each 50	Each 75	Each 200
18.	Video in Hindi on PPE usage – 15 minutes duration	1	-	-	-	1

Note 1: Items mentioned under 17 is video. Items under 3 (a) and 5 (a) are metal signage boards and all other items are posters.

Table No.: 2 – Size of Posters / Signage's

Sl. No	Item	Size
1.	Posters – Standard	17”x22” –135 GSM 4 Color Printing
2.	Posters – Special (Wherever required)	17”x22” card laminated FA Poster
3.	Posters - Mega size (Wherever required)	32”x40” Flex FA Poster
4.	First-Aid Booklet	6”x4”
5.	Safety Handbook	6”x4”

6.	Signage's	Small : 12"x6" Big : 24"x12"
7.	Road Traffic Sign Boards	Strictly as per Indian Road Congress (IRC) specifications

Table No.: 3 – Safety Signage Colour (as per IS 9457)

Sl. No	Type of signage	Color
1	Mandatory	Blue
2	Danger	Yellow
3	Prohibit	Red
4	Safe conditions	Green

K-RIDE

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited**General Instruction: K-RIDE/SHE/CEO/010****Experts / Agencies for SHE Services**

Sl. No.	Organization	Services
1.	Bureau Veritas Industrial Services (India) Pvt. Ltd., B-21 & 22, First Floor, Sector-16, NOIDA-201 301 (U.P.) Phone: 0120 - 2515055 Fax: 0120 - 2515248 E-mail: enp.delhi@in.bureauveritas.com	<ul style="list-style-type: none"> External SHE Audit SHE Management / Technical Training
2.	Central Labor Institute Post box no: 17851, N.S.Monkikar Marg Sion , Mumbai- 400 022 Tel.: 022- 4092203 Fax: 022 – 4071986 E-mail: cli@dgfasli.nic.in	<ul style="list-style-type: none"> SHE Management / Technical Training
3.	Construction Industry Development Council 801, 8 th Floor, Hemkunt Chambers, 89, Nehru Place, New Delhi – 110 019 E-mail: cidc@vsnl.com	<ul style="list-style-type: none"> SHE Management / Technical Training
4.	Delhi Productivity Council 1E/10, Swami Ramtirath Nagar New Delhi – 110 055 Tel.: 23522835	<ul style="list-style-type: none"> SHE Management / Technical Training
5.	Det Norske Veritas AS, 203, Savitri Sadan 1, 11 Preet Vihar Community Centre, New Delhi-110 092 Phone: 011-22531502/2253/1503, 22427688/22531278 Fax: 011-2253 0247 Website: www.dnv.com	<ul style="list-style-type: none"> External SHE Audit SHE Management / Technical Training
6.	Dr. A. V. Baliga Memorial trust	<ul style="list-style-type: none"> HIV / AIDS

	Link House, Bagadur Shah Zafar Marg Press Area New Delhi – 110 002 Phone: 011 – 23311119	awareness
7.	Dr. Cris Research Centre For Occupational Health & Safety 306, Guru Arjuna Dev Bhawan, Ranjit Nagar Complex, New Delhi – 110 008 Phone: 9810040406 Fax: 011 – 25702929 E-mail: team@drcri.com Website: www.drcri.com	<ul style="list-style-type: none"> • Ambulance Room & Van • Communication Materials • First-aid box • First-aid Training • HIV / AIDS awareness • ID Card • Medical Facilities • SHE Orientation Training
8.	DuPont Safety Resources, E.I. DuPont India Private Limited, Arihant Nitco Park 6 th Floor, 90, Dr. Radhakrishnan Salai, Mylapore, Chennai-600 004 Phone: 044-2847 2800, 2847 3752 Fax: 044-2847 3800 Mobile: 9381201040 Website: in.dupont.com	<ul style="list-style-type: none"> • SHE Management Training
9.	EQMS INDIA PVT. LTD. 304 & 305, 3rd Floor, Rishabh Towers, Plot No. 16, Community Centre, Karkardooma, Delhi - 110092. Phone: 011 - 22374729 / 22374775 Fax: 011- 22374662 E-mail: eqms@eqmsindia.org Website: www.eqmsindia.com	<ul style="list-style-type: none"> • ISO Certification • SHE Management / Technical Training
10.	Green Cross Consultants	<ul style="list-style-type: none"> • SHE Management / Technical Training

	59, 7 th Cross, 1 st Floor, Jai Bharath Nagar, Bangalore-560 033 Phone: 080-2549 6782 E-mail: etgrangan@yahoo.com	
11.	HSRTC, PENTASAFE, 201, 2 nd Floor, Town Centre, Andheri Kurla Road, Marol, Andheri (East), Mumbai-400 059 Phone: 022-2850 2210/20/50 Fax: 022-2850 2260 E-mail: training@penta-safe.com	<ul style="list-style-type: none"> • SHE Practical Field Training for Height Safety
12.	Institute of Driving Training & Research, Wazirabad Road, Adjoining Loni Road flyover. New Delhi – 110 094 Phone: 011 – 22813474, 22815833 Fax: 011 - 22811131	<ul style="list-style-type: none"> • SHE Technical Training for Vehicle Drivers.
13.	Institute for Research, Development & Training of Construction Trades & Management, An Educational Institute, Society and Trust, 1 st Floor, UVCE Alumni Association Building, K.R. Circle, Bangalore-560 001 Phone: 080-22294291/22243257 Fax: 080-22243257 E-mail: ubrco@vsnl.com Website: www.instructindia.org	<ul style="list-style-type: none"> • SHE Technical /Field Training
14.	International Engineering Company K – 10, South Extension, Part – 2, New Delhi – 110 049 Phone: 011 – 26254761, 26258130 Mobile: 9312260130 E-mail: ashok@intenco.net	<ul style="list-style-type: none"> • Crane and Lifting appliances and Gears Certification • SHE Practical Field Training for Crane Safety
15.	L & T Eutectic	<ul style="list-style-type: none"> • SHE Practical Field

	32, Sivaji Marg, New Delhi – 110 015 Phone: 011 - 51419538, 51419539 Fax: 011 - 51419600 Website: www.Inteutecticwelding.com	Training for Welding Safety
16.	Loss Prevention Association of India Ltd. Warden House, Sir P.M. Road, Mumbai – 400 001 Website: www.lpaidia.org	<ul style="list-style-type: none"> • SHE Management / Technical Training
17.	MFA Crucial Moments Healthcare Pvt. Ltd., 42, Okhla Industrial Estate, Phase – II New Delhi – 110 020 Phone: 011 – 55624000 Fax: 011 – 55624010 E-mail: contact@crucialmoments.net	<ul style="list-style-type: none"> • First-aid Training
18.	Modicare Foundation 4 Community Centre, New Friends Colony, New Delhi – 110 065 Phone: 011 – 5167235059 Fax: 011 – 26915469 E-mail: nivedita@modi.com nivedita@gmavil.com Website: www.modicarefoundation.org	<ul style="list-style-type: none"> • HIV / AIDS awareness
19.	National Safety Council HQ and Institute Building 98A, Sector 15, industrial Area C.B.D Belapur, Navi Mumbai – 400614 Phone: 27579924	<ul style="list-style-type: none"> • SHE Management / Technical Training
20.	NICMAR (National Institute of Construction Management and Research) 910,9 th Floor, Hemkunt Chambers, 89, Nehru Place, New Delhi – 110 019 Phone: 011 – 51618415, 51618417, 51618418 Fax: 011 – 51618416	<ul style="list-style-type: none"> • SHE Management / Technical Training
21.	Quality Growth Services Pvt. Ltd.	<ul style="list-style-type: none"> • ISO Certification

	H-13, Kirti Nagar, New Delhi – 110 015 Fax: 011 – 25431737 / 25438598 / 25918332 E-mail: qgs@qgspl.com Website: www.qgspl.com	
22.	Safety Engineers Association / Safety Educational Trust – India 2/257, First Floor, Dr. Ambedkar Nagar, Manapakkam, Chennai – 600 116 Phone: 044 – 22523461 E-mail: safetrustindia@rediffmail.com	<ul style="list-style-type: none"> • SHE Management / Technical Training
23.	SHE Management Consultancy & Support Services, 145 A, Pocket-VI, (DDA Flats), Kondli Gharoli, Mayur Vihar-II, Delhi-110 096 Fax: 011-2262 5015 Mobile: 9811153873 E-mail: r_k_p@vsnl.net	<ul style="list-style-type: none"> • SHE Management / Technical Training
24.	St. Johns' Ambulance Red Cross Road New Delhi – 110 001	<ul style="list-style-type: none"> • First-aid Training
25.	Vexil Business Process Services Pvt. Ltd. 208, A/4, Savitri Nagar, New Delhi – 110 017 Mobile: 9350232714, 98102832201, 9350232716 E-mail: info@vexilbps.com Website: www.vexilbps.com	<ul style="list-style-type: none"> • Emergency Preparedness Mock drill • SHE Management / Technical Training
26.	Welding Research Institute Bharat Heavy Electricals Ltd. (BHEL) Trichirappalli, Tamil Nadu – 620 014 Phone: 0431 – 2577029, 2577283 Fax: 0431 – 2520770 E-mail: wri@bheltry.co.in	<ul style="list-style-type: none"> • SHE Practical Field Training for Welding Safety

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited

General Instruction: K-RIDE/SHE/CEO/011
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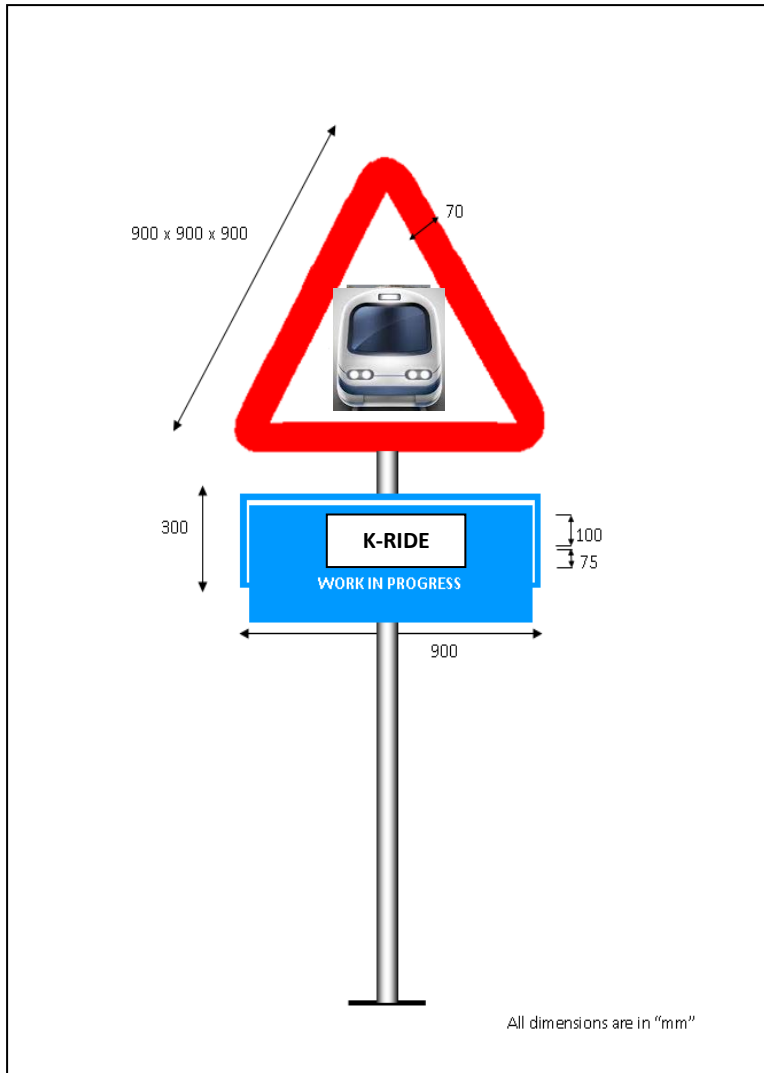
Minimum Lighting Requirements

