



ರೈಲು ಮೂಲಸೌಲಭ್ಯಅಭಿವೃದ್ಧಿ 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)

Tender Number KRIDE/2025-26/OW/WORK_INDENT34

Dated 12.05.2025

TENDER DOCUMENT

NAME OF WORK:

PACKAGE – Corridor 4

“Design & Construction of Cast in situ RCC Box at Channasandra Station location from ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore.”

RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED (K-RIDE)

Samparka Soudha,
1st Floor, Dr. Rajkumar Road,
Opposite Orion Mall,
Rajajinagar 1st Block, Bengaluru-560010
Email: gmpurchasement@kride.in

TENDER DOCUMENT

(Through e-Tendering Mode)

NAME OF WORK

PACKAGE – Corridor 4

“Design & Construction of Cast in Situ RCC Box at Channasandra Station location from Ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore.”

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SCHEDULE OF BIDDING PROCESS:

SL. NO.	EVENT DESCRIPTION	DATE
1	TENDER NO:	KRIDE/2025-26/OW/WORK_INDENT34 Dated 12.05.2025
2	TENDER DOCUMENT CAN BE DOWNLOADED FROM	12.05.2025
3	PERIOD OF SALE OF TENDER DOCUMENT	NA
4	LAST DATE FOR SALE OF TENDER DOCUMENT	NA
5	LAST DATE FOR RECEIVING QUERIES	The tenderer is requested to submit any questions in writing or by cable to reach the Employer not later than two days after the Pre-Bid meeting on or before dated as notified in GoK e-procurement portal
6	PRE-BID MEETING AT VENUE	As notified in GoK e-procurement portal
7	AUTHORITY RESPONSE TO QUERIES LATEST BY	As Per KPPP Portal
8	LAST DATE FOR SALE OF TENDER DOCUMENT	Upto Bid Due Date
9	LAST DATE AND TIME FOR RECEIPT OF BIDS	As Per KPPP Portal
10	DATE AND TIME OF OPENING OF COVER ONE OF TENDER (TECHNICAL BID)	As Per KPPP Portal
11	PLACE OF OPENING OF COVER TWO OF TENDERS (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
12	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
13	DATE AND TIME OF OPENING OF COVER TWO OF TENDERS (FINANCIAL BID)	Will be intimated to the Qualified Tenderers through Karnataka Public Procurement Portal.
14	ADDRESS FOR COMMUNICATION	General Manager / Procurement & Contracts 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 E Mail: gmprocurement@kride.in

LIST OF ABBREVIATIONS	
ABBREVIATION	FULL FORM
AASHTO:	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS.
AC:	ALTERNATING CURRENT
AEN:	ASST. DIVISIONAL ENGINEER
AFC:	AUTOMATIC FARE COLLECTION
AMCP:	AIR MONITORING AND CONTROL PLAN
API:	AMERICAN PETROLEUM INDUSTRY
ASCE:	AMERICAN SOCIETY OF CIVIL ENGINEERS
ASM:	ASST. STATION MASTER
ASME:	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASS:	AUXILIARY SUB STATION
ASTM:	AMERICAN SOCIETY FOR TESTING MATERIALS
AWS:	AMERICAN WELDING SOCIETY
BBMP:	BRUHAT BENGALURU MAHANAGARA PALIKE
BC:	BITUMINOUS CONCRETE
BESCOM:	BANGALORE ELECTRICITY SUPPLY COMPANY
BG:	BANK GUARANTEE
BIFR:	BUREAU OF INDUSTRIAL AND FINANCIAL RECONSTRUCTION
BIM:	BUILDING INFORMATION MODELLING
BMRL:	BANGALORE METRO RAIL CORPORATION LIMITED
BOCW:	BUILDING AND OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OF SERVICE) CENTRE RULES
BS:	BRITISH STANDARD
BSNL:	BHARAT SANCHAR NIGAM LIMITED
BSRP:	BENGALURU SUBURBAN RAILWAY PROJECT
BWSSB:	BANGALORE WATER SUPPLY AND SEWERAGE BOARD
C-1:	CORRIDOR-1 OF BSRP
C-2:	CORRIDOR-2 OF BSRP
C-4:	CORRIDOR-4 OF BSRP
CAD:	COMPUTER AID DESIGN
CAO/C:	CHIEF ADMINISTRATIVE OFFICER/ CONSTRUCTION
CBR:	CALIFORNIA BEARING RATIO
CBTC:	COMMUNICATION BASED TRAIN CONTROL
CC CRIBS:	CHRIST CHURCH CRIBS
CC:	CONDITIONS OF CONTRACT
CCA:	CONTROLLER OF CERTIFYING AUTHORITIES
CCTV:	CLOSED CIRCUIT TELEVISION
CD ROM:	COMPACT DISC, READ ONLY MEMORY
CDPC:	CONSTRUCTION DESIGN PACK CERTIFICATE
CDR:	CORPORATE DEBT. RESTRUCTURING
CFL:	COMPACT FLUORESCENT LAMP
CGM:	COMPUTOR GRAPHICS METAFILE
CH:	CHAINAGE
CIP:	CO-ORDINATED INSTALLATION PROGRAMME
CIP:	CO-ORDINATE INSTALLATION PLAN
CIRIA:	CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION ASSOCIATION

LIST OF ABBREVIATIONS	
ABBREVIATION	FULL FORM
CNC:	COMPUTERISED NUMERICAL CONTROL
COE:	CONTRACTOR'S OWN EARTH
COL:	CUT-OFF LEVEL
CPM:	CRITICAL PATH METHOD
CPVC:	CHLORINATED POLYVINYL CHLORIDE
CPWD:	CENTRAL PUBLIC WORKS DEPARTMENT
CR:	CORE RECOVERY
CSDR:	CHENNASANDRA RAILWAY STATION
CV:	CURRICULLUM VITAE
DBM:	DENSE BITUMINOUS MACADAM
DBR:	DESIGN BASIS REPORT
DC:	DIRECT CURRENT
DDC:	DETAILED DESIGN CONSULTANT
DFC:	DEDICATED FREIGHT CORRIDOR
DFCCIL:	DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LTD.
DFT:	DRY FILM THICKNESS
DG:	DISTRIBUTED GENERATION
DGPS:	DIFFERENTIAL GLOBAL POSITIONING SYSTEM
DIN:	DEUTSCHES INSTITUT FUR NORMUNG e.V.
DIPP:	DEPARTMENT OF INDUSTRIAL POLICY AND PROMOTION
DL:	DANGER LEVEL
DLP:	DEFECT LIABILITY PERIOD
DODL:	DRAWING OFFICE DISPATCH LIST
DPIIT:	DEPARTMENT FOR PROMOTION OF INDUSTRY AND INTERNAL TRADE
DPT:	DYE PENETRATION TEST
DSC:	DIGITAL SIGNATURE CERTIFICATE
DTI:	DIRECT TENSION INDICATORS
Dy. CE/C:	DEPUTY CHIEF ENGINEER/CONSTRUCTION
Dy. CSTE/C:	DEPUTY CHIEF SIGNALLING TELECOMMUNICATION ENGINEER/CONSTRUCTION
EMD:	EARNEST MONEY DEPOSIT
EOT CRANE:	ELECTRIC OVERHEAD TRAVELLING CRANE
EPC:	ENGINEERING, PROCUREMENT AND CONSTRUCTION
EPF:	EMPLOYEES PROVIDENT FUND
EQM:	ENVIRONMENTAL QUALITY MANAGEMENT MANUAL
ESIC:	EMPLOYEES STATE INSURANCE SCHEME
EWC:	EUROPEAN WATER CLOSET
FBIL:	FINANCIAL BENCHMARK INDIA PRIVATE LIMITED
FDR:	FIXED DEPOSIT RECEIPT
FDT:	FOREST DEVELOPMENT TAX
FOIS:	FREIGHT OPERATIONS INFORMATION SYSTEM
FY:	FINANCIAL YEAR
GAD:	GENERAL ARRANGMENT DRAWING
GAIL:	GAS AUTHORITY OF INDIA LIMITED
GCC:	GENERAL CONDITIONS OF CONTRACT
GFC:	GOOD FOR CONSTRUCTION

LIST OF ABBREVIATIONS	
ABBREVIATION	FULL FORM
GGBS:	GROUND GRANULATED BLAST FURNACE SLAG
GIF:	GRAPHICS INTERCHANGE FORMAT
GM:	GENERAL MANAGER
GPR:	GROUND PENETRATION TEST
GSB:	GRANULAR SUB BASE
GTI:	GEO TECHNICAL INVESTIGATION
HAZ:	HEAT AFFECTED ZONE
HDPE:	HIGH DENSITY POLY ETHELENE
HFL:	HIGH FLOOD LEVEL
HLE:	HEELALIGE RAILWAY STATION
HSFG:	HIGH STRENGTH FRICTION GRIP
HTML:	HYPER TEXT MARKUP LANGUAGE
IBH:	INTERMEDIATE BLOCK HUT
ID:	IDENTIFICATION
IDCC:	INDEPENDENT DESIGN CHECKER CERTIFICATE
IFC:	INDUSTRY FOUNDATION CLASSES
IFT:	INVITATION FOR TENDERS
IISC:	INDIAN INSTITUTE OF SCIENCES
IITM:	INDIAN INSTITUTE OF TECHNOLOGY MADRAS
IMP:	INTERFACE MANAGEMENT PLAN
INR:	INDIAN RUPEE
IPC:	INTERIM PAYMENT CERTIFICATE
IR:	INDIAN RAILWAYS
IRBM:	INDIAN RAILWAY BRIDGE MANUAL
IRC:	INDIAN ROAD CONGRESS
IRMRA:	INDIAN RUBBER MANUFACTURERS RESEARCH ASSOCIATION
IRP:	INTERIM RESOLUTION PROFESSIONAL
IRP:	INTERIM RESOULTION PROFESSIONAL
IRPWM:	INDIAN RAILWAY PERMANENT WAY MANUAL
IRS:	INDIAN RAILWAY STANDARD
IRS: CBC	INDIAN RAILWAY STANDARDS: CONCRETE BRIDGE CODE
IS:	INDIAN STANDARD
IST:	INDIAN STANDARD TIME
ITBT:	INSTRUCTIONS TO BIDDERS/TENDERERS
ITT:	INSTRUCTIONS TO TENDERERS
IWC:	INDIAN WATER CLOSET
JAG:	JUNIOR ADMINISTRATIVE GRADE
JIS:	JAPANESE INDUSTRIAL STANDARD
JPEG:	JOINT PHOTOGRAPHIC EXPERTS GROUP
JPO:	JOINT PROCEDURE ORDER
JV:	JOINT VENTURE
JVA:	JOINT VENTURE AGREEMENT
KD	KEY DATE
KM:	KILOMETRE
KPTCL:	KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

LIST OF ABBREVIATIONS	
ABBREVIATION	FULL FORM
KPWD:	KARNATAKA PUBLIC WORKS DEPARTMENT
K-RIDE:	RAIL INFRASTRUCTURE DEVELOPMENT COMPANY(KARNATAKA) LIMITED
KTPP:	KARNATAKA TRANSPARENCY IN PUBLIC PROCUREMENTS
KTPP:	KARNATAKA TRANSPARENCY IN PUBLIC PROCUREMENT
L SECTION:	LONGITUDINAL SECTION
LC:	LEVEL CROSSING
LD:	LIQUIDATED DAMAGES
LDPE:	LOW DENSITY POLYETHYLENE
LED:	LIGHT EMITTING DIODE
LG:	LAUNCHING GIRDER
LL:	LIVE LOAD
LLP:	LIMITED LIABILITY PARTERSHIP
LOA:	LETTER OF ACCEPTANCE
LPB:	LETTER OF PRICE BID
LS COST:	LUMP SUM COST
LTB:	LETTER OF TECHNICAL BID
MARS:	MONTHLY AUDIT RATING SCORE
MCLR:	MARGINAL COST OF FUNDS BASED LENDING RATE
MD:	MANAGING DIRECTOR
MEP:	MECHANICAL, ELECTRICAL AND PLUMBING
MIG:	METAL INERT GAS
MMAW:	MANUAL METAL ARC WELDING
MOHUA:	MINISTRY OF HOUSING AND URBAN AFFAIRS
MORTH:	MINISTRY OF ROAD TRANSPORT AND HIGHWAYS
MPR:	MONTHLY PROGRESS REPORT
MPT:	MAGNETIC PARTICLE TEST
MSP:	MICRO SOFT PROJECT
NABL:	NATIONALACCREDITATIONBOARDFORTESTINGANDCALIBRATION LABORATORIES
NCLT:	NATIONAL COMPANY LAW TRIBUNAL
NHAI:	NATIONAL HIGHWAY AUTHORITY OF INDIA
NI :	NON-INTERLOCKING
NMCP:	NOISE MONITORING AND CONTROL PLAN
NOC:	NO OBJECTION CERTIFICATE
NONO:	NOTICE OF NO OBJECTION
NOR:	NOTICE OF REJECTION
NTP:	NOTICE TO PROCEED
OD:	OUTER DIAMETER
ODBC:	OPEN DATA BASE CONNECTIVITY
OFC :	OPTICAL FIBER CABLE
OHE:	OVER HEAD EQUIPMENT
OMC	OPTIMUM MOISTURE CONTENT
OPC:	ORDINARY PORTLAND CEMENT
OWG:	OPEN WEB GIDER
P.Way:	PERMANENT WAY
PAN:	PERMANENT ACCOUNT NUMBER

LIST OF ABBREVIATIONS	
ABBREVIATION	FULL FORM
PCC:	PARTICULAR CONDITIONS OF CONTRACT
PDF:	PORTABLE DOCUMENT FORMAT
PDM:	PRECEDENCE DIAGRAMMING METHOD
PERT:	PROGRAM EVALUATION REVIEW TECHNIQUE
PH:	POTENTIAL OF HYDROGEN
PMC:	PROJECT MANAGEMENT CONSULTANT
PMIS:	PROJECT MANAGEMENT INFORMATION SYSTEM
POA:	POWER OF ATTORNEY
PPE:	PERSONAL PROTECTIVE EQUIPMENTS
PQMP:	PROJECT QUALITY MANAGEMNT PLAN
PQR:	PROCEDEEE FOR QUALIFICATION RECORD
PRS:	PASSENGER RESERVATION SYSTEM
PSC:	PRE-STRESSED CONCRETE
PSU:	PUBLIC SECTOR UNIT
PVC:	PRICE VARIATION CLAUSE
PVC:	POLYVINYL CHLORIDE
PWD:	PUBLIC WORKS DEPARTMENT
QA:	QUALITY ASSURANCE
QAP:	QUALITY ASSURANCE PLAN
QC:	QUALITY CONTROL
QSC:	QUALITY SYSTEM CERITFICATE
RA BILL:	RUNNING ACCOUNT BILL
RCC:	REINFORCED CEMENT CONCRETE
RDSO:	RESEARCH DESIGNS AND STANDARDS ORGRANISATION
RE WALLS:	REINFORCED EARTH WALLS
UTES:	RAIL INDIA TECHNICAL AND ECONOMIC SERVICE
RM:	RUNNING METER
RMC:	READY MIXED CONCRTE
RNN:	RAJANUKUNTE RAILWAY SATATION
ROB:	ROAD OVER BRIDGE
ROR:	RAIL OVER RAIL
ROW:	RIGHT OF WAY
RPF:	RAILWAY PROTECTION FORCE
RQD:	ROCK QUALITY DESIGNATION
RRI:	ROUTE RELAY INTERLOCKING
RSI:	RAIL STRUCTURAL INTERACTION ANALYSIS
RT:	RADIOGRAPHY TEST
RUB:	ROAD UNDER BRIDGE
S&T:	SIGNALLING AND TELECOMMUNICATION
SAP:	SYSTEMS APPLICATIONS AND PRODUCTS IN DATA PROCESSING
SAW:	SUBMERGED-ARC-WELDING
SBI:	STATE BANK OF INDIA
SCADA:	SUPERVISORY CONTROL AND DATA ACQUISITION
SCC:	SPECIAL CONDITIONS OF CONTRACT
SCC:	SPECIAL CONDITIONS OF CONTRACT