Sl. No.	Facility or Function	Luminance – lx (lm/ft ²)
1.	Administrative areas (offices, drafting and meeting rooms, etc.)	540 (50)
2.	Construction areas i) general indoor ii) general outdoor iii) tunnel and general underground work areas (minimum 110 lux required at tunnel and shaft heading during drilling, mucking and scaling)	55 (5) 33 (3) 55 (5)
3.	Access ways i) exit ways, walkways, ladders, stairs	110 (10)
4.	Maintenance / Operating areas / Shops i) vehicle maintenance shop ii) carpentry shop iii) outdoors field maintenance area iv) refueling area, outdoors v) shops, fine details work vi) shops, medium detail work vii) welding shop	325 (30) 110 (10) 55 (5) 55 (5) 540 (50) 325 (30) 325 (30)
5.	Mechanical/electrical equipment rooms	110 (10)
6.	Hoists, Elevators, freight and passenger	215 (20)
7.	Warehouses and storage rooms/area i) indoor stockroom, active/bulk storage ii) indoor rack storage iii) outdoor storage	110 (10) 270 (25) 33 (3)
8.	Health Centers and First aid stations and infirmaries	325 (30)
9.	Toilets, wash and dressing rooms	110 (10)
10.	Work areas – general (not listed above)	325 (30)
11.	Parking areas	33 (3)
12.	Visitor areas	215 (20)
13.	Laboratories	540 (50)

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited

General Instruction: K-RIDE/SHE/CEO/012

Warning Traffic Sign



K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited
FORM No: SF/001

FORMATION OF SITE SHE COMMITTEE	
Contract No	
Contractor Name	
Contract Title	

<u>CIRCULAR</u>
<p><u>Committee</u> The following SHE Committee is constituted with immediate effect: Chairman: Members: 1) 2) 3) Secretary:</p>
<p><u>Periodicity</u> The committee will meet at least once in a month on the day (specify date)</p>
<p><u>Agenda</u> Secretary will circulate agenda of the meeting at least two days in advance of the schedule date of the meeting.</p>
<p><u>Circulation</u> Gist of the meeting will be in minutes in the standard format and circulated to the following under the signature of the secretary 1. Chairman 2. Members</p>
<p>Date: _____ Signed By: _____ CHAIRMAN</p>

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited
FORM No: SF/002

MINUTES OF SHE COMMITTEE MEETING	
Contract No.	
Contractor Name	
Contract Title	
Meeting No.	<i>Date of Meeting</i>
Location of Meeting	

MEMBERS PRESENT	INVITEES	MEMBERS ABSENT

REPORT SENT TO					
No. of Copies	Name / Dept.	No. of Copies	Name / Dept.	No. of Copies	Name / Dept.
Prepared by:					
			Location:		Date:

MINUTES OF SHE MEETING				
Item No.	Description of Discussion	Action By	Target	Remarks
1	Complaints received from Clients and corrective and preventive action			
2	Review of MOM of previous meeting			
3	NCR's / Observation from third party			
4	First - Aid cases / Reportable accident cases			
5	Future jobs and specific requirement			
6	Status of implementation of Safety plan			
7	Sub-contractor performance			
8	Analysis of first-aid cases			
9	Need for any specific system / training / PPE's / resources			
10	Observation of SHE committee during last walk down			

Next SHE Meeting is scheduled on:

Date:	Chief SHE Manager (Signature & Name)
Date:	Project Manager (Signature & Name)

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited

FORM No: SF/003

**K-RIDE
COLD WORK PERMIT**

(to be used for works other than Hot, Confined Space Entry or Electrical)

S.No. _____

Work clearance from _____ hrs of date _____ To _____ hrs of date _____
(Valid for the shift unless renewed)

Issued to (Department / Section / Contractor) _____

Exact Location of work (Area / Unit / Equipment No. etc) _____

Description of work _____

THE FOLLOWING ITEMS SHALL BE CHECKED BEFORE ISSUING THE PERMIT

(Tick mark in the appropriate box. Checklist items marked with asterisk (*) shall be complied by receiver)

Sl No	Item	Done	Not Reqd.	S. No.	Item	Done	Not Reqd.
1	Equipment / Work Area inspected			1	Equipment water flushed		
2	Surrounding area checked, cleaned and covered			2	Equipment properly steamed/ purged		
3	Equipment blinded/ disconnected / closed / isolated / wedge opened			3	Proper ventilation and lighting provided		

4	Equipment properly drained and depressurized			4	Area cordoned off & caution boards / tags provided.		
5	Equipment electrically isolated and tagged vide Permit No. ----- -			5	Gas test: HCs / Toxic etc. HCs = % LEL Toxic gas= ppm		

Remarks:

1. The activity has the following expected residual hazards (Tick the relevant items):
Lack of Oxygen / H2S, Toxic Gases / Combustible gases / Pyrophoric Iron / Corrosive Chemicals / Steam – Condensate / Others _____

2. Following additional PPE to be used in addition to standards PPE (Helmet, Safety Shoes, Hand gloves, Boiler suit) Face Shield/ Apron/ Goggles/ Dust Respirator/ Fresh Air Mask/ Lifeline/ Safety Belt/ Airline/ Earmuff etc.

3. Additional precaution if any _____

Issuer Name & Designation	Issuer Signature	Receiver Name & Designation	Signature

Clearance renewal:

Date	Time		Additional precautions if any, otherwise mention "NIL"	Issuer's Name, Designation & Signature	Receiver's Name, Designation and Signature
	From	To			

Closing of the work permit:

Receiver: Certified that the subject work has been completed / stopped and area cleared			Issuer: Verified that the job has been completed and area cleared and is safe from any hazard.		
Date & Time	Name & Designation	Signature	Date & Time	Name & Designation	Signature

General Instructions:

1. The work permit shall be filled up carefully and accurately in clear handwriting ensuring that complete information is provided in all the sections / subsections. Sketches should be provided wherever possible to avoid miscommunication.
2. Appropriate safe guards and required personnel protective equipment (PPEs) shall be determined by a careful analysis of the potential hazards and the operations to be performed prior to starting the work.
3. Requirement of standby personnel from Contractor / SHE team if any shall be mentioned in the additional requirement.
4. In case of fire alarm / siren, all work must immediately be stopped.
5. For renewal of work clearance, the issuer shall ensure that the conditions are satisfactory for the work to continue. If the conditions have changed, it may be necessary to issue a new permit or amend the existing permit.
6. This clearance on the same permit can be renewed / extended up to a maximum of seven calendar days.
7. This permit must be available at work site at all times.
8. This permit shall remain valid for 12 hours of the day of issue/ renewal
9. On completion of the work, the permit shall be closed.

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited**FORM No: SF/004**

K-RIDE
HOT WORK PERMIT
(HOT WORK / ENTRY TO CONFINED SPACE)

Sl.No. _____

Work clearance from _____ hrs of date _____ To _____ hrs of date _____
(Valid for the shift unless renewed)

Issued to (Department / Section / Contractor) _____

Exact Location of work (Area / Unit / Equipment No. etc) _____

Description of work _____

THE FOLLOWING ITEMS SHALL BE CHECKED BEFORE ISSUING THE PERMIT
(Tick mark in the appropriate box. Checklist items marked with asterisk (*) shall be complied by receiver)

Sl. No.	Item	Done	Not Reqd.	S. No.	Item	Done	Not Reqd.
A	General points			B	For Hot work / Entry to confined Space		
1	Equipment / Work Area inspected			1	Proper ventilation and Lighting provided		
2	Surrounding area checked, cleaned and covered			2	Proper means of exit / escape provided		
3	Sewers, manholes, CBD etc. and hot surfaces nearby covered			3	Standby personnel provided from Process / Main / Contractor / Fire / Safety dept.		

Section 8C: Safety, Health and Environment (SHE) Manual

4	Considered hazard from other operations and concerned persons Alerted.			4	Checked for oil and Gas trapped behind the lining in Equipment		
5	Equipment blinded/ disconnected / closed / isolated / wedge opened			5*	Shield provided against spark		
6	Equipment properly drained and depressurized			6*	Portable equipment / Nozzles properly grounded		
7	Equipment properly steamed / purged			7*	Standby persons provided for entry to confined space		
8	Equipment water flushed						
9	Iron sulfide removed / kept wet			C	For Vehicle Entry		
10	Equipment electrically isolated and tagged vide permit no.			1*	Spark Arrestor on the mobile equipment / vehicle Provided.		
11	Gas test : HCs = %LEL Toxic gas = ppm, O2 =						
12*	Running water hose / Fire extinguisher provided. Fire water system available.			D	For Excavationworks		
13*	Area cordoned off and Precautionary tags / Boards provided.			1	Clearance obtained for excavation / road cutting / Dyke cutting from concerned dept.		

REMARKS:

1. The activity has the following expected residual hazards (Tick the relevant items): Lack of Oxygen / H₂S, Toxic Gases / Combustible gases / Pyrophoric Iron / Corrosive Chemicals / Steam – Condensate / Others
2. Following PPEs to be used in addition to standards PPEs (Helmet, Safety Shoes, Hand gloves, Boiler suit): Face Shield / Apron / Goggles / Dust Respirator / Fresh Air Mask / Lifeline / Safety Belt / Airline / Earmuff etc.
3. Additional precautions if any: _____

Issuer Name & Designation	Issuer Signature	Receiver Name and Designation	Receiver Signature

Clearance renewal:

Date	Time		Additional precautions if any, Otherwise mention "NIL"	Issuer's Name, Designation & Signature	Receiver's Name, Designation and Signature	Receiver's Name, Designation and Signature
	From	To				

Closing of the work permit:

Receiver: Certified that the subject work has been completed / stopped and area cleared			Issuer: Verified that the job has been completed and area cleared and is safe from any hazard.		
Date & Time	Name & Designation	Signature	Date & Time	Name & Designation	Signature

General Instructions

1. The work permit shall be filled up carefully and accurately in clear handwriting ensuring that complete information is provided in all sections / subsections and none of column is left blank. Sketches should be provided wherever possible to avoid miscommunication.
2. Appropriate safe guards and required personnel protective equipment shall be determined by a careful analysis of the potential hazards and the operations to be performed prior to starting the work.
3. In case of fire alarm / siren, all work must immediately be stopped.
4. Only certified vehicle / engines and permitted type of electrical equipment and tools are allowed in operating areas.
5. Welding machines should be located in non-hazardous and ventilated areas.
6. No hot work should be permitted unless the explosive meter reading is Zero.
7. When a person is entering confined space, the receiver must keep minimum two standby-designated persons at the manhole or entry point.
8. Before box up of any vessel manhole cover, ensure that no men / materials are inside the vessel.
9. For renewal of work clearance, the issuer shall ensure that the conditions are satisfactory for the work to continue. If the conditions have changed, it may be necessary to issue a new permit or amend the existing permit.
10. This clearance shall remain valid for 12 hours on the date of issue/ renewal.
11. This permit must be available at work site at all times.
12. On completion of the work, the permit must be closed and kept as record.

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited
FORM No: SF/005

K-RIDE
ELECTRICAL ISOLATION / ENERGISATION PERMIT

Section-A: Isolation Permit.

S.No. _____ Request for Isolation:

Date: _____ Time: ____

Department / Section / Area issuing the permit _____

Equipment number to be isolated: _____

Name of the equipment / circuit to be isolated: _____

The above-mentioned equipment / circuit shall be de-energized and isolated from all liveconductors to carry out the maintenance work by

_____s
action/ for operational requirement.

Issuer Name	Designation	signature

Certificate of Isolation: Date: _____ Time: _____

Certified that Equipment / Circuit no. _____ of _____

_____ plant has been electrically isolated by switches / isolators / links / fuses (tick as applicable) and the danger tag is put on the supply panel. Actions in respect of electrical isolation have been recorded in the electrical shift logbook.

Name of Authorized Person	Designation	Signature

Section-B: Energisation Permit.

SI.No. __

Request for Energisation:

Date: _____ Time: _____

Department / Section / Area issuing the Permit _____

Equipment number to be energized: _____

Name of the equipment / circuit to be energized: _____

Work on the above mention equipment / circuit has been completed and all the applicable permits closed.
This equipment / circuit may be energized.

Issuer Name

Designation

Signature

Certificate of Energisation:

Date: _____ Time: _____

Certified that Equipment / circuit No. _____ of
_____ plant has been electrically energized and the danger
tag removed from the supply panel. This is also
recorded in the electrical shift logbook.

Name of Authorized Person

Designation

Signature

K-RIDE: Rail Infrastructure Development Company (Karnataka) Limited

FORM No: SF/006

COMPETENCY CERTIFICATE

“Certified that Shri_____ P. Way supervisor of M/S_____ has been examined regarding P. Way working on_____ work. His knowledge has been found satisfactory and he is capable of supervising the work safely.

Employer/Authorized Representative /K-RIDE

Annexure-I

Silica Exposure Reduction Strategies

PART 1 GENERAL APPLICATION

1.1 Description

- A. This addendum specifies minimum environmental health and safety equipment, practices and procedures to minimize exposures to airborne silica dust during quarry operations, stone crushing, transport, and site construction. The scope of this section is limited to dust controls and employee protection in these environments.
- B. This addendum shall take precedence over overlapping requirements in the Technical Specification unless otherwise stated.
- C. This document is an integral part of the contract and the contractor has the responsibility to fully implement it. Any request to deviate from any specified requirement shall be made in writing to the project sponsor.
- D. This addendum supplements all local, regional and national laws and regulations concerning the location, environmental emissions, and occupational safety in these operations. If regulatory requirements are more stringent, or require more frequent verification than outlined in this standard, then the regulatory provisions shall take precedence and become the de facto requirement in that jurisdiction.
- E. Contractor(s) shall provide a copy of the licensing documentation (NOC/ Consent to Establish) for each facility from where they purchase crushed stone including each quarry, stone crusher mill, and hot mix plant indicating they meet all applicable requirements.

1.2 General Site Requirements Quarries

- i) Operator must establish a reliable source of water with adequate capacity and pressure to run all dust suppression systems at the quarry site;
- ii) Operator must establish a reliable source of power for all mechanical equipment at the stone quarry site;
- iii) Residential areas and temporary employee housing must be located a minimum of 100 meters from any quarrying operations;
- iv) Stone drilling, cutting and conveying operations shall be equipped with either continuous wet uppression system or dry dust collectors designed and operated per minimum requirements below.
- v) Dust controls in quarries must include water fed compressed air drilling equipment, enclosed screens; enclosed transfer points, covered conveyors, and chutes.
- vi) Wet the surface of rock materials with a hose before blasting operations.

1.3 General Site Requirements Stone Crusher Mills and Hot Mix Plants

- A. Contractor shall submit a detailed plan for any temporary stone crusher or hot mix plant sites intended to be utilized for this project. The plan shall show adjacent areas within 100 meters and depict all structures and roadways. All temporary sites must meet all requirements specified in this addendum and must obtain a Consent to Establish/ (NOC) from the applicable authorities.
- B. Temporary or permanent stone crusher sites or hot mix plants must meet all of the following requirements
1. Site must be at least 250 meters from National and State Highways and 500
 2. meters from schools, educational institutions and religious places.
 3. Establish green belt zone as required by applicable local requirements;
 4. Residential areas and temporary employee housing must be located a
 5. minimum of 200 meters from any stone crushing equipment or operations;
 6. Operator must establish a reliable source of water with adequate capacity and pressure to run all dust suppression systems installed at the stone crusher site;
 7. Operator must establish a reliable source of electricity for powering all mechanical equipment and pollution controls installed at the stone crusher site;
 8. Crushing, screening, and conveying operations shall be equipped with either continuous wet suppression system or dry dust collectors designed and operated per minimum requirements below.
 9. Crushing, screening, and conveying operations must be enclosed with sheet
 10. metal or other rigid material. Do not use cloth or plastic enclosures.
 11. Roadways inside the crusher mill shall be metalled, paved or otherwise treated
 12. with chemical suppressants for dust suppression.
 13. Waste dust materials from stone crushing operations shall be stored in close
 14. containers or closed structures.
 15. Lorries exiting the site must be cleaned with shovel and broom to minimize
 16. dust being tracked off site.
 17. Minimize drop heights to storage piles;
 18. Windbreak walls that are at least six times longer than its height shall be in
 19. place.
 20. Regularly remove and safely dispose of waste materials (rock dust) from the
 21. plant site in covered lorries;
 22. Fugitive emissions including emissions from stockpiles, conveyors and other areas shall be minimized as far as practicable. Emissions from these sources shall be substantially free from visible dust emission.

1.4 General Site Requirements Construction Sites

The following requirements shall be implemented during the following operations:

- a) Stockpiling;
 - b) Earth moving/ earth works, grading, and leveling;
 - c) Transfer from stock pile to work site;
 - d) Final placement; and
 - e) Laying the track.
- i) Operator must establish a reliable source of water with adequate capacity and for all dust suppression required at the construction site;
 - ii) Regularly remove and safely disposing of waste materials (rock dust) from the site in covered lorries;
 - iii) Waste dust materials from stone crushing operations if used for fill shall be covered within 4 hours;
 - iv) Minimize spillage of raw materials. Promptly clean up all spillage and accumulations of dust.
 - v) Fugitive emissions including emissions from stockpiles and other areas shall be minimized as far as practicable. Emissions from these sources shall be substantially free from visible dust emission.

1.5 General Environmental Protection

The Contractor shall take steps to protect the environment and surrounding populations from silica dust hazards. Ensure that the water required for dust suppression operations is sourced from a supply that will not impact the quality or availability of water in the surrounding environment. Follow all State requirements for siting criteria and obtain consent from applicable state pollution control board. Ensure that emissions, surface discharges and site closure practices shall comply with all applicable laws including but not limited to:

- i) The water (prevention and control of pollution) act 1974; no. 6 of 1974.
- ii) The air (prevention and control of pollution) act, 1981; no. 14 of 1981.

PART 2 - TECHNICAL REQUIREMENTS TO MINIMIZE AIRBORNE DUST EMISSIONS

2.1 General

The handling of raw materials, products, wastes or by-products should be carried out as to minimize the release of airborne dust. Use Table 1 below for guidance in employing dust suppression methods.

Table 1: Feasible Control Measures for Open Dust Sources Fugitive Emission Control Measure

Source	Enclosures	Wet uppression	Chemical tabilization	Green Belt	Surface Cleaning	Wind Break Walls
Unpaved roadways and staging areas		X	X			
Storage piles	X	X	X			X
Stone crushing operations	X	X		X	X	X
Paved roadways and staging areas					X	
Exposed areas	X	X	X	X	X	X
Batch drop operations	X	X				X
Continuous drop operations	X	X				X

2.2 Wet Methods: Water spray Dust Suppression Systems for Stone Crushing Mills

Details of system components for all stone crusher facilities:

- A. Minimum number and locations of pressure spray nozzles:
- i) 1 nozzle on the top of the crusher
 - ii) 2 nozzles at the delivery point of crushing material
 - iii) 1 nozzle on the bottom of the vibrator screen or rotary screen
 - iv) 2 nozzles within the storage hopper
 - v) 1 nozzle at the delivery point of raw materials
 - vi) 1 nozzle at the bottom of the dust hopper
- B. A water pump with adequate motor horsepower and discharge pressure as required for optimal performance of spray nozzles.

- C. Minimum number and locations of pressure spray nozzles:
 - i) 1 nozzle on the top of the crusher
 - ii) 2 nozzles at the delivery point of crushing material
 - iii) 1 nozzle on the bottom of the vibrator screen or rotary screen
 - iv) 2 nozzles within the storage hopper
 - v) 1 nozzle at the delivery point of raw materials
 - vi) 1 nozzle at the bottom of the dust hopper
- D. A water pump with adequate motor horsepower and discharge pressure as required for optimal performance of spray nozzles.
- E. Covered water storage tank, with a manhole type maintenance provision. The cover should prevent atmospheric dust from entering the tank. The tank can be located at the ground level. Water from a bore well or other source could be pumped to fill the tank periodically.
- F. Centrifugal monoblock type self-priming pump capable of delivering 3 to 5 kg/cm² pressure and 72 liters per minute.
- G. 100 stainless steel mesh online water filter with two parallel cells. Parallel cells should be set up in order for connections to be reversed such that one cell undergoes backwash cleaning while the other cell is in operation. Only filtered water should be supplied to the spray nozzles.
- H. Chemical surfactants or wetting agents may be added to water used in the spraying systems.
- I. All spraying systems used for dust suppression shall be maintained in good condition. The flow rate and operating pressure of the spraying liquid/solution shall be sufficient to suppress dust emissions from the corresponding sources. The spraying system shall be able to cover the areas of emission points concerned.
- J. All water spray equipment shall be operational during all stone crushing operations at the site.
- K. No domestic showers, sprinklers, or other general water spray devices may be substituted for pressure misting nozzles. Nozzles may be hollow cone, solid cone or fan type.

2.3 Dry Methods: Dust Extraction Systems for Stone Crusher Mills/ Hot Mix Plants
Details of system components:

- A. Minimum requirements for dry dust capture and collection systems:
 - i) Hood or enclosure to capture emissions;

- ii) Dust collector that separates particulates (e.g. centrifugal dust collectors);
And
- iii) Duct to transport particulates in air stream from dust collector to air pollution Control device (e.g. baghouse).

2.4 Dry Methods: Dust Extraction Systems for Stone Crusher Mills/ Hot Mix Plants
Details of system components:

- A. Minimum requirements for dry dust capture and collection systems:
 - i) Hood or enclosure to capture emissions;
 - ii) Dust collector that separates particulates (e.g. centrifugal dust collectors);
And
 - iii) Duct to transport particulates in air stream from dust collector to air pollution Control device (e.g., baghouse).
- B. Capture hoods shall be installed over all crusher units and screens. Enclosures shall surround all sources of dust to the extent possible.
- C. Dust collector shall be connected in-line via an enclosed duct to a cyclone and baghouse for dust removal.
- D. Air handling system shall be a suitable size to prevent the escape of untreated airborne dust. Maintain minimum airflow as per design. A minimum draft velocity of 1 meter/ second shall be maintained through all open hoods.
- E. Inspect bag filters routinely and at least once per month for damage and clean, repair or replace as needed.

2.5 Dust Containment Enclosures for Stone Crusher Mills and Hot Mix Plants: Particulate emissions shall be controlled by installing dust containment enclosures at the following locations:

- A. Primary crusher discharge area
Enclosure shall cover discharge areas to all conveyor belts or secondary crusher.
- B. Vibratory screen
All vibratory screens shall be totally enclosed. Screen houses shall be rigid and reasonably dust tight with self-closing doors or close-fitted entrances and exits for access. Where conveyors pass through the screen house, flexible covers should be installed at entries and exits of the conveyors to the housing.
- C. Conveyor belts (optional)

The enclosures should be complete from all the four sides and roof. There should not be any open windows/openings etc. Any opening should be kept closed during operation. The gaps should be sealed using gaskets or wool type packing etc. Crusher enclosures shall be rigid and be fitted with self-closing doors and close-fitting entrances and exits. Where conveyors pass through the crusher enclosures, flexible covers should be installed at entries and exits of the conveyors to the enclosure.

D. Inlet hopper

The inlet hopper shall be enclosed on three sides.

E. Inlet hopper

The inlet hopper shall be enclosed on three sides.

F. Rotary dryer

The plant rotary dryer in a hot mix plant.

Malfunctioning or breakdown of equipment leading to abnormal emissions shall be dealt with promptly. In any case, the abnormal emission due to equipment failure shall be stopped as soon as practicable. The dust collection system shall be routinely inspected and maintained in good condition and shall be used as required. The owner shall conduct an inspection of the dust control system at least once per month.