LIST OF ABBREVIATIONS	
ABBREVIATION	FULL FORM
SD:	SECURITY DEPOSIT
SDR:	STRATEGIC DEBT RESTRUCTURING
SDR:	STRATEGIC DEBT. RESTRUCTURING
SE:	SECTION ENGINEER
SFMS:	STRUCTURED FINANCIAL MANAGING SYSTEM
SHE MANUAL:	SAFETY, HEALTH AND ENVIRONMENT MANUAL
SLS:	SERVICEABILITY LIMIT STATE
SOD:	SCHEDULE OF DIMENSION
SPCB:	STATE POLLUTION CONTROL BOARD
SPT:	STANDARD PENETRATION TEST
SPV:	SPECIAL PURPOSE VEHICLE
Sr. DSTE:	SENIOR DIVISIONAL SIGNALLING AND TELECOMMUNICATION ENGINEER
Sr.DEE:	SENIOR DIVISIONAL ELECTRICAL ENGINEER
Sr.DEN:	SENIOR DIVISIONAL ENGINEER
SRR:	SUBMISSION RESPONSE REQUEST
SRR:	SUBMISSION RESPONSE REQUEST
STR:	SCHEDULE OF TECHNICAL REQUIREMENT
STR:	SCHEDULE OF TECHNICAL REQUIREMENTS
SWR:	SOUTH WESTERN RAILWAY
T&P:	TOOLS AND PLANTS
TAD:	TEMPORARY ARRANGEMENT DRAWINGS
TBM:	TEMPORARY BENCH MARK
TDS:	TAX DEDUCTION AT SOURCE
TPIA:	THIRD PARTY INSPECTING AGENCY
TRD:	TRACTION DISTRIBUTION
TSS:	TRACTION SUB STATION
UPS:	UNINTERRUPTIBLE POWER SUPPLY
UPV:	ULTRA SONIC PULSE VELOCITY
UPVC:	UNPLASTICIZED POLYVINYL CHLORIDE
USD:	U S DOLLAR
USSOR:	UNIFIED STANDARD SCHEDULE OF RATES
UT:	ULTRASONIC TEST
VC:	VIDEO CONFERENCING
WBS:	WORK BREAKDOWN STRUCTURE
WMM:	WET MIX MACADAM
WPQRS:	WELDING PROCEDURE QUALIFICATION RECORDS
WPSS:	WELDING PROCEDURE SPECIFICATION SHEET

SECTION - 1

NOTICE FOR INVITATION FOR TENDERS (IFT)

K- RIDE [Rail Infrastructure Development Company (Karnataka) Limited]
**INVITATION FOR BIDS
(Through e-tendering mode)**
Tender Notice No. **KRIDE/2025-26/OW/WORK_INDENT34****Date: 12.05.2025**

RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED (K-RIDE), a Joint Venture of Government of Karnataka and Ministry of Railways with its corporate office, at #8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall, Rajajinagar 1st Block, Bengaluru-560010, India, invites Bids from eligible Bidders, for the construction of works detailed below under Single stage Two Packet system (Technical Bid and Financial Bid in separate packets) on including Detailed Design and Construction for Civil and Structural Works.

NAME OF WORK	TENDER SECURITY / EMD	APPROX.VALUE OF WORK	PERIOD OF COMPLETION
PACKAGE – Corridor 4 “Design & Construction of Cast in Situ RCC Box at Channasandra Station location from ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore”	₹ 41 Lakhs Refer ITT clause 13.7	₹ 40,15,93,962 Cr. Excl GST	12 months

NOTES:

The Selected Bidder (Contractor) shall be responsible for Construction of all the works mentioned under and in accordance with the provisions of agreement to be entered into between the Selected Bidder and the Authority (K-RIDE). The scope of work consists of Design & Construction of Foundation, Secant Piling, Structure and other allied works including detailed design for Cast in Situ RCC Box at Channasandra Station location (Chainage - 24+242 to 24+600) along the Corridor-4 Heelalige to Rajankunte of Bengaluru Suburban Railway Project.

Diversions of Civil Engineering related and any other hitherto including Utilities and other related Infrastructural and miscellaneous works including survey, Geotechnical investigations, testing, etc. of Corridor – 4 (RCC Box at Channasandra Station) of Bengaluru Suburban Railway Project (BSRP)”.

1. The detailed terms and conditions of the Project, including the scope of the works, services and obligations are mentioned in Employer's Requirement, Conditions of Contract (GCC & PCC) and all other related documents in the Bid Document.
2. The tenderers are advised to examine the Project in greater detail, and to carry out, at their cost, all such studies and analysis as may be required for submitting their respective Bids for award of the contract.
3. The tenderers shall submit the tender through e - procurement portal. The tenderers shall submit scanned copies of their registration certificate, work done certificates and any other documents online. More information can be had from the website <https://www.kppp.karnataka.gov.in>.
4. On the schedule date of opening of Tenders, initially, only the Technical Bids will be opened through Karnataka Public Procurement Portal. The Technical Bids will be evaluated by K-RIDE in accordance with the stipulated Qualification and Evaluation criteria. No amendments or changes to the Bids would be permitted after the opening of Bids.
5. Financial Bids of tenderers, qualified in the Technical Evaluation, will be opened on the date and at the time advised by K-RIDE through e-tendering portal. The Financial Bids are evaluated, and the Contract is awarded to the tenderer, whose tender has been determined to be the lowest evaluated substantially responsive tender.
6. The tenderers are advised to note the eligibility and minimum qualifying criteria specified in the Section 2: Instruction to Tenderers.
7. Tenders must be accompanied by a Tender Security / EMD as per ITT 13.7 in the form mentioned in Section 3: Qualification Information / Bidding Forms - in any one of the forms as specified. The Tender Security / EMD shall have

to be valid for 45 days beyond the validity of the tender, specified in the tender documents. Any tenders received without Bid security will be summarily rejected.

8. Incomplete tenders will be considered non-responsive and such tenders will not be considered for further evaluation.
9. Tender Documents can be downloaded free of cost from Karnataka Public Procurement Portal i.e., <https://www.kppp.karnataka.gov.in> and the tenders must be submitted online via Karnataka Public Procurement Portal only.
10. Drawings referred in the tender document, if any, 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 ₹5,000/- (Rupees Five Thousand only) by an e-Payment mode (credit card/debit card/net banking/UPI) in favour of Rail Infrastructure Development Company (Karnataka) Limited (K-RIDE), Bengaluru.
11. It will be the responsibility of the tenderers, who are submitting their tender based on the tender documents downloaded by them on a particular date, to check for any Addendum/Corrigendum issued in this regard after the date of their downloading, from the relevant website from time to time and to ensure submission of their bids along with all Addenda/Corrigenda. Bids submitted without all Addenda/Corrigenda will be treated as incomplete.
12. **Validity** of the tender: The tenders shall remain valid for a period of **180 days** after the submission deadline prescribed by the Employer. A tender valid for a shorter period will be summarily rejected as non-responsive.
13. In case of need, K-RIDE may request the tenderers to extend the period of validity of their tenders. The request will be made in writing. If a Bid security is requested in accordance with ITT 13.7, it shall also be extended up to the date mentioned in the letter of request for extension. The tenderers may refuse the request without forfeiting their Tender Security. Tenderers extending the validity of their tenders shall not be either required or permitted to modify their tender.
14. **Pre-Bid meeting:** A Pre- Bid meeting will be held on as notified in GoK e-procurement portal in the office of K-RIDE, Bengaluru to understand / discuss the issues / queries with regard to the Bid Document, if any, as stated in Clause – 8.3 of ITT of the Tender document. The queries may be answered subsequently, based on their merits. However, the **queries** shall be sent to K-RIDE by bidders on or before as notified in GoK e-procurement portal **through E-mail (gmprocurement@kride.in)**.

The tenderers are advised to submit a copy of the queries in soft copy (word/excel) also in the following format only.

S. N	Reference section	Reference clause	Queries

The tenderer or his authorized representative is invited to attend a pre-bid meeting which will take place at the office of K-RIDE Bengaluru and or @ VC as per the date and time specified in the e-procurement portal. If the tenderer is willing to attend Pre- Bid meeting online then the tenderer is requested to communicate via email- gmprocurement@kride.in at least 02 days prior to date of pre bid meeting so that link can be communicated to the tenderers.

Prospective bidders shall keep checking the websites for any change in the above dates and times.

15. REGISTRATION IN E-TENDERING PORTAL:

- a. The tenderers are required to enroll on the e-tendering Portal (<https://www.kppp.karnataka.gov.in>) by 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. The 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) 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 DSCs to others, which may lead to misuse.
- f. The tenderers shall then login to the site through the secured log-in process by entering their user ID/password and the password of the DSC / e-Token.
- g. Once the tenderers have searched and selected the proposals, they are interested in, they can pay nonrefundable processing fee as mentioned in the Karnataka Public Procurement Portal.
- h. The scanned copies of all original documents shall be uploaded on e-tendering Portal (<https://www.kppp.karnataka.gov.in>).
- i. For any query regarding e-procurement on the Karnataka Public Procurement Portal, the tenderers can contact helpdesk number **+91-80-46010000**, support@eprochelpdesk.com

16. PRECAUTIONS FOR SUBMITTING/PREPARATION OF PROPOSALS THROUGH E-TENDERING PORTAL

- a. The tenderers, in advance, shall make ready the proposal documents to be submitted, as indicated in the proposal documents / schedule and they shall be in PDF/JPEG formats.
- b. The tenderers, without waiting till last minute, shall 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 deadline of the proposal submission time. The bidders themselves will be responsible for any delay in the last minute due to any issues whatsoever viz., server issues, connectivity issues etc.
- c. The tenderer has to digitally sign and upload the required proposal documents as indicated in the Bid Document.
- d. The server time (which is displayed on the Employer's dashboard) will be considered as the standard time for referencing the deadlines for submission of the proposals by the bidders, opening of proposals etc.
17. The tenderers shall furnish the Name of the individual / firm / Company / Joint venture with address and telephone number with place of registration, year of incorporation etc.
18. Tenders by a joint venture of contractors are permitted subject to conditions indicated in tender document.
19. 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.
20. Bids submitted through any other mode will not be entertained.
21. Deleted.
22. All necessary certificates/documents in support fulfilling qualifying criteria stipulated shall be scanned separately and attached to bid document. The original documents if required by the Employer shall be produced whenever asked by Employer on Technical Bid/ Financial Bid.
23. Deleted.
24. Site visit and verification of information:
The tenderers are, in their own interest, 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, all applicable laws and regulations, and any other matter considered relevant by them. The tenderers are advised to visit the site and familiarize themselves with the Project within the stipulated time of submission of the bids. No extension of the deadline either for submission of pre-bid queries or for submission of bids is likely to be considered on this pretext.
It will be deemed that by submitting a bid, the tenderers have:
 - (a) made a complete and careful examination of the Bidding Documents, Schedules annexed to the bid document.
 - (b) received all relevant information requested from K-RIDE.
 - (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 25 above. Technical details and drawings provided in the Bid Document are tentative and for indicative purpose. No claim will be admissible at any stage on this account.
 - (d) satisfied themselves about all matters, things, and information, including matters referred to in Clause 25 herein above, necessary and required for submitting an informed Bid in the interest of complete execution of the Project in accordance with the Bidding Documents and performance of all 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 25 herein above shall not be a basis for any claim for compensation, damages, extension of time for performance of their obligations, loss of profits etc. from the Authority, or a ground for termination of the Agreement by the Contractor.
 - (f) acknowledged that there is no Conflict of Interest, and
 - (g) agreed to be bound by the undertakings provided by them under and in terms hereof.
25. K-RIDE will 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 in this bid document.
26. The qualification criteria as indicated in bid document shall be met by the tenderers intending to submit bids.
27. The 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.
28. Conditional Tenders will not be accepted and will be summarily rejected.
29. K-RIDE will not be responsible for any delay by the bidder in accessing Karnataka Public Procurement Portal.
30. The rates quoted by the tenderer shall be inclusive of all Taxes, Levies & Duties etc. excluding GST.
31. 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, Bengaluru, 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.

32. **Last Date of Receipt and opening of Bids:** The tenders, complete in all respects, shall be submitted through Karnataka Public Procurement Portal <https://www.kppp.karnataka.gov.in> not later than **as notified in GoK e-procurement portal** and will be opened on **as notified in GoK e-procurement portal**. If the office of K-RIDE happens to be closed on the date of opening of tender, the tenders will be opened on the next working day at the same time and venue.
33. K-RIDE will not be responsible for any delays in the receipt of tenders by K-RIDE. Late Tenders (received after stipulated date and time of submission of Tenders) will not be accepted under any circumstances. K-RIDE reserves the right to accept/reject any or all the proposals without assigning any reason thereof.
34. K-RIDE reserves the right to either postpone or to cancel the entire process of the tender.
35. 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, Karnataka only and no other court or any other district of the country or any other country shall have any jurisdiction in the matter.
36. For any **Query regarding e tendering portal / tender submission**, the following **help desk numbers** can be contacted **on any working day from 10:30 am to 05:00 pm**, till closing date and time of bids:
+91-80-46010000
Email: support@eprochelpdesk.com
37. **Communication:** Interested eligible bidders may obtain further information (with regard to the bid document) required, if any, shall email to gmprocurement@kride.in only. Pre-bid queries will not be entertained after the deadline for their submission.
38. Queries regarding e tendering portal, tender submission and related minor issues shall not be addressed to the address below and shall be got clarified from helpdesk mentioned above.

General Manager / Procurement & Contracts

K-RIDE [Rail Infrastructure Development Company (Karnataka) Limited],

#8, 1st Floor, Samparka Soudha,
 Dr. Rajkumar Road, Opposite Orion Mall
 Rajajinagar 1st Block, Bengaluru-560010
 E-mail: gmprocurement@kride.in

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 RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED (K-RIDE), a Joint Venture of Government of Karnataka and Ministry of Railways, with its corporate office at # 8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road, Opposite Orion Mall, Rajajinagar 1st Block, Bengaluru -560010, India, invites tenders from eligible tenderers, for the works detailed in the invitation for the Tenders (IFT).

2. ELIGIBLE TENDERERS

2.1 The tenderers, who wish to participate, shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by Govt. of Karnataka / Govt. of India / PSUs.

2.2 JOINT VENTURES

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

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 Govt. of Karnataka, Govt of India, and PSUs.

a. The joint venture must collectively satisfy 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 specified five financial years shall be submitted and they must demonstrate the current soundness of the Tenderer's financial position and 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)

b. 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 the similar work as specified in sub clause 3.2 b, for at least for a period of five years and the period ending last day of the month previous to the month of bid submission (From FY: 19-20 to FY: 23-24).
- 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 period mentioned in Para (i) above and must demonstrate the current soundness of the Tenderer's financial position and indicate prospective long-term profitability. If deemed necessary, the Employer shall have the authority to make enquiries with the Tenderer's 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 period mentioned in Para (i) above. Any history of awards against the tenderer or any partner of a joint venture or failure to provide accurate information then the acceptance/ rejection is at sole discretion of the Employer. Bidders having litigation with KRIDE are not eligible to participate in this tender.
- v. In accordance with the above, the bid shall include all related information required for individual partners in the joint venture.

c. **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/lead number 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.

- d. 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, net-worth and Line of credit / liquid assets.**

- e. A copy of the Joint Venture Agreement (JVA) entered into by the partners shall be submitted with the bid. Pursuant to Sub-Clauses 2.2(c) to 2.2(f), 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. If found so all these bids shall be treated as ineligible.

The lead partner shall enter into a Joint Venture agreement on a Rs 200.00 stamp paper in the prescribed format which shall be concluded prior to tender and enclosed to the Tender document. A JV Partner shall not enter in to multiple JVs with different tenderers for the same work.

- f. 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 written 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:

- i. "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 tenderer has participated, to be disqualified."
- ii. A firm shall submit only one tender in the same tendering process, either individually as a tenderer or as partner of Joint Venture.
- iii. The necessary certificates/documents in support of pre-qualification criteria fulfilled as stipulated shall be scanned and attached to the bid document. Scanned signature of the tenderer/authorized representatives of the tenderer shall be attached while uploading the tender document.
- iv. 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 and 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 being blacklisted.
- v. 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 KPPP Rules. The name of the tenderers who do not produce the original documents shall be debarred from participation in any of the future tenders to be invited by K-RIDE apart from forfeiting the EMD paid.
- vi. The bidder, JV Partner shall not be under Corporate Debt Restructuring (CDR)/ Strategic Debt Restructuring (SDR) or Bureau of Industrial & financial reconstruction (BIFR) in last Five 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 CDR/SDR or BIFR.
- vii. Further information about e-tendering can be had from Karnataka Public Procurement Portal <https://www.kppp.karnataka.gov.in>.

2.3 Multiple Contracts: “

Not Applicable

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 shall have to be formed prior to the Bidding.

Pre-qualification will be based on tenderers 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 Tenderer's responses in the Information Forms attached to the Letter of Technical Bid. 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 ₹ 81 Crore in Five Financial Years from 2020-21 to 2023-24 (both inclusive).**

NOTE: The tenderers shall submit certificates to this effect which may be **attested certificates** from the concerned **Departments/Client or Audited balance sheet** duly certified by the statutory Auditor 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 **FY: 2023-24 price level.**

- b) I) The tenderer / Firm / Company / JV should have substantially completed at least one similar work of "Construction of RCC Box / Under pass/ Road Under Bridge / Road Over Bridge for Metro Railway / Railway / High Speed Railway / Regional Railway / Light Railway / Highway / Any other roads" of value not less than ₹20 Crore at FY:2023-2024 price level in the five financial years (from FY2019-20 to FY2023-24 both inclusive) and till the last day of the month previous to the month of bid submission.