2.6 Minimize Fugitive Dust From Roadways and Stock Piles

Minimize fugitive dust emissions from all sites where crushed rock is stored. Particulate emissions from unpaved roads and stock piles shall be controlled with the application of suitable compounds to minimize the control of dust. Petroleum-based products, waste oils or other waste products shall never be used for this purpose. Acceptable compounds for this purpose include

- i) Acrylic polymers;
- ii) Solid recycled asphalt;
- iii) Chloride compounds (calcium chloride and magnesium chloride);
- iv) Lignin compounds (lignin sulfate and lignin sulfonate powders);
- v) Natural oil resins (soybean oil); and
- vi) Organic resin emulsions.

Contractor shall provide a product information sheet prepared by the manufacturer or distributor indicating the chemical composition, application instructions, and other environmental, safety and health considerations 30 days in advance of its intended application to Engineer's Representative. The product information shall be reviewed and approved in writing before the contractor proceeds

to apply it on the project site.

2.7 Minimize Fugitive Dust from Heavy Equipment and Road Transport Vehicles Minimize fugitive dust emissions from all vehicles when loading, unloading and operating vehicles on project sites, staging areas, or stone crusher mills. Settled dust and particulate emissions from lorries used to transport stone or waste products generated in stone crushing operations, and other heavy construction vehicles, shall be minimized in accordance with the following practices:

- a. Lorries shall be filled with the material using wet methods. Load waste fine materials and powders onto tankers or closed trucks through a lengthy sleeve attached to the spout to minimize drop height and dust release.
- b. Lorries once filled with stone or other waste materials shall be covered before leaving the site. A single layer impermeable tarp shall be placed over the entire load and secured with rope or other tension bar.
- c. Designate a decontamination area that is required to be used by all vehicles before exiting the site. This area shall be covered with an impervious tarp. Use wet methods to wipe all accessible exterior surfaces of vehicles and tires.
- d. Impose strict speed limits for all vehicles operating on service roads, loading areas, or staging areas.

2.8 Minimize Fugitive Dust During Rock Quarry Operations

Particulate emissions shall be controlled during drilling, blasting, loading, and hauling with wet methods using surfactants applied in either water or foam spray.

Dust controls for stone drilling shall use water fed into the compressed air to suppress the dust.

2.9 Work Practices for Reducing Employee Exposures

This section pertains to all activities with potential for dust exposure to workers employed in quarries, stone crusher units, hot mix plants, and construction sites.

Use wet methods where feasible to reduce dust emissions from working surface or equipment.

Use a gentle spray or mist to moisten settled dust particles. When washing large quantities of dust from a surface, increase the water force only after pre-wetting all the dust with a gentle spray.

Use only the minimum amount of water needed to get the job done without creating runoff.

Rewet surfaces as necessary to control dust.

PART 3 - TECHNICAL REQUIREMENTS FOR WORKER MEDICAL SURVEILLANCE

3.1 General

This section pertains to workers employed in quarries, stone crusher units, and hot mix plants.

3.2 Medical Monitoring

Medical monitoring shall be conducted for each worker before the start of work and at least annually thereafter. Examination shall as a minimum meet requirement as set forth below

Examination

1. The employer shall ensure that all medical examinations and procedures are performed by a licensed physician, and are provided at no cost to the employee and at a reasonable time and place.
2. Persons employed under the licensed physicians may administer the pulmonary function testing, chest x-ray or other testing procedures required by this section if adequately trained by an appropriate academic or professional institution.
3. A physical examination directed to the pulmonary system, including a chest x-ray to be administered and pulmonary function tests of forced vital capacity (FVC) and forced expiratory volume at one second (FEV(1)). Interpretation and classification of chest roentgenograms shall be conducted in accordance with ILO classification system. Interpretation of the chest x-ray shall be conducted under the ILO Classification of Radiographs of Pneumoconiosis by a reader trained under this protocol. Evaluate chest x-ray for possible tuberculosis because people exposed to silica have increased susceptibility.

Report from Medical Examination: A report must be submitted from all medical examinations conducted within the last 12 months to document compliance with this medical surveillance requirement for each worker employed in quarries and stone crusher units. Submit, at a minimum, for each worker the following:

4. Name and Employee Identification Number

Physician's Written Opinion from examining physician including at a minimum the following:

- i) Whether worker has any detected medical conditions that would place the worker at an increased risk of material health impairment from exposure to silica.
- ii) A statement that the worker may wear a negative pressure respirator or any recommended limitations on the worker or on the use of personal protective

equipment such as respirators.

- iii) Statement that the worker has been informed by the physician of the results of the medical examination and of any medical conditions that may result from dust exposure.

3.2 Record Keeping

1. The employer shall establish and maintain accurate records of medical surveillance to include the physician's written opinion on each employee's health status.
2. Records shall be maintained for at least the duration of the contract period.
3. A copy of each employee's records must be provided to the affected employee who has undergone the medical surveillance stipulated above within 30 days of the date of the examination.

PART 4 - REQUIREMENTS FOR EMPLOYEE TRAINING

4.1 General

- A. This section pertains to all workers employed in quarries, stone crusher units, hot mix plants, and any construction workers using powered tools or equipment to cut, grind, core, or drill concrete or masonry materials. The training provided under this section shall be provided to workers at no cost to these employees and in a language understood by workers at each training program. The course shall be taught by an environmental health and safety specialist with adequate education, experience and training.
- B. Incorporate general information about silica dust hazards in all orientation and site training sessions covering health or safety aspects.

4.2 Training Topics

The employer shall provide training on the following topics to all employees prior to their assignment to jobs where the employer will be conducting these operations during this project

- A. The potential health hazards of exposure to airborne silica dust including silicosis, tuberculosis, lung cancer, chronic obstructive lung disease (COPD) and decreased lung function.
- B. Methods used by the employer to control employee exposures to airborne silica dust including wet or dry methods for stone crushing, drilling, cutting, local exhaust ventilation systems, and isolation of the process from employees by means of distance, enclosure, or other means, as applicable.

- C. Proper use and maintenance of dust reduction systems, including the safe handling and disposal of waste materials.
- D. The importance of good personal hygiene and housekeeping practices when working in proximity to silica dust including:
 - i) Not smoking tobacco products; appropriate methods of cleaning up before eating, and appropriate methods of cleaning clothes.
 - ii) Avoiding, to the extent practical, activities that would contribute significantly to exposure to airborne dusts.

PART 5 – WORKER PROTECTION

5.1 General

Contractors shall supply respirators and other specified safety equipment to all workers employed in quarries, stone crusher units, hot mix plants, and any construction workers using powered tools or equipment to cut, grind, core, or drill concrete or masonry materials as described below,

- A. Do not eat, drink, smoke, chew gum or smoke tobacco in the work area. To eat, drink, chew, or smoke, workers shall follow the procedures described below and leave the work area.
- B. Provide workers with a clean source of water for a facility to wash hands and face with soap and water. This should be done before eating, smoking or drinking and at the end of the day before going home. Hand washing facilities shall be set up adjacent to the work area.
- C. Engineering and work practice controls must be used whenever the possibility exists that employees may be exposed to silica including during stone crushing and construction operations.
- D. The use of compressed air, dry sweeping, or any cleaning method that would cause elevated silica dust air concentrations are prohibited.

5.2 Respiratory Protection

Minimum Respiratory Protection: Require that the minimum level of respiratory protection used be Respirator Class FFP3 under European standard EN 143 or N99 under the U.S. National Institute for Occupational Safety and Health (NIOSH) classification. Respirators shall be single use disposal respirators for dusts or reusable half-face air-purifying respirators with high efficiency particulate air filters.

Require that a respirator be worn by anyone in a Work Area at all times during any operation. Do not allow the use of surgical masks or other types of disposable respirators not specified above for any purpose.

Fit testing shall be conducted on any reusable air-purifying respirator assigned to the worker.

Only assign respirators to workers medically approved to wear negative pressure respirators as per the physicians written opinion following an annual medical examination as per the requirements in Part 3 of this addendum.

5.3 Protective Equipment

Do not allow workers to leave the work place wearing any clothing or equipment worn during the work shift. Provide the following

- A. Eye Protection: Provide eye protection as needed for the type of work being performed.
- B. Shoes: Provide shoes to all workers and require that they be worn at all times in the Work Area.
- C. Hearing protection: Provide all workers at all quarries, stone crushing sites, and hot mix plants and all other workers exposed to loud noise with ear plugs or other suitable hearing protection.

PART 6 - EMISSION AND AMBIENT AIR LIMITS

6.1 General

Contractors shall conduct all required emissions monitoring as required to prove compliance with all applicable State Pollution Control Board Regulations and the limits specified within this section. This section applies to all permanent and temporary stone crushing mills and hot mix plants.

6.2 Suspended Particulate Matter (SPM)

The Suspended Particulate Matter (SPM) at a distance of 40 meters from a stone crusher unit in a cluster should be less than 600 micro-grams per cubic metre ($\mu\text{g}/\text{Nm}^3$).

The concentration of total particulate matter in any contained emissions to air, for example the bag filter exhaust air outlet, shall not exceed 150 micro-gram per cubic metre ($150 \mu\text{g}/\text{Nm}^3$). The introduction of dilution air to achieve the emission concentration limits shall not be permitted.

Monitoring of the 24-hour average concentration of the total suspended particulate and/or respirable suspended particulate in ambient air shall be conducted at the site boundary and/or any other locations to be agreed by the Authority. SPM sampling shall conform to the United State Environmental Protection Agency's Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-volume Method) and shall be conducted at a frequency of not less than once every 6 months.

PART 7 – CHAIN-OF-CUSTODY FOR CRUSHED STONE

7.1 General

Contractor shall maintain records of suppliers for each load of crushed stone brought to the construction site with the procedures as outlined below. Such records shall be collected at a central location at least monthly during the duration of the project and be available for inspection by Engineer's Representative.

7.2 Supplier Validation

Contractor shall maintain records of all suppliers and all internally sourced supplies of crushed stone brought to the construction site to include:

- i) Name of supplier;
- ii) Location of stone crusher operation;
- iii) Location and name of the quarry;
- iv) Proof of registration and consent from the applicable Mining Department;
- v) Proof of registration and consent for operation from applicable Pollution Control Board;
- vi) The supplied material size and quantity (by weight or volume);
- vii) Date and specific location material was brought to site.

PART 8 – RESTORATION OF TEMPORARY STONE CRUSHER SITES

8.1 General

This section applies to the removal of any temporary stone crusher sites established and used during the duration of the project. During operation all temporary operations shall meet the requirements specified in Parts 1 and 2 above.

8.2 Equipment removal

Temporary equipment shall be cleaned before being taken down and prepared for off- site

transport. Clear off all temporary structures and garbage.

8.3 Site restoration

Remove all debris and visible accumulations of dust from ground surfaces. Cover all bare soil surfaces with vegetation or pavement to reduce exposure to residual silica dust.

PART 9 - ANNEXURE-II

9.1 National Safety Day (4th March) – History & Background

The Labour Ministers' Conference in its 22nd Session held in 1962 recommended:

“A conference on ‘Safety in Factories’ should be convened and the question of setting up a National Safety Council for conducting a campaign on accident prevention should be considered”.

The President's first conference on Industrial Safety organized in Delhi from 11th to 13th December, 1965 by the Ministry of Labour and Employment, Government of India in cooperation with the State Governments, Employers' Organizations, Trade Unions and Institutions concerned had affirmed “There is a consensus of opinion in favour of setting up National and State Safety Councils”.

The 24th Session of the Standing Labour Committee accepted the proposal concerning the constitution of the National Safety Council (NSC) in February, 1966. Accordingly, National Safety Council (NSC) was set up by the Ministry of Labour, Government of India on 4th March, 1966 to generate, develop and sustain a voluntary movement on Safety, Health and Environment (S, H & E) at the National level.