II) Deleted.

NOTE:

- The criteria above apply 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 shall be submitted along with the Technical Bid. (The certificate from Project Manager of Client / Concessionaire OR Independent Engineer (Project Management Consultant of Client/Concessionaire) duly validated by the Employer / SPV / Corporation can also be considered).
- Similar Work** is defined as below:
For para 3.2 b (i) Execution of "**Similar Work**" for this contract shall mean the work of Construction of RCC Box / Under pass/ Road Under Bridge / Road Over Bridge for Metro Railway / Railway / High Speed Railway / Regional Railway / Light Railway / Highway / Any other roads.
- The contract is considered as substantially 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). The certificate from Project Manager of Client/Concessionaire OR Independent Engineer (Project Management Consultant of Client/Concessionaire) duly validated by the Employer / SPV / Corporation shall also be considered.
- For completed works, the value of work done shall be updated to current FY 2023-24 price level assuming 5% inflation for Indian rupees every year or part thereof up to the month previous to the Bid submission month. The value of work done shall be inclusive of taxes, duties and Price Variations, excluding GST. 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 India Private limited (www.fbil.org.in) 28 (twenty-eight) days before the date of bid submission 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 (twenty-eight) days before tender submission is being considered for conversion to Indian Rupees.

5. In case of JV, full value of the work, if done by the same JV shall be considered. However, if qualifying work (s) done by them in JV having different constituents, then the value of work as per their percentage participation in such JV shall be considered.

- c) The intending tenderer / firm/ company / Joint Venture should have executed all the components (mentioned below) in the five financial years (FY 2019-20 to FY 2023-24) and till the last day of the month previous to the month of bid submission

Component No.	Nature of Work	Minimum Component of work
1	Construction of RCC Box / Under pass/ Road Under Bridge / Road Over Bridge	1 nos
2	Completed Design and Approval of RUB/Underpass (Can be met through nominated subcontractor),	Minimum length of 100m

Note: clause 3.2 c).2: Bidder shall submit the undertaking for engagement of DDC during the bid submission. After award of the work, the bidder will propose two or more detailed design consultants (DDC) who has designed similar type of work for approval of the Employer.

- d) The intending tenderer / firm / company / Joint Venture should have completed the following within five financial years (from FY 2019-20 to FY 2023-24 both inclusive) and till the last day of the month previous to the month of bid submission.

Deleted.

NOTES:

1. The criteria above apply 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. The certificate from Project Manager of Client / Concessionaire OR Independent Engineer (Project Management Consultant of Client / Concessionaire) duly validated by the Employer / SPV / Corporation shall also be considered.
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 nominated Subcontractors if any and for which the same qualification criteria as indicated in paras above are required.

3.3 Each tenderer should further demonstrate the following:

- 3.3 a) KEY PLANT AND EQUIPMENT: Key Plant & Equipment can be deployed on own basis or Lease/ or Hire basis. Bidder shall submit the undertaking.**

The intending tenderer / firm / company / Joint venture should furnish the undertaking that the following minimum requirement of machineries will be deployed for execution of work.:

PLANT AND EQUIPMENT

- (I) KEY AND CRITICAL EQUIPMENTS**

Refer Appendix-05 of Employer's Requirement Part -1

(II) **Other Plant and equipment to be deployed the tenderer has to furnish the details of Own basis or Lease/Hire basis for the following equipment.**

Refer Appendix-05 of Employer's Requirement Part -1

Notes:

- The above equipment is the minimum requirement and the contractor shall mobilize additional resources as and when required, based on the work requirements without any additional cost to the Employer.
- 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.
- The contractor will be penalized as deemed fit by the Employer, in case of any shortage.

3.3 b) LIQUID ASSETS: The tenderer / firm / company / Joint Venture should furnish details of liquid assets and or availability of **credit facilities of ₹ 10 Crore 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. 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 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:

Refer Appendix-04 of Employer's Requirement Part -1

Notes:

- The CVs to be given for Serial No. 1 to 10 as per Form-6 of section-3 and for Serial No. 1 to 20 the details of required Personnel's/Staff to be given as per Form-5 of section-3 (Qualification information /Bidding Forms).
 - The above equipment is the minimum, and the contractor shall mobilize additional resources as and when required based on the work requirement with our any additional cost to the Employer.
- 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 will 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 ₹ 41 Crore**. 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 five financial years ending 31.03.2023 and the financial year 2023-24 (till the last day of the month previous to the month of bid submission) 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 years (*period of completion of the works for which Tenders are invited*).

Note: Up-dation 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.**

The Bidder's net worth for the last Financial Year calculated as the difference between **current** assets and **current 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:**

Pursuant ITT Clause 3, The Employer shall assess bidder against the following qualification criteria.

Requirement	Single Entity	Joint Venture			Submission Requirements
		Lead Partner	Other Partners	All partners combined	
Clause: 3.2.(a) MINIMUM AVERAGE ANNUAL CONSTRUCTION TURNOVER of ₹ 81 Crore in Five Financial Years from 2019-20 to 2023-24 (both inclusive).	Must meet 100% of the requirement	Must meet 50% of the requirement	Must meet 25% of the requirement	Must meet 100% of the requirement	Form FIN-2
Clause: 3.2 (b) (i) "Execution of "Similar Work" for this contract shall mean the work of Construction of RCC Box / Under pass/ Road Under Bridge / Road Over Bridge for Metro Railway / Railway / High Speed Railway / Regional Railway / Light Railway / Highway / Any other roads" of value not less than ₹ 20 Crore at FY:2023-2024 price level in the five financial years (from FY2019-20 to FY2023-24 both inclusive) and till the last day of the month previous to the month of bid submission.	Must meet 100% of the requirement	NA	NA	Must meet 100% of the requirement	Form at Para 1.3 / Section:3

Requirement	Single Entity	Joint Venture			Submission Requirements
		Lead Partner	Other Partners	All partners combined	
Clause:3.2 (b) (II) Deleted	-	-	-	-	-
Clause: 3.2 (c) 1 Construction of RCC Box / Under pass/ Road Under Bridge / Road Over Bridge	100%	NA	NA	Must meet 100% of the requirement	Form at Para 1.4/Section:3
Clause: 3.2 (c) 2 Completed Design and Approval of RUB/Underpass (Can be met through nominated subcontractor) Minimum length 100m	Bidder shall submit the undertaking that DDC will be deployed for the above said work after the award.				Form at Para 1.4/Section:3
Clause: 3.2(d) Deleted	-	-	-	-	Form at Para 1.4/Section:3
Clause: 3.3 (I) <u>KEY & CRITICAL EQUIPMENTS</u> <u>Refer Appendix-05 of Employer's Requirement Part -1</u>	Must meet 100% of the requirement	All Partners Combined Must Meet 100% requirements.			Form at Para 1.6 / Section:3
Clause: 3.3 (II) Other Plant and equipment to be deployed the tenderer has to furnish the details of Own basis or Lease / Hire basis for the following equipment. <u>Refer Appendix-05 of Employer's Requirement Part -1</u>	Must meet 100% of the requirement	All Partners Combined Must Meet 100% requirement			Form at Para 1.6 / Section:3
Clause: 3.3(b) LIQUID ASSETS: The tenderer / firm / company / Joint Venture should furnish details of liquid assets and or availability of credit facilities of ₹ 10 Crore for the work mentioned above for meeting the required funds in the form of own funds/credit lines/certificate from scheduled Nationalized Bank	Must meet 100% of the requirement	Must meet 50% of the requirement	Must meet 25% of the requirement	Must meet 100% of the requirement	Form at Para 1.10 / section:3
Clause: 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. <u>Refer Appendix-04 of Employer's Requirement Part -1</u>	Must meet 100% of the requirement	All Partners Combined Must Meet 100% requirement			Form No.5 & 6 of Section 3

Requirement	Single Entity	Joint Venture			Submission Requirements
		Lead Partner	Other Partners	All partners combined	
<p>Clause: 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 ₹41 Crore. The available tender capacity will be calculated</p> <p>Evaluation of Bid Capacity: The Bidders will be qualified only if their available bid capacity is more than the approximate cost of work as per Employer assessment. Available bid capacity will be calculated based on the following formula: Available Bid Capacity = $1.5 \times A \times N - B$ Where, A = Maximum of the value of construction works executed in any one year during the last 05 (five) financial years reckoned up to 31st March'2024 (Updated to price level shall be done at 10% per year) N = Number of years prescribed for completion of the present work B = Value of existing commitments as on first day of the month of this Bid submission i.e. for on-going construction works during completion period of proposed work. Proportionate value will be taken if it falls during the financial year.</p>	Must meet 100% of the requirement	Must meet 50% of the requirement	Must meet 25% of the requirement	Must meet 100% of the requirement	Form at Para 1.5 / Section:3 and Form FIN-3 / section:3
<p>Clause: 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.</p>	Must meet 100% of 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) will cause all the proposals with the Tenderer's participation to be disqualified for that particular package.