It was registered as a society under Societies Registration Act, 1860 and subsequently as a Public Trust under Bombay Public Trust Act 1950. It is an apex non-profit making, tripartite body, registered under the Societies Registration Act 1860 and the Bombay Public Trust Act 1950.

The foundation day of the National Safety Council of India is observed as National Safety Day since 1972. Focus of the Day to have accident & incident free industrial activities and spread Safety & Occupational Health awareness among all citizens & workers across the country.

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SECTION – 9

PRICE SCHEDULES (FINANCIAL BID)

EPC TENDER

CONTENTS

Section 9: Price Schedules (Financial Bid)

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K-RIDE

BANGALORE SUBURBAN RAIL PROJECT (BSRP)
PRICE SCHEDULES (FINANCIAL BID)
EPC TENDER.

Tender No: KRIDE/BSRP/10/2021

- A. NAME OF WORK: “DESIGN AND CONSTRUCTION OF ELEVATED VIADUCT OF LENGTH 8.027 Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 Km to 18.350 Km) INCLUDING RAMPS AND FORMATION IN EMBANKMENTS /CUTTINGS INCLUDING BLANKETING, MAJOR BRIDGES, MINOR BRIDGES, RUB, ROB, ROR, RETAINING WALL, SACRIFICIAL RETAINING WALL AND DRAINS, UTILITY DIVERSIONS OF AT-GRADE SECTION OF LENGTH 17.551 Km (CH: -0.964 Km to CH:-0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) AND OTHER RELATED INFRASTRUCTURAL WORKS FROM BENNIGANAHALLI TO CHIKKABANAVARA, EXCLUDING STATION BUILDINGS, OF CORRIDOR - 2 OF BENGALURU SUBURBAN RAILWAY PROJECT (BSRP)”.**

PREAMBLE

1. The Price Schedule shall be read in conjunction with the Instructions to Tenderers, Conditions of Contract, Notice Inviting Tender, Employer's requirement PART-1 and 2, Scope of work, Technical Specifications, Tender Drawings, Schedule, Annexures and Addendums.
2. The Amount are to be quoted in each section of the Price Schedule (i.e., Schedule-A: Design and construction of elevated viaduct and Schedule-B Design and construction of formation in embankment/cuttings including Bridges. The Schedule -C: consists of Lump sum provision to be operated for incidental and unforeseen items likely to require while execution of work. These items **will be executed under schedule of rates 2019-20 or latest, published by Government Departments KPWD/USSOR/CPWD/ BWSSB/BESCOM**). The cost under this Schedule (Schedule-C) will stand fixed as Rs 10,00,00,000/- and this amount of Rs Ten Crores already provided as fixed amount in the summary of Financial Bid/Price Schedule. The amount of Schedule-A & Schedule-B to be carry forward to summary sheet. The quoted amount is for completed and finished items of work and complete in all respects. It will be deemed to have included all constructional plant, tools, machinery, labour, supervision, materials, fuel, oil, consumables, electric power, water, transportation, all leads and lifts, dewatering, all temporary works and false works, construction of temporary stores and buildings, fencing, watering, lighting, erection maintenance, night working, inspection facilities, safety measures at work sites/casting yard for workmen and road users, design and drawings, casting yard, staging, shuttering, form work, stacking yard, etc. establishment and overhead charges, labour camps, insurance costs for labour and works, contractor's profit, all taxes, royalties, duties, cess, octroi, GST and other levies and other charges together with all general risks, liabilities and obligations set out or implied in the contract and including remedy of any defects during the Defect Liability Period, unless otherwise provided in Price Schedule.
3. Providing concrete for all works deemed to be inclusive of the cost towards production of concrete by batching plant, transit mixer, transportation of concrete with all leads and lifts, form work, shuttering including staging as required, pouring of concrete by pump/tower crane to all heights /depths, tremie or other approved means, compaction by vibrators, curing by approved means

such as water, steam or curing compound and all labour, tools, plants, machinery required for execution of work complete in all respects including deshuttering after completion of work.

4. The amount for various Schedules and Summary of Price Schedule shall be quoted in Indian Rupees both in figures and in words.
5. The whole cost of complying with the provisions of the Contract shall be deemed to have been included in the quoted amount.
6. All columns in the "Summary of Price Schedule"- shall be filled in ink or typewritten and the total tender amount shown in the bottom. The person authorized to sign on behalf of the Tenderer shall sign in full at bottom of all pages and at the end of schedule.
7. General directions and description of works and materials are not necessarily repeated or summarized in the Price Schedule.
8. The method of measurement of completed work for payment shall be in accordance with the requirements as stated in the individual sections of the Technical Specifications and Conditions of Contract.
9. Shuttering required for concrete work shall be of steel except wherever there are site constraints as decided by Engineer.
10. In the defined grade of concrete mix, the first figure defines the strength of concrete and second figure defines the maximum size of coarse aggregates to be used for production of particular concrete mix, E.g., M 35/20 means "M-35" is the grade of concrete and "20" is the maximum size of coarse aggregate in mm to be used.
11. Tenderer may please note that to perform this contract, nothing extra shall be payable on account of field constraints, availability of front, preparation of detailed scheme for taking necessary clearance and approval from the concerned authority and other local bodies etc.
12. For Pier heights more than 12m above the starter for cast in situ piers, more than one pour shall be considered, but a maximum of two pours is allowed to complete pier concreting. In case of more than one pour, Engineer's approval for "method statement" must be obtained.
13. The tripods shall be permitted for casing driving. Hydraulic rig can be used for installation of casing in exceptional cases.
14. Couplers may be used in pile caps and Open foundations for reinforcement above 25 mm. in diameter. Welding of reinforcement can be permitted by Engineer in lieu of Coupler.
15. Geo technical data given is an indicative, only for tendering purpose. The successful tenderer will have to carry out the Geo-technical Investigations, if required to perform this contract.
16. If work is stopped due to non-shifting of utilities, no claim shall be entertained on this account.
17. The Tenderer's offer shall be inclusive of all taxes and duties payable by them. Income Tax and any other statutory taxes to be deducted at source, if any, will be deducted by the Employer in accordance with the Income Tax Act and any other acts in force and in accordance with instructions issued by the Authorities on this behalf, from time to time.
18. The Tenderer is required to furnish the PAN for all members of Group.

19. Mock-up pier and mock-up segments to be cast at casting yard & nothing extra will be paid.
20. It is also informed that the area available for launching of segment is limited in certain stretches in the Viaduct construction and there may be difficulties in keeping segments directly below the span within the base width of overhead launching assembly. The tenderer will inspect and conduct survey for studying the field constraints and quote their amount accordingly to perform the contract.

Important Notice:

- **The Tenderer should quote his amount against schedule-A and schedule-B of Price Schedule in e-Procurement Portal.**
- **The cost under Schedule-C will stand fixed as Rs 10,00,00,000/- and this amount of Rs. Ten Crores already provided as fixed amount in the summary of Financial Bid/Price Schedule.**
- **The total value of the Tender quoted by the Tenderer shall be computed based on the amount quoted in schedule-A and schedule-B and adding the fixed amount of schedule-C.**

K-RIDE

SUMMARY OF PRICE SCHEDULE.				
EPC TENDER				
NAME OF WORK: "Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".				
Tender no: K-RIDE/BSRP/10/2021				
Sl. No.	Schedule	Description	Quoted by Tenderer	
			Quoted Amount in INR (Lumpsum Cost)	
			In Figures	In Words
1	2	3	4	5
1	Schedule - A	"Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".		
2	Schedule - B	"Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".		
3	Schedule -C	Miscellaneous Items for works which are not covered in Schedule A & B. (Items not covered in Schedule A & B are to be executed under schedule of rates 2019-20 or latest, published by Government Departments KPWD/USSOR/CPWD/ BWSSB/BESCOM).	10,00,00,000/-	Ten Crores.
Grand Total		A+B+C= (In Figures)		
		(In Words)		

Signature of the Tenderer

Note:-

- 1) The above quoted cost covers all items of the work as detailed in the “Employer’s Requirement” contained in Section 8A as well as conforming to all Technical Specifications in Section 8B and stipulations laid down in the Bid Document including all addenda/corrigenda thereof till the date of submission of Bids.
- 2) It is inclusive of all costs on Design, Drawings, Reports, Survey, Site Facilities, Construction, Equipment, Plants, Instruments, Labour, Supervision, Casting Yard Facilities, Launching Girders, Materials, Erection, Testing, Maintenance, Temporary Works, Site Office, Site Access, Safety, Security, Defect Rectification, Insurance, Profit duties, Taxes, Levies, Royalties as per applicable law together with all general risks, liabilities and obligations set out or implied in the contract.
- 3) Schedule-C consists of Lump sum provision to be operated for incidental and unforeseen items likely to require while execution of work. These items will be executed under schedule of rates 2019-20 or latest, published by Government Departments KPWD/USSOR/CPWD/ BWSSB/BESCOM). The cost under this Schedule (Schedule-C) will stand fixed as Rs 10,00,00,000/- and this amount of Rs. Ten Crores already provided as fixed amount in the summary of financial bid.
- 4) Total section length of Corridor-2 is 25.578 km (approximate) and in that 8.027 km (approx..) is elevated section and 17.551 km (approx.) is at grade section.
- 5) The contractor to start the work from the both the ends (minimum) of the Corridor.
- 6) Schedule for which no rate or price has been entered in will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Price Schedule (refer: ITB Clause 11.2 and CC Clause 37.2).
- 7) Lumpsum Amount shall be quoted by the Tenderer in Indian Rupees.
- 8) Where there is a discrepancy between the rate in figures and words, the lower of the two will govern. [ITT Clause 24.1]

PRICE SCHEDULE				
SCHEDULE-A				
<p>NAME OF WORK: “Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.</p>				
Tender no: K-RIDE/BSRP/10/2021				
Sl. No.	Schedule	Description	Quoted by Tenderer	
			Quoted Amount in INR (Lumpsum Cost)	
			In Figures	In Words
1	2	3	4	5
1	Schedule - A	“Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)”.		

Signature of the Tenderer

PRICE SCHEDULE				
SCHEDULE-B				
NAME OF WORK: "Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".				
Tender no: K-RIDE/BSRP/10/2021				
Sl. No.	Schedule	Description	Quoted by Tenderer	
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			In Figures	In Words
1	2	3	4	5
1	Schedule - B	"Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".		

Signature of the Tenderer

PRICE SCHEDULE				
SCHEDULE-C				
<p>NAME OF WORK: "Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".</p>				
Tender no: K-RIDE/BSRP/10/2021				
Sl. No.	Schedule	Description	Quoted by Tenderer	
			Quoted Amount in INR (Lumpsum Cost)	
			In Figures	In Words
1	2	3	4	5
1	Schedule -C	<p>Miscellaneous Items for works which are not covered in Schedule A & B. (Items not covered in Schedule A & B are to be executed under schedule of rates 2019-20 or latest, published by Government Departments KPWD/USSOR/CPWD/ BWSSB/BESCOM).</p> <p>Note: If the same item is available in all schedule of rates given above, then the priority of schedule of rates is as follows: a) KPWD b) USSOR c) CPWD d) BWSSB/SR e) BESCOM/SR. If SR rate 2019-20 is not available, then the previous SR rates are to be adopted. Irrespective of the year, the rates available as per priority will be given.</p>	10,00,00,000/-	Ten crores

Signature of the Tenderer

ANNEXURE-1

SCHEDULE FOR ON ACCOUNT PAYMENTS UNDER LUMP SUM PORTION

Name of Work: "Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".

Description of Schedule-A: Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".

The payment would be governed by the stage payment schedule as detailed below:

Overall percentage 100% i.e., quoted lumpsum price shall be divided in following heads. The Percentage breakup of cost component for each Head is as below:

1. APPORTIONMENT OF CONTRACT PRICE OF SCHEDULE-A:

Schedule	Description	Component	Percentage of Schedule-A
1	2	3	4
Schedule-A	"Design and Construction of Elevated Viaduct of length 8.027 km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".	1. General Items (Head-G)	2.5%
		2. Design & Drawings (Head-D)	2.0%
		3. Construction of Viaduct (Head-V)	95.5%
Total			100%

2. WEIGHTAGES OF COMPONENTS FOR INTERIM PAYMENTS:

2.1 GENERAL ITEMS

Sl. No.	Stage Payments	Percentage of Cost of Schedule -A	Payable Unit	Percentage breakup (Weightages)
1	2	3	4	5
1	Submission of Soil investigations, buildings condition survey report of entire Corridor and construction of site office.	2.5% of the cost of Schedule-A	L.S.	20%
2	Commissioning of site laboratory, submission of quality, safety, environment and public health manuals, submission of Interface Management Plan and submission of instrumentation scheme of entire Corridor and diversion schemes if any.		LS	10%
3	Submission of utility identification report of entire Corridor after actual trenching and making good road etc. complete and submission to utility owning agency.		L.S.	10%
4	a) Resources allocated to ESHS management.		LS	10%
	b) Drafting and updating the ESHS documentation,			

	<p>reporting, inspections.</p> <p>c) Implementation of the Health and Safety Plan: Meetings, health care center, medical check-ups, emergencies and evacuations, safety protective equipment, hygiene</p> <p>d) Protection of adjacent areas, prevention of erosion and wastewater management.</p> <p>e) Traffic, noise and atmospheric emissions management, land take</p> <p>f) Waste and hazardous products management.</p> <p>g) Vegetation clearing and site rehabilitation.</p> <p>h) Accommodation, drinking water, meals and transportation of staff.</p> <p>i) Training and local recruitment management costs.</p> <p>j) Submission of quarterly audit report of SHE of entire Corridor and Action Taken on non-compliance of non-conformance report and its closure during last month</p> <p>Note: To be paid quarterly on pro-rata basis for submission of quarterly audit report.</p>			
5	<p>a) Deployment of SHE personnel as per SHE Manual for the entire Corridor. The payment shall be made on monthly basis starting from 3 months after the Commencement Date.</p> <p>b) Accommodation, drinking water, meals and transportation of staff.</p> <p>c) Training and local recruitment management costs</p> <p>Notes:</p> <p>1) 80% of the apportioned payment as per this Milestone shall be equally spread over 25 months (after initial 3 months) for the purpose of payment.</p> <p>2) Remaining 20% payment shall be released on completion of work, subject to continued deployment of SHE personnel in the period beyond 28 months.</p> <p>3) Any shortfall of deployment of SHE personnel from the numbers indicated in the SHE Manual will attract penalty at the rate of 3 times the prorata shortfall. For example, if the SHE Manual requires 17 staff and the deployment is 16 staff for a particular month, then $[3 \times 1 / 17 =]$ 17.65% of the payment due for that month will be permanently deducted. Likewise, shortage of 2 staff will result in 35.3% lesser payment and so</p>		LS	20%

	on. This penalty shall also apply to 20% final payment also on prorata manner.			
6	<p>IT requirements of K-RIDE (online project management platform, documentation management system, enterprise work program platform, BIM modeling, PMIS etc.) – Refer relevant Para under Employer’s Requirements for details.</p> <p>Notes:</p> <ol style="list-style-type: none"> 30% of the apportioned payment under this Milestone (i.e. 30% of 15%) shall be released after Contractor put in place the necessary hardware, IT center and software licenses. This should be accomplished not later than 3 months from commencement date. 50% of the apportioned payment under this Milestone (i.e. 50% of 15%) shall be equally spread over 25 months after completion of SN -1 above and deployment of requisite IT staff in full as per requirement. Shortfall of staff shall attract penalty in similar manner as for SHE staff as per Sl. No.5 above. Balance 20% will be released on completion of work, subject to continued deployment of IT staff in the period beyond above 25 months. 		LS	15%
7	<p>Regular maintenance and repair of existing road, service road, foot path, construction and maintenance of temporary diversions as required for traffic management during construction period to keep them in traffic worthy condition. Restoration of road damaged for construction purpose is also included for the entire Corridor of 25.39 Kms.</p> <p>Note: To be paid monthly on pro-rata basis. Payment of this item will start from 6 months from commencement of project.</p>		L.S.	15%
Total				100%

2.2 DESIGN & DRAWING

Sl.No.	Stage Payments	Percentage of Cost of Schedule - A	Payable Unit	Percentage breakup (Weightages)
1	2	3	4	5
1.	Preliminary Design, Definitive Design	2.0% of the cost of Schedule-A	LS	30%
2.	Construction Drawings		LS	40%
3.	Completion Drawings/As Built Drawings		LS	30%
Total				100%

2.3 CONSTRUCTION OF VIADUCT.

Sl. No.	Stage Payments	Percentage of Cost of Schedule -A	Payable unit	Percentage breakup (Weightages)
1	2	3	4	5
1.	Commissioning of Casting Yard (Contractor and Engineer shall make jointly program of commissioning of various activities of casting yard. Payment shall be released on monthly basis based on progress achieved as certified by Engineer).	95.5% of the cost of Schedule-A	Proportionately till Commissioning	2%
2.	Pile Foundations including testing of Piles, ND Tests, Soil Boring, Trial trenching, GPR Survey, Safety Barricading.		Per Pile Group	15%
3.	Pile Caps, Open Foundations including PCC, shoring, Plate Load Test.		Per Pile Cap/Open Foundations	10%
4.	Piers including Pier Caps, Portal, Eccentric Piers, Precast Pier Caps & Pre-stressing, Pedestals, Median, Crash Barrier & Shear Keys/Stopppers		per pier	15%
5.	Casting of segments (Box/U Girders), I-Girders including parapet		Per span	30%
6.	Supply and Erection of Composite Steel Girders/open web girder for viaduct.		Per span	3%
7.	Erection of segments (Box/U Girders), I-Girders, including parapet including pre-stressing, grouting etc., all complete.		per span	13%
8.	Bearing - Supply and fixing for all spans including Elastomeric Bearing and POT-PTFE Bearings. Note : 50 % on supply and 50% on fixing		per span	2%
9.	Providing & Fixing Expansion Joints (Omega Joints and Strip Seal Joints) Note : 50 % on supply and 50% on fixing		per span	1%
10.	Misc. Items: Completion of the work in all respects including railing, G.I. Brackets for cable, earthing, manholes, rain water harvesting, clearing of Sites in all respects so that area is in traffic worthy condition, drainage pipes, hand rails, drainage spouts, Traffic/Cautioning Sign Boards, Road Diversions, Setting out, Span Load testing of Girders, Dismantling and transportation, etc.,		per span	7%
11.	All other balance works to complete the entire work as per the scope & specifications, handing over of viaduct to K-RIDE and submission of As-built drawings.		LS	2%
TOTAL				100%

Note (For Viaduct)

1.	Total Route km covered in this contract is shown in GAD attached with tender documents. The details are shown in GAD enclosed with the tender. In case of variation in route length on either side, i.e., increase or decrease, the total value of viaduct, i.e., "V" (Construction of Viaduct) & "D" (Design & Drawing), will get modified accordingly on prorata basis for payment purpose.
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2.	The successful Contractor will submit a quantity schedule for the work as per the details finalized by them for the components listed in the table above, which will be subject to approval by the employer/engineer. Unit payment of the items shall be governed by the Quantity schedule within the total % payment specified against that item. For example, if there are 'N' no of pile groups in the viaduct, the payment due on completion of individual pile group would be $0.15 \times V/N$.
3.	The quantity schedule after being approved by the Engineer will be used for making all stage payments. The Contractor should note that while stage payment will be governed by the quantity schedule, total cost of the 'Lump Sum' component would remain unchanged for the specified work subject to adjustment for the length of the viaduct brought out in (1) above.

Signature of Tenderer

K-RIDE

ANNEXURE-2

SCHEDULE FOR ON ACCOUNT PAYMENTS UNDER LUMP SUM PORTION

Name of Work: "Design and Construction of Elevated Viaduct of length 8.027Km (CH: -0.675 Km to -0.050 Km & CH: 11.137 km to 18.350 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to Ch: -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".

Description of Schedule-B: "Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".

The payment would be governed by the stage payment schedule as detailed below:

Overall percentage 100% i.e., quoted lumpsum price shall be divided in following heads. The Percentage breakup of cost component for each Head is as below:

1. APPORTIONMENT OF CONTRACT PRICE OF SCHEDULE-B:

Schedule	Description	Component	Percentage of Schedule-B
1	2	3	4
Schedule-B	"Design and Construction of Formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 17.551 Km (CH: -0.964 Km to -0.675 Km, CH: -0.050 Km to CH: 11.137 Km & CH: 18.350 Km to 24.425 Km) and other related Infrastructural Works from Benniganahalli to Chikkabanavara, excluding station buildings, of Corridor - 2 of Bengaluru Suburban Railway Project (BSRP)".	1. Design & Drawings	2.0%
		2. Earthwork, Retaining Wall & Drains	61%
		3. Minor Bridges	11%
		4. Major Bridges	5%
		5. RUB (Road Under Bridges)	15%
		6. ROB (Road Over Bridges)	6%
Total			100%

2. WEIGHTAGES OF COMPONENTS FOR INTERIM PAYMENTS:

2.1 DESIGN & DRAWING

Sl.No.	Stage Payments	Percentage of Cost of Schedule -B	Payable Unit	Percentage breakup (Weightages)
1	2	3	4	5
1.	Preliminary Design, Definitive Design	2.0% of the cost of Schedule-B	LS	30%
2.	Construction Drawings		LS	40%
3.	Completion Drawings/As Built Drawings		LS	30%
Total				100%

2.2 EARTHWORK, RETAINING WALL & DRAINS.

Sl. No.	Stage Payments	Percentage of Cost of Schedule -B	Payable unit	Percentage breakup (Weightages)	Payment Procedure
1	2	3	4	5	6
1.	General clearance, ground improvement, embankment /cutting including compaction so as to achieve 50% of desired height below the bottom of blanketing layer.	61% of the cost of Schedule-B	LS	15%	1. Unit of measurement is linear length along alignment. Payment of each stage will be made on prorata basis on completion of a stage in a continuous length of minimum 500 m as per weightage given in this Schedule. 2. Provided that payment for the blanketing layer shall be made on completion of minor bridges including slab/RCC box in the length for which stage payment is claimed. For the avoidance of doubt, payment for minor Bridges shall be payable separately in accordance with relevant item.
3.	Balance earthwork in embankment/ cutting including compaction up to bottom of blanketing layer.		LS	15%	
4.	Earthwork in Blanketing layer complete in all respect. Including bitumen / Asphalt layer as per IR specification and Geo-textile layers.		LS	4%	
5.	Longitudinal/cross drains including cable ducts on either side of drain, retaining structures, retaining walls, sacrificial retaining walls, pitching, turfing and other incidental works, complete.		LS	66%	
TOTAL				100%	

Note :

- i) Payment will be made on certification and recommendation of the Engineer to the Employer for various items.
- ii) Track center, Ground level, formation level etc. shown in indicative plan (Tender Drawings) and profile are indicative which may change as per design and site conditions. However, stage payment shall be made as per approved definitive plan and profile. The rates shall be inclusive of all minor variations.
- iii) LS = Lumpsum.