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 through an email as indicated in the invitation to tender. The Employer will respond to any request for clarification which he receives earlier than the date mentioned in the e-procurement portal of Karnataka for queries. Copies of the Employer's response will be uploaded on KPP portal and KRIDE website.

8.2 Pre-Bid meeting:

- 8.2.1 The tenderer or his authorized representative is invited to attend a pre-bid meeting which will take place at the office of K-RIDE Bengaluru and or @ VC as per the date and time specified in the e – procurement portal.

If the tenderer is willing to attend Pre- Bid meeting online then the tenderer is requested to communicate via [email- gmpurchase@kride.in](mailto:gmpurchase@kride.in) at least 02 days prior to date of pre bid meeting so that link can be communicated to the tenderers.

Venue:

#8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road,
Opposite Orion Mall, Rajajinagar 1st Block,
Bengaluru-560010

Date and Time: As per IFT

Prospective bidders shall keep checking the website e – procurement portal for any change in the above date/time.

- 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 through an email to reach the Employer not later than the date and time 2 days before the meeting.
- 8.2.4 Any modification of the tender documents listed in Sub-Clause 7.1 which may become necessary as a result of the pre-bid meeting will 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 Attending Pre-Bid meeting is not mandatory for the tenderers. Non-attendance at the Pre-Bid meeting will not be a cause for disqualification of any 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 only on e – procurement portal. The Provisions in corrigenda /addenda shall take priority over the Tender Documents issued previously.

- C. 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.

D. PREPARATION OF TENDERS

10. DOCUMENTS COMPRISING THE TENDER

- 10.1 The Tender submitted by the tenderer shall be in shall contain the documents as follows:

10.1.1 Technical Bid

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

10.1.2 Financial bid

- i. The Tender (in the format indicated in Section: 4) (as per Karnataka Public Procurement Portal)
- ii. 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 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. (As per Karnataka Public Procurement Portal).

10.2 DELETED

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 lump sum 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 (excluding GST) 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 **180 (one hundred and eighty) days** after the deadline date for tender submission specified in Clause 16. A tender valid for a shorter period will 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 till the 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 2 of the Table of IFT for this particular work. This earnest money deposit shall be paid as per clause 13.7 of Section 2.

- 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

The 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.

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 (Lump sum Price) shall be quoted by the tenderer entirely in Indian Rupees (INR) only. The rates quoted by the bidder in schedule through Karnataka e-procurement portal will only be considered 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> <ul style="list-style-type: none"> a) 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. b) In case of proprietorship tenderers, Power of Attorney by the Proprietors. c) In case of partnership tenderers, Power of Attorney duly signed by all the partners. d) 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. e) 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 signed by person who is duly authorized to sign on behalf of the bidder. This authorization shall consist of a written confirmation as specified in the BDF 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.

- i. 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.
- 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, each firm in the Joint venture 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.
- v. Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Tender.

E. SUBMISSION OF TENDERS

15. SEALING AND MARKING OF TENDERS

The 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, if necessary, in the opinion of Employer, 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 DELETED

F. TENDER OPENING AND EVALUATION

19. OPENING OF TECHNICAL BID OF ALL TENDERS AND EVALUATION TO DETERMINE QUALIFIED TENDERERS:

19.1 The Employer will open the Technical Bid of all the Tenders received (except those received late or withdrawn), including modifications for Technical Bid 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 name of the tenderer, 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 will 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 after deliberations by a committee constituted for this purpose.
20. **OPENING OF FINANCIAL BID 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 Financial Bid containing the priced Tenders published in Karnataka Public Procurement Portal. The Employer will open the Financial Bid 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 Cover (Financial Bid) will be opened at the appointed time and location on the next working day.
- 20.2 **DELETED**
- 20.3 The names of tenderers, 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 will prepare minutes of the Financial Bid 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 Lump sum Price. The request for clarification and the response shall be in writing through email, 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 10:30 AM to 5:00 PM on any working day. Ph. No.: +91-8046010000 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:

- a) 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 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) Deleted.
- 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.

G. 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 email. 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 20 days following the notification of award along with the Letter of Acceptance. Within 10 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 21 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** in accordance with Clause 25.6 of ITT and Clause 43 of the Conditions of Contract.
- Banker's /E-Bank Guarantee/Demand draft/Pay Order/ BG in favour of K-RIDE, Bangalore or
 - A bank guarantee in the form given in Section 10.
- 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 of India.
- 29.3 DELETED
- 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:
- 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;
 - 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 2019' issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry vide letter no. K-14011/09/2014/MRTS-Coord dated 28.11.2019 or as per latest guideline/ amendment, shall be applicable to the tendering process and award of the contract shall be done accordingly. A certificate in regard to Minimum Local Content duly Certified by a Practicing Cost Accountant or a Practicing Chartered Accountant is necessarily to be enclosed with the bid documents.
 - BIDDER FROM A COUNTRY WHICH SHARES A LAND BORDER WITH INDIA in connection with the Para Govt. of India, vide its OM dated 23/07/2020 has inserted Rule 144(xi) to General Financial rules 2017 or as per latest guideline/ amendment according there is mandatory for bidder from a country which shares a land border with India, to have been registered with the Registration Committee, in the manner as stated therein, that shall be followed by such bidder

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.

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.</p> <p>For any purpose herein, 'Joint Venture' means an adhoc 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 format intent to enter into an agreement or under an existing agreement in the form of a Joint venture. The tenderer must ensure the following</p> <p>(a) In case of Single Entity:</p> <p>(i) Submit Power of Attorney authorizing the signatory of the Tender to commit the tenderer.</p> <p>(b) In case of Joint Venture:</p> <p>(i) The number of partners in the JV shall not be more than three.</p> <p>(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 Agreement should be registered and shall be submitted along with the performance security.</p> <p>(iii) The JV 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 during the Tendering process and, in the event the JV is awarded the Contract, during contract execution.</p> <p>(iv) Submit Power of Attorney by individual partners to lead partners as per the form given in Section 3.</p> <p>(v) In case a Joint Venture are the successful tenderer, the appropriate Joint Venture Agreement for execution of work should be entered by the Joint Venture partners. The duly signed Joint Venture Agreement should be submitted along with the tender submission.</p> <p>(vi) Performance Guarantee as per Clause 29, shall be submitted by Lead Partner only in case of Joint Venture.</p> <p>(vii) 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 and the entire execution of the contract.</p> <p>(viii) All members of the Joint venture shall be jointly and severally responsible for the execution of the Contract.</p> <p>(ix) Change in constitution or percentage participation of JV 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 shares a land border with India" for the purpose of this Order means: -</p> <ol style="list-style-type: none"> 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,

ITT Clause Ref.	Description
	<p>7. A joint venture where any member of the joint venture falls under any of the above</p> <p>(e) The beneficial owner for the purpose of above clause will be as under:</p> <p>(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.</p> <p>Explanation-</p> <p>a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five percent of share or capital or profits of the company;</p> <p>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;</p> <p>(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;</p> <p>(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;</p> <p>(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;</p> <p>(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.</p>
2.4	<p>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.</p> <p>Tenderers having a conflict of interest will be disqualified. The conflict of interest is detailed below.</p> <p>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:</p> <p>(a) they have controlling shareholders in common; or</p> <p>(b) they receive or have received any direct or indirect subsidy from any of them; or</p> <p>(c) they have the same legal representative for purposes of this Tender; or</p> <p>(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</p> <p>(e) any firm, either individually or in Joint Venture (JV), 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 formation or any common partner in partnership firms, or an individual will be treated as having conflict of interest or</p> <p>(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.</p> <p>(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</p> <p>(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.</p>
2.5	<p>The tenderer will be disqualified if,</p> <p>(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</p>

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	<p>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.</p> <p>(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 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.</p> <p>(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 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> <ol style="list-style-type: none"> has suffered bankruptcy/insolvency or 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>(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>
2.6	<p>PARTNERS IN CASE OF JV</p> <ol style="list-style-type: none"> Lead partner must have a minimum of 50% participation in the JV. Partners having 25% or more percentage participation shall be termed as substantial partner / other Partners. In case of JV, change in constitution or percentage participation shall not be permitted at any stage after the bid submission.

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	The bidder, in case of JV, 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 in favour of other JV partner or any change in constitution of partners of JV (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 must have experience in execution of similar work.
3.3(a)	The following Para is added: Materials, Equipment and Services 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.
7.3	The following Para is added: 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. The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all the information or documentation required by the Bidding Document may result in the rejection of the bid.
8.1.1	Additional Para The Employer shall endeavour to respond to the questions raised or clarifications sought by the Bidders. However, the Employer reserves the right not to respond to any question or provide any clarification, in its sole discretion, and nothing in this Clause shall be taken or read as compelling or requiring the Employer to respond to any question or to provide any clarification. The Employer may also on its own motion, if deemed necessary, issue interpretations and clarifications to all Bidders. All clarifications and interpretations issued by the Employer shall be deemed to be a part of the Bidding Documents. Verbal clarifications and information given by the Employer, or its employees or representatives shall not in any way or manner be binding on the Employer.
8.3	The following Para is added: The Pre-Bid meeting may also be attended through video conferencing (VC). Those tenderers who wish to join the meeting through Video Conferencing shall send a request email on the email id (i.e., gmpurchase@kride.in) till 2 working days before the scheduled date of pre-bid meeting up to 15:00 hours IST. A link for Video Conferencing will be sent by K-RIDE to such tenderers only. Any request for VC received after the given date and time for sending the link for VC will not be entertained. 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. K-RIDE may allow a maximum of two email IDs for one company to participate in the VC. Only one person will be allowed through one Email ID. The tenderers can join the VC through the link provided to them on Email ID. During the pre-bid meeting, the prospective tenderers may clarify/explain their queries submitted by them earlier (before the time limit as mentioned in Section 1). The clarifications/answers may not be given in the pre-bid meeting itself. The responses of K-RIDE will be intimated to the tenderers (who sought the clarification) in due course, depending upon the merits of the query. K-RIDE reserves the right not to respond to any question/query or to provide any clarification, in its sole discretion, without assigning any reason thereof.
10.0	Document comprising Technical and Financial Bid: The following Para to be read as: The Bidders shall submit the Technical BID & Financial Bid online through e-procurement portal (https://www.kppp.karnataka.gov.in). Only comprising of the following documents along with supporting documents as appropriate.
10.3	The following Para is added: Documents Comprising the Tender

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	<p>i. 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.</p> <p>ii. 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 tenders would be permitted after the opening of the tenders.</p> <p>iii. 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> <p>The Technical Tender shall contain the following:</p> <p>i. All the Forms of Section-3: Qualification Information/Bidding Forms including letter of technical Bid (LTB) shall be scanned and uploaded.</p> <p>ii. 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.</p> <p>iii. 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.</p> <p>iv. 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.</p> <p>v. The tenderer should note that non-submission of the Letter of Technical Bid (LTB) by the tenderer will result in summary rejection of his/her Tender.</p> <p>vi. The tenderer shall submit the Approach and Methodology for performing the assignment by using appropriate Performa given in Section 3: Qualification Information/Bidding Forms.</p> <p>vii. Scanned copy of Tender Security/Tender Security Declaration form (Section 3), in accordance with ITT Clause 13;</p> <p>viii. 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 initialled by the person signing the Tender.</p> <p>ix. 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.</p> <p>x. Domestic tenderers, individually or in joint ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility.</p> <p>xi. Scanned copy of Approach and Methodology - Performa given in Section-3: Qualification Information/Bidding Forms.</p> <p>xii. Scanned copy of Joint Venture Agreement entered into by all partners.</p> <p>The Price Tender shall contain the following:</p> <p>i. Scanned copy of Letter of Price Bid.</p> <p>ii. All documents mentioned in Section-3 shall be scanned and submitted.</p> <p>iii. Filled/completed schedules as required including Price Schedule in accordance with ITT Clauses should be submitted through Karnataka Public Procurement Portal only;</p> <p>iv. The tenderer shall submit through Karnataka Public Procurement Portal, separate Technical Proposal and Price Proposal, 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.</p> <p>v. The tenderer shall submit, as part of the Price Tender, the Schedules, including the Price Schedule through Karnataka Public Procurement Portal only.</p>

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11.5	<p>Tender Prices and Discounts The following Para to be read as:</p> <ol style="list-style-type: none"> 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 is 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 lump sum amount in figures and words as per format for such schedule in the summary sheets. (No rate and amount shall be quoted in technical bid.) 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 lump sum amount quoted in the price schedule. The price to be quoted in the letter of Price Schedule in accordance with ITT, shall be the total price of the Tender. Deleted Unless otherwise provided in the ITT and the Contract, the lump sum 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 weightage for the price adjustment formulae shall be as specified in the Tables of Adjustment Data included in Contract Data. All duties, taxes excluding 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 shall be included in the lump sum amount of Price Schedule and the total Tender Price submitted by the tenderer. GST shall be paid by the Employer as applicable in accordance with the prevailing rules of Government of India. 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 Bid (LPB) 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: In this tender, a tender security/ EMD of ₹41 Lakhs (Rupees Forty one Lakhs only) shall have to be paid. In this tender, the tender security/ EMD shall be paid as per the column 2 of Table 1 of Section 1 of the contract through e-payment in the e-procurement portal using any of the following five options only: Online Mode payment 1. Credit Card. 2. Debit Card. 3. Net Banking 4. National Electronic Fund Transfer (NEFT)/RTGS/e-Transfer. Offline Mode Payment 5. Over the Counter (OTC) – DD/ Banker's cheque/ Unconditional Bank Guarantee / Pay Order.</p> <p>Out of this ₹41 Lakhs (Rupees Forty Lakhs Thirty One Thousand only), ₹ 4.1 lakhs/- (Rupees Four Lakhs Ten Thousand Only) shall have to be paid through 'Online Modes'. This ₹ 4.1 lakhs/- (Rupees Four Lakhs Ten Thousand Only) shall be directly transferred to e-proc</p>

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	<p>pooling account at the time of submission of bids. The balance amount of ₹36.9 Lakhs/- (Rupees Thirty Six Lakhs Ninety Thousand Only) shall be paid through 'Offline Modes'.</p> <p>The Technical bids along with the Earnest Money Deposit (EMD) i.e., ₹36.9 Lakhs/- shall be furnished in the form of Bank Guarantee (BG) of any Nationalized Bank/Scheduled Bank (as per RBI guidelines) payable in favour of "Rail Infrastructure Development Company (Karnataka) Ltd" payable at Bengaluru.</p> <p>The EMD shall have to be valid for 45 days beyond the validity of the tender. The scanned copy of the BG should be uploaded to the tender in the e-procurement platform. The Original Bank Guarantee shall compulsorily be produced & submitted for verification after the bid submission closing time but before the opening of the technical bid date and time as specified in e-portal to General Manager Procurement & contracts in K-RIDE office. In case bidder has not opted the option of e-BG, the bidder shall note that the Original Bank Guarantee submitted through post/in person, if it does not reach before the opening of the technical bid date and time as specified in e-portal to the GM Procurement in K-RIDE office, the bid will not be considered for technical evaluation. The bids of the contractors who have failed to produce and submit the original bank guarantee of earnest money deposit of tender before the opening of the technical bid date and time as specified in e-portal to the concerned GM, the bids will not be opened. Even if they are opened by default/manual/electronic error, the bids will not be considered for technical evaluation and the bids will be rejected. In case of non-reconciliation of tender earnest money deposit receipt of payment in Government of Karnataka central pooling account held at the ICICI Bank, the bid gets rejected</p> <p>Bank Guarantee Format</p> <ol style="list-style-type: none"> An unconditional bank guarantees 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: <ol style="list-style-type: none"> a Scheduled Bank in India, or a Foreign Bank having their operations in India, or a Foreign Bank which do not have operations in India is required to provide a counter-guarantee by State Bank of India, The Scheduled Bank issuing the Bank Guarantee must be on "Structure Financial Messaging System (SFMS)" platform. A separate advice of the BG shall be invariably 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>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. The Issuing Bank shall send the SFMS to:</p> <p>Beneficiary: Rail Infrastructure Development Company (Karnataka) Limited (K-RIDE) Bank Name: Canara Bank Branch: Prime Corporate Branch Account No. 0430201012110 IFSC Code: CNRB0002636</p> <p>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.</p> <p>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. Non submission of scanned copy of Bank Guarantee with the Tender on e-tendering portal and non-submission of original Bank Guarantee within the specified period shall lead to summary rejection of Tender. The details of the</p>