2.3 MINOR BRIDGES.

Sl. No.	Stage Payments	Percentage of Cost of Schedule -B	Payable unit	Percentage breakup (Weightages)	Payment Procedure
1	2	3	4	5	6
1.	On ground clearance, ground improvement if required to suit design bearing capacity and testing, completion of the foundation works, On completion of RCC Boxes, abutment, piers for slab/girder bridges etc.,	11% of the cost of Schedule-B	LS	75%	1. Cost of each bridge shall be determined on prorata basis with respect to the total linear length (Barrel length in case of RCC box and width of slab for slab bridges) of the Minor Bridges. 2. Payment shall be made on completion of each component/ stage of a Minor Bridge as per the weightage given in this schedule.
2.	On completion of balance works as per drawing like walkway, footpath, cable duct, railings, wing walls, return walls, Ballast Retainer, hand railing, all types of protection work, pitching, turfing, back filling and approaches, river training works, if any, etc. complete in all respects.		LS	25%	
TOTAL				100%	

Note-

1. Payment will be made on certification and recommendation of the Engineer to Employer for various items.
2. If a bridge is constructed using precast elements, then 50 % payment against the cost of the item shall be released upon finishing casting of elements and transporting all such elements to the site of bridge construction. Balance 50% shall be released after completion of erection/laying in all respects. The rates shall be inclusive of all minor variations.
3. LS= Lumpsum

2.4 MAJOR BRIDGES.

Sl. No.	Stage Payments	Percentage of Cost of Schedule -B	Payable unit	Percentage breakup (Weightages)	Payment Procedure
1	2	3	4	5	6
1.	Foundation: Ground clearance, preparation of base below the pile cap or below the pier base for open foundation as applicable, ground preparation work, completion of the foundation works for wing walls and return walls and testing.	5% of the cost of Schedule-B	LS	30%	(a) Cost of each bridge shall be determined on pro rata basis with respect to the total linear length of the Major Bridges. (b) Payment shall be made on completion of each component/stage of an Major Bridge as per the weightage given in this schedule. (c) For item no. 3 Superstructure: if a bridge is constructed using pre-cast concrete element / composite girders/plate girders: 50% payment shall be released upon finishing casting of concrete pre-cast elements/Assembled plate girders/open web girders & transportation to site.
2.	Substructure: Completion of abutment, piers including Pier caps/bed blocks, Pedestals (without bearings) as applicable, work up to the bottom of super-structure, completion of wing walls and return walls in all respects.		LS	10%	
3.	Superstructure: Completion of super structure including bearings ready for track linking, walkway footpath, cable duct, testing etc.		LS	45%	
4.	Misc. works: Completion of balance works as per drawing, hand rails, curtain walls, all protection works, pitching, completion of approaches including back filling, turfing, river training works if any, testing on completion etc. complete in all respects and fit for use.		LS	15%	
TOTAL				100%	

NOTE:

1. Payment will be made on certification and recommendation of the Engineer to Employer for various items.
2. The rates shall be inclusive of all minor variations.
3. LS= Lumpsum

2.5 RUB (ROAD UNDER BRIDGES).

Sl. No.	Stage Payments	Percentage of Cost of Schedule -B	Payable unit	Percentage breakup (Weightages)	Payment Procedure
1	2	3	4	5	6
1.	On ground clearance, ground improvement if required to suit design bearing capacity and testing, Road diversion works, completion of the foundation works, on completion of RCC Boxes (Barrel), abutments, piers & slab for slab bridges etc.,	15% of the cost of Schedule-B	LS	80%	1. Cost of each bridge shall be determined on prorata basis with respect to the total linear length (Barrel length in linear meter) of the RUBs. 2. Payment shall be made on completion of each component/stage of RUB as per the weightage given in this schedule.
2.	On completion of balance works as per drawing like walkway, footpath, cable duct, railings, wing walls, return walls, Ballast Retainer, hand railing, all types of protection works, pitching, turfing, back filling, drains, retaining wall for approach roads, approach roads, river training works, if any, etc. complete in all respects.		LS	20%	
TOTAL				100%	

Note-

1. Payment will be made on certification and recommendation of the Engineer to Employer for various items.
2. If a bridge is constructed using precast elements, then 50% payment against the cost of the item shall be released upon finishing casting of elements and transporting all such elements to the site of bridge construction. Balance 50% shall be released after completion of erection/laying in all respects. The rates shall be inclusive of all minor variations.
3. LS= Lumpsum

2.6 ROB (ROAD OVER BRIDGES).

Sl. No.	Stage Payments	Percentage of Cost of Schedule -B	Payable unit	Percentage breakup (Weightages)	Payment Procedure
1	2	3	4	5	6
1.	Foundation: Ground clearance, preparation of base below the pile cap or below the pier base for open foundation as applicable, ground preparation work, completion of the foundation works for wing walls and return walls and testing.	6% of the cost of Schedule-B	LS	35%	(a) Cost of each bridge shall be determined on pro rata basis with respect to the total linear length of the ROBs including approaches. (b) Payment shall be made on completion of each stage of a ROB as per the weightage given in this schedule. (c) For item no. 3 Superstructure: if a bridge is constructed using pre-cast concrete element /composite girders/plate girders: 50% payment shall be released upon finishing casting of concrete pre-cast elements / Assembled plate girders/open web girders & transportation to site.
2.	Substructure: Completion of abutment, piers including Pier caps/bed blocks, Pedestals (without bearings) as applicable, work up to the bottom of super-structure, completion of wing walls and return walls in all respects.		LS	10%	
3.	Superstructure: Completion of super structure including bearings, walkway footpath, cable duct, testing etc.		LS	45%	
4.	Misc. works: Completion of balance works as per drawing, hand rails, walls, all protection works, pitching, completion of approaches including back filling, turfing, river training works if any, testing on completion, Approach roads, retaining walls, drains etc. complete in all respects and fit for use.		LS	10%	
TOTAL				100%	

NOTE:

1. Payment will be made on certification and recommendation of the Engineer to Employer for various items.
2. The rates shall be inclusive of all minor variations.
3. LS= Lumpsum

Note (For At-Grade Section, Schedule-B)

1. **Total Route km covered in this contract is shown in GAD attached with tender documents.** The details are shown in GAD enclosed with the tender.
- A. Earthwork, retaining wall and drains:** Unit of measurement is linear length along the alignment, In case of variation in route length on either side, i.e. increase or decrease, the total value of component of Earthwork, Retaining wall and drains will get modified accordingly on prorata basis for payment purpose. The component of design and drawing charges for Earthwork, retaining wall and drains also worked out proportionately on the basis of component value of Earthwork, retaining wall and drains as per schedule-B and the variations shall be calculated on prorata basis. Note: The variations due to width and height of Earthwork, retaining wall and drains are included in the linear length cost.
- B. Minor Bridges:** Cost of each bridge shall be determined on prorata basis with respect to the total linear length (Barrel length in case of RCC box and width of slab for slab bridges) of the Minor Bridges. In case the variation in barrel length on either side i.e., increase or decrease, the total value of the component of Minor bridges will get modified accordingly on prorata basis for payment purpose. The component of design and drawing charges for Minor bridges also worked out proportionately on the basis of component value of Minor bridges as per schedule-B and the variations shall be calculated on prorata basis. Note: The variations due to span and height of minor bridges are included in the barrel length cost.
- C. Major Bridges:** Cost of each bridge shall be determined on pro rata basis with respect to the total linear length of the Major Bridges. In case the variation in total linear length (along the alignment) on either side i.e., increase or decrease, the total value of the component of Major bridges will get modified accordingly on prorata basis for payment purpose. The component of design and drawing charges for Major bridges also worked out proportionately on the basis of component value of Major bridges as per schedule-B and the variations shall be calculated on prorata basis. Note: The variations due to width and height of major bridges are included in the linear length cost.
- D. RUB:** Cost of each bridge shall be determined on prorata basis with respect to the total linear length (Barrel length in linear meter) of the RUBs. In case the variation in barrel length on either side i.e., increase or decrease, the total value of the component of RUB will get modified accordingly on prorata basis for payment purpose. The component of design and drawing charges for RUB also worked out proportionately on the basis of component value of RUB's as per schedule-B and the variations shall be calculated on prorata basis. Note: The minor variations due to span and height of minor bridges are included in the barrel length cost.
- E. ROB:** Cost of each bridge shall be determined on prorata basis with respect to the total linear length (span from abutment face to abutment face) of the ROBs along the road. The cost of ROB is including the approaches. In case the variation in total linear length (span from abutment face to abutment face) along the road on either side i.e., increase or decrease, the total value of the component of ROB will get modified accordingly on prorata basis for payment purpose. The component of design and drawing charges for ROB also worked out proportionately on the basis of component value of ROB as per schedule-B and the variations shall be calculated on prorata basis Note: The variations due to width and height of ROB's are included in the linear length cost.

2.	The successful Contractor will submit a quantity schedule for the work as per the details finalized by them for the components listed in the table above, which will be subject to approval by the employer/engineer. Unit payment of the items shall be governed by the Quantity schedule within the total % payment specified against that item.
3.	The quantity schedule after being approved by the Engineer will be used for making all stage payments. The Contractor should note that while stage payment will be governed by the quantity schedule, total cost of the 'Lump Sum' component would remain unchanged for the specified work subject to adjustment for the length of the above works brought out in (1).

K-RIDE

SECTION-10
**FORMAT OF BANK GUARANTEE FOR
SECURITY DEPOSIT ETC.,**

INDEX

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NOTE: This Section contains forms which, once completed, will form part of the Contract. The forms for Performance Security and Advance Payment Security, when required, shall only be completed by the successful Bidder after contract award.

All italicized text is for guidance how to prepare the various forms and shall be deleted from the final documents.

FORMAT OF BANK GUARANTEE FOR SECURITY DEPOSIT

To,.....(Name of the Employer)
(Address of the Employer).

Whereas(Name and Address of the contractor) (herein after called the Contractor) has undertaken, in pursuance of contract no.....
 Dated:.....(Name of the contract and brief description of the work) (herein after called the Contract)

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of Rs. _____ *[amount of guarantee]*
 Rupees _____ *[in words]*, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____ *[amount of guarantee]* as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall be valid until 28 days from the date of expiry of the Defects Liability Period.

Signature and seal of the guarantor _____
 Name of Bank _____
 Address _____
 Date _____

FORM OF BANK GUARANTEE FOR PERFORMANCE SECURITY

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).

From:

Name and Address of the Bank.....
.....

To:

The Managing Director,
Rail Infrastructure Development Company (Karnataka) Limited,
"Samparka Soudha", 1st Floor,
B.E.P Premises (Opp. Orion Mall),
Dr. Rajkumar Road,
Rajajinagar 1st Block,
Bangalore - 560 010

WHEREAS, Rail Infrastructure Development Company (Karnataka) Limited, hereinafter called the **Employer**, acting through **[Insert Designation and address of the Employer's Representative]**, has accepted the bid of **[Insert Name and address of the Contractor]**, hereinafter called the **Contractor**, for the work of **[Insert Name of Work]**, vide Notification of Award No **[Insert Notification of Award No...]**
AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of **[Insert Value of Performance Security required]**, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, **[Insert Name of the Bank]**, with its Branch **[Address]** having its Headquarters office at **[Address]**, hereinafter called the **Bank**, acting through **[Designation(s) of the authorised person of the Bank]**, have, at the request of the **[Insert name of the JV partner]**, a JV partner on behalf of the contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

- 1 KNOW ALL MEN by these present that I/We the undersigned **[Insert name(s) of authorized representatives of the Bank]**, being fully authorized to sign and incur obligations for and on behalf of the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of **[Insert Value of Performance Security required]** as above stated.
- 2 The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal not withstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

- 3 On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.
- 4 The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.
5. The Bank Guarantee shall be unconditional and irrevocable.
- 6 The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.
- 7 The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.
- 8 This guarantee is valid and effective from the date of its issue, which is *[insert date of issue]*. The guarantee and our obligations under it will expire on *[Insert the date twenty-eight days after the expected end of defect liability period]*. All demands for payment under the guarantee must be received by us on or before that date.
- 9 The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.
- 10 The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.
- 11 The expressions Bank and Employer herein before used shall include their respective successors and assigns.
- 12 The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.
- 13 The Guarantee shall be in addition to and without prejudice to any other security Guarantee (s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.
14. This guarantee shall be valid for 28days from the date of expiry of defect liability period.

Date

Place.....

.....

*[Signature of Authorized person of
Bank/Guarantor]*

.....
[Name in Block letters]

.....
[Designation]

.....
[P/Attorney] No.

.....
Bank's Name and Seal

[P/Attorney] No.....

Witness:

1. *Signature*
Name & Address & Seal

2. *Signature*
Name & address & Seal

Note :

1. *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*

2. *In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.*

3. *In case the Contractor is a JV, the Performance Security is required to be furnished on behalf of the JV in favour of the Employer by the JV Partners in proportion of their respective percentage share specified in the JV Agreement. The percentage share of M/s **[Insert Name of the JV Partner]** in the JV is **[Fill share % in the JV]** percent. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.*

FORM OF BANK GUARANTEE FOR ADDITIONAL PERFORMANCE SECURITY

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank)

From:

Name and Address of the Bank.....

.....

To:

The Managing Director,
Rail Infrastructure Development Company (Karnataka) Limited,
"SamparkaSoudha" , 1st Floor,
B.E.P Premises (Opp. Orion Mall),
Dr. Rajkumar Road,
Rajajinagar 1st Block,
Bangalore - 560 010

WHEREAS, Rail Infrastructure Development Company (Karnataka) Limited, hereinafter called the **Employer**, acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the **Contractor**, for the work of ***[Insert Name of Work]***, vide Notification of Award No. ***[Insert Notification of Award No.]***.
AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of ***[Insert Value of Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the **Bank**, acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the ***[Insert name of the JV partner]***, a JV partner on behalf of the contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

- 1 KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank]***, being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of ***[Insert Value of Performance Security required]*** as above stated.
- 2 The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank..

- 3 On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.
- 4 The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.
- 5 The Bank Guarantee shall be unconditional and irrevocable.
- 6 The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.
- 7 The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.
- 8 This guarantee is valid and effective from the date of its issue, which is *[insert date of issue]*. The guarantee and our obligations under it will expire on *[Insert the date twenty-eight days after the expected end of defect liability period]*. All demands for payment under the guarantee must be received by us on or before that date.
- 9 The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.
- 10 The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.
- 11 The expressions Bank and Employer herein before used shall include their respective successors and assigns.
- 12 The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.
- 13 The Guarantee shall be in addition to and without prejudice to any other security Guarantee (s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date

Place.....

.....

[Signature of Authorised person of Bank]

.....

[Name in Block letters]

.....
[Designation]

.....
[P/Attorney] No.

.....
Bank's Seal

[P/Attorney] No.....

Witness:

3. *Signature*
Name & Address & Seal
4. *Signature*
Name & address & Seal

Note :

- 1 *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*
- 2 *In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.*
- 3 *In case the Contractor is a JV, the Performance Security is required to be furnished on behalf of the JV in favour of the Employer by the JV Partners in proportion of their respective percentage share specified in the JV Agreement. The percentage share of M/s **[Insert Name of the JV Partner]** in the JV is **[Fill share % in the JV]** percent. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.*

ADVANCE PAYMENT SECURITY

(On non-judicial stamp paper of appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank)

From

[Name and Address of the Bank]

To

The Managing Director,
Rail Infrastructure Development Company (Karnataka) Limited,
"Samparka Soudha" , 1st Floor,
B.E.P Premises (Opp. Orion Mall),
Dr. Rajkumar Road,
Rajajinagar 1st Block,
Bangalore - 560 010

Beneficiary/Employer: Rail Infrastructure Development Company (Karnataka) Limited.

Guarantee No.: *[.... reference number of the guarantee....]* **Dated:** *[.....]*

WHEREAS, Rail Infrastructure Development Company (Karnataka) Limited (**hereinafter called the Employer**) has entered into Contract No. *[.... reference number of the Contract....]* dated *[.....]* for the execution of *[name of the contract]* (**hereinafter called the Contract**) with *[....name of the Contractor....]* (**hereinafter called the Contractor**).

WHEREAS, according to the Conditions of the Contract, an advance payment is admissible to the contractor against submission of bank guarantee(s).

At the request of the Contractor, we *[....name of the Bank....]* with our branch at *[....address....]* having our Head Office at *[....address....]* (**hereinafter called the Bank**) have, at the request of *[.....Insert name of the JV partner.....]*, a JV partner on behalf of the Contractor, agreed to give the said guarantee as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned *[....Insert name(s) of authorized representative(s) of the Bank....]*, being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantees to pay the Employer the sum of Rs.*[....value in figure....]* (Rupees *[....value in words....]* **only**) (**hereinafter called the Full Amount**).
2. The Bank undertakes to immediately pay to the Employer, without any demur, reservation or recourse, any amount up to and including aforementioned full amount upon first written demand/demands from the Employer.
3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount so demanded without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.
5. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank, the Contractor or the Employer.
6. The Bank agrees that no change, addition, modification to the terms of the Contract Agreement or to any document, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.
7. This guarantee is valid and effective from the date of it's issue, which is [...date of issue...]. The guarantee and our obligations under it will expire on dated[...Please refer note 4 & 5...]. All demands for payment under the guarantee must be received by us on or before that date.
8. The Bank agrees that the Employer's right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will continue until either the aforementioned full amount is paid to the Employer or the guarantee validity period expires.
9. The Bank agrees that it's obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.
10. The expressions Bank and Employer herein before used shall include their respective successors and assigns.
11. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

Dated[.....]

Place[.....]

.....
(Signature of the Authorized Person of the Bank)

.....
(Name in Block Letters)

.....
(Designation)

.....
(Bank's Seal)

.....
(Authorization No.)

Witness:

-
1.
Signature, Name & Address
 2.
Signature, Name & Address

Note:

1. *All italicized text in brackets [...text...] is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*
2. *In case the guarantee is issued by a foreign Bank, the said bank shall have operations in India and should be issued by Indian operations branch of the said bank.*
3. **Mobilization Advance**

(a) For Single Entity

For each Installment of Advance, two Bank Guarantees of equal amounts (each equal to half of the first installment of advance plus 10%) shall be furnished. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

OR

(b) For JV/Consortium

For each Installment of Advance, individual JV/Consortium partner shall furnish Bank Guarantee equal to his share in the installment of Advance plus 10%. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

4. Advance against Plant and Machinery**(a) For Single Entity**

For each Installment of Advance, a Bank Guarantee equal to the installment of advance plus 10% shall be furnished. The Bank Guarantee shall be valid for the stipulated completion period of the contract.

OR

(b) For JV/Consortium

For each Installment of Advance, individual JV/Consortium partner shall furnish a Bank Guarantee equal to his share in the installment of advance plus 10%. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

**INDEMNITY BOND FOR THE SAFE CUSTODY OF THE
MATERIALS SUPPLIED BY THE CONTRACTOR**

(To be executed on Non-Judicial Stamp Paper of Appropriate Value and notarized)

THIS INDEMNITY BOND made on this _____ day of _____ 20__ by _____ (*insert the name of the Contractor and its registered address*) (hereinafter called "the Contractor") which expression shall where the context do admits or implies be deemed to include its executors, administrators and assigns, in favour of the Rail Infrastructure Development Company (Karnataka) Limited, Samparka Soudha" ,
1st Floor, B.E.P Premises (Opp. Orion Mall), Dr. Rajkumar Road, Rajajinagar 1st Block, Bangalore - 560 010 (hereinafter called "K RIDE") on the other part.

WHEREAS by an Agreement/Letter of Acceptance No. _____ dated _____ (hereinafter called "the said agreement"), the Contractor has agreed to execute the _____ (*Name of Work*) (hereinafter called "the Works") .

AND WHEREAS the Contractor has submitted to K RIDE/ the Engineer for payment on materials procured by him and brought to the site of the Works or his workshop for use in the Works.

AND WHEREAS K RIDE/ the Engineer has agreed to make advance/stage payment to the Contractor the total sum of Rs. _____ (*in Figures*) [Rupees _____ (*in Words*) in Interim Payment Certificate (IPC) No. _____, the quantities and other particulars of which are detailed in this IPC for the said works signed by the Contractor on _____ for the Materials brought by the Contractor to site of the works. Brief details are also mentioned in schedule 1 appended hereto.

NOW THIS INDEMNITY BOND WITNESS that in pursuance of the said agreement and in consideration of the sum of Rs. _____ (*in Figures*) _____ (*in Words*) on or before the execution of these presents to be paid to the Contractor by K RIDE so aforesaid, the Contractor doth hereby covenant and agree with K RIDE and declare as follows: -

1. That the said sum of Rs. _____ (*In Figures*) _____ (*in Words*) to be paid by K RIDE to the Contractor as aforesaid shall be utilized by the Contractor in or towards the execution of the said works and for no other purpose whatsoever.
2. That the Materials detailed in the said IPC which have been offered to and accepted by K RIDE/ the Engineer, are absolutely the Contractor's own property and free from encumbrances of any kind and the Contractor will not make any application for or receive any further payment on the Materials which are not absolutely his own property and free from encumbrances of any kind, the Contractor indemnifies the K RIDE against all claims on any Materials in respect of which payment is to be made to him as aforesaid.
3. That the Contractor undertakes that the Materials shall be used exclusively for the performance / execution of the Contract strictly in accordance with the terms and conditions of the Contract and no part of the Materials shall be utilized for any other work or purpose whatsoever.
4. That the Contractor is obliged and shall remain absolutely responsible for the safe transit / protection

and custody of the Materials against all risks whatsoever including acts of the God till the Materials are duly incorporated in the works, commissioned and are taken over by K RIDE/Railway (including surplus Materials, if required as instructed by K RIDE/ the Engineer) in accordance with the terms of the Contract. The Contractor undertakes to keep K RIDE harmless against any loss or damage that may be caused to the Materials.

5. That the said Materials shall not on any account be removed from the site of the works except with the written permission of K RIDE/ the Engineer. Further, K RIDE/ the Engineer shall always be free at all times to take possession of the materials in whatever form the materials may be in, if in its opinion, the Materials are likely to be endangered, mis-utilized or converted to uses other than those specified in the Contract, by any acts or omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of K RIDE to return the Materials without any demur or reservation.
6. That the said materials shall, at all times, be open to inspection by K RIDE/ the Engineer or any authorized representative. In the event of the said material or any part thereof at any time being found to be in lesser quantity than for which payment has been released or the same has been stolen, destroyed or damaged or becoming deteriorated, the Contractor will forthwith replace the same or repair and make good the same as required by K RIDE/ the Engineer.
7. That making payment does not mean that Materials are of required specifications and quality or that whole of the quantity brought to site by Contractor will be used in the work. The Contractor is fully responsible for the materials to conform to required quality and specification and if at any time K RIDE/ the Engineer do not find the material satisfactory, the Contractor at his own cost would replace these. K RIDE/ the Engineer would be at liberty to recover cost of these from any dues of the Contractor. Also any Materials which are in excess of what is finally required under the contract would be the Contractor's property without any liability on K RIDE/ the Engineer who would recover the cost of this from the Contractor.
8. That this INDEMNITY BOND is irrevocable. If at any time, any loss or damage occurs to the Materials or the same or any part thereof is mis-utilized in any manner whatsoever, then the Contractor hereby agrees that the decision of K RIDE/ the Engineer as to assessment of loss or damage to the Materials shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Materials at its own cost and/or shall pay the amount of loss to K RIDE without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to K RIDE/ the Engineer against the Contractor under the Contract or under this Indemnity Bond
9. That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of those presents, the total amount of the payment shall immediately on the happening of such default be recovered by K RIDE/ the Engineer from any dues of Contractor. It is also clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal / penal consequences.

10. IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorized representative, the day, month and year first above mentioned.

11. SCHEDULE 1

Particulars of the Materials	Quantity	Value of the Materials

Signed, Sealed and Delivered by the said Contractor

(Contractor's Name)

Dated:

(AUTHORISED SIGNATORY)

Place:

SEAL OF COMPANY

IN THE PRESENCE OF:

WITNESS: SIGNATURE _____

NAME: _____

ADDRESS : _____

Note:

The contractor has the option to submit the INDEMNITY BOND to cover all the items and quantities of Materials of stage payment or to submit INDEMNITY BOND each time the stage payment is to be taken or Materials advance is to be taken.

No.

Office of the.....

Date:.....

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