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	<p>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.</p> <ol style="list-style-type: none"> 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. The Tender security of the Tenderer who have been determined to be unqualified for opening of their financial bid shall be returned within 03 working days after the opening of financial bid. The security amount (EMD) of unsuccessful Tenderers who have been determined to be unsuccessful in financial tender there Tender Security shall be returned within 07 working days from the date of receipt of Performance Guarantee from the successful bidder of this tender. 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. The Tender security may be forfeited: <ol style="list-style-type: none"> 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 if a Tenderer misrepresents or omits the facts in order to influence the procurement process; if the successful Tenderer fails to: <ol style="list-style-type: none"> sign the Contract in accordance with ITT Clause 28; furnish a performance security in accordance with ITT 29; accept the correction of its Tender Price pursuant to ITT 24; or furnish a domestic preference security if so required. 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. <p>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)</p>
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>

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15	<p>Sealing and Marking of Tenders The following Para to be read as: The tenderer shall submit the technical Tender, Price Tender and the Tender Security/Tender Security Declaration through Karnataka Public Procurement Portal i.e., https://www.kppp.karnataka.gov.in. The original of the Technical Proposal, which will contain all Forms of Section 3 except Price Schedule of Section 9 and all other relevant data specified in the Tender document. The Price Bid shall be submitted through Karnataka Public Procurement Portal only. This "PRICE BID" will contain only 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. The above forms should be scanned and submitted through Karnataka Public Procurement Portal. 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 are permitted.</p> <p>Bidder has to submit following documents in original as submitted in e-portal after 24 Hours from the submission of bid and before scheduled date and time of opening of technical bid. a) Letter of Bid b) EMD as per clause 13.7 of ITT. c) Power of Attorney</p>
19.7	<p>The following Para is added: Tender Opening</p> <ol style="list-style-type: none"> The Employer shall conduct the opening of Technical Tenders through Karnataka Public Procurement Portal i.e., https://www.kppp.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 the 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. The 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 after due process. The Employer shall conduct the opening of Price Tenders through Karnataka Public Procurement Portal i.e., https://www.kppp.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: Deviations, Reservations, and Omissions During the evaluation of Tenders, the following definitions apply: (a) "Deviation" is a departure from the requirements specified in the Tendering Document; (b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Tendering Document; and (c) "Omission" is the failure to submit part or all of the information or documentation required in the Tendering Document.</p>

ITT Clause Ref.	Description
24.3	<p>The following Para is added: Nonconformities, Errors, and Omissions</p> <ol style="list-style-type: none"> Provided that a Tender is substantially responsive, the Employer may waive any non-conformity 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: Correction of Arithmetical Errors and Omissions in Tender and Evaluation of Tender Price</p> <ol style="list-style-type: none"> 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"> 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. 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. 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. 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 lump sum amount of the schedule shall be considered as zero and shall be calculated accordingly. 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. Deleted. 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: Conversion to Single Currency</p> <p>For evaluation and comparison purposes the currencies of the Tender shall be converted into Indian Rupees.</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>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>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 the Bill of Quantities, 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 to 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 under the contract.</p>

ITT Clause Ref.	Description
26.2	<p>The following Para is added: Award Criteria</p> <ol style="list-style-type: none"> The Employer will 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, the contract will be awarded to the tenderer with 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: Performance Security</p> <p>The successful tenderers shall have to submit a Performance Guarantee (PG) Within Twenty-One (21) days from the date of issue of Letter of Acceptance (LOA). If the contractor fails to submit the requisite PG within 21 days from the date of issue of LOA, the contract is liable to be terminated. In case contract is terminated, K-RIDE will 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 Clause-1	<p>LITIGATION HISTORY: (Please see Annexure Tendering Forms)</p> <p>The tenderer/tenderers should provide accurate information on any litigation or arbitration resulting from contracts completed or under its execution over the five years as on date of submission of this tender. 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. Any history of awards against the tenderer or any partner of a joint venture or failure to provide accurate information then the acceptance/ rejection is at sole discretion of the Employer. Bidders having litigation with KRIDE are not eligible to participate in this tender.</p> <p>Note: The 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 5 years as on date of submission of this tender. A separate sheet should be used for each partner of a Joint Venture</p>

ITT Clause Ref.	Description
New Clause-2	Jurisdiction of Courts 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
New Clause-3	Stamp duties and charges: The contractor has to bear the stamp duties and charges for agreements/registration as per Karnataka stamp Act.

K-
RIDE

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.

Sl. No.	Description	Form Number/ Para No.	Page No.
	A) Qualification Information/Bidding Forms		
1.	Legal status of Tenderer	Para No. 1.1	41-45
2.	Executed and Payment Received statement for 5 Years	Para No. 1.2	
3.	Similar Work Experience	Para No. 1.3	
4.	Quantities of Work executed in 5 years	Para No. 1.4	
5.	Information on Works (Existing, Ongoing and Works for which Tenders already submitted)	Para No. 1.5	
6.	Availability of Plant and Equipment Details	Para No. 1.6	
7.	Reports of Financial Standing (Profit and Loss Statements)	Para No. 1.7	
8.	Qualification and Experience of Key Personnel	Para No. 1.8	
9.	Tenderer's bankers Details	Para No. 1.9	
10.	Evidence of access to Financial Resources	Para No. 1.10	
11.	Proposed Subcontracting components	Para No. 1.11	
12.	Information on Litigation History	Para No. 1.12	
13.	Proposed Methodology and Program of construction	Para No. 1.13	
	B) Additional Qualification Information/Bidding Forms		
14.	Letter of Technical Bid	Form PS 1	46 -57
15.	Letter of Price Bid	Form PS 2	
16.	Format for Affidavit (along with Bid)	Form PS 3	
17.	Bid Security (Bank Guarantee)	Form BDF/1	
18.	Letter of participation from Each partner of Joint Venture (JV)	Form JV /1	
19.	Power of attorney for authorized signatory of Joint Venture (JV)partners	Form JV /2	
20.	Power of attorney to Lead partner of joint venture (JV)	Form JV /3	
21.	Draft Joint Venture Agreement	Form JV /4	
	Bidder Qualification		
22.	Bidder's Information Sheet	Form ELI - 1	58-74
23.	JV Information Sheet	Form ELI – 2	
24.	Financial Situation	Form FIN - 1	
25.	Annual Construction Turnover	Form FIN – 2	
26.	Current Contract Commitment	Form FIN - 3	
27.	Deleted	Form No 1	
28.	Checklist for clauses pertaining to Summary Rejection of bid	Form No 2	
29.	Format for certificate to be submitted by bidder along with the bid	Form 3 C1	
30.	Format for certificate to be submitted by Bidder along with the bid for subcontracting	Form 3 C2	
31.	Deleted	Form 4	
32.	Key Personnel for the work	Form 5	
33.	Format of Curriculum Vitae (CV) for proposed key professional staff	Form 6	
34.	Power of Attorney (POA) for Submitting Bid	Form 7	
35.	Undertaking from specialist sub-contractor	Form CL-2	

Sl. No.	Description	Form Number/ Para No.	Page No.
36.	Availability of Financial Resources	Form CL-3	
37.	Evidence of Availability of Credit Line Financial Resources	Form CL-4	
38.	Work Experience Certificate	Form EXP-1	

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]

Total value of construction works executed and payments received in the following five Financial Years (attach certificate from Statutory Auditors)

2019-2020: _____

2020-2021: _____

2021-2022: _____

2022-2023: _____

2023-2024: _____

1.2. 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).

Refer Para 3.2 b (I) of section: 2 ITT).

Project Name	Name of Employer	Description of Work	Contract Number	Value of Contract ₹. Cr.	Date of Issue of Work Order	Specified Period of Completion	Actual Date of Completion	If Partner in a JV , Specify Participation in Total Contract Amount	Remarks Explaining Reasons for Delay in
1	2	3	4	5	6	7	8	9	10

Refer Para 3.2 b (II) of section: 2 ITT).

Project Name	Name of Employer	Description of Work	Contract Number	Value of Contract ₹. Cr.	Date of Issue of Work Order	Specified Period of Completion	Actual Date of Completion	If Partner in a JV , 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

Notes:

- (1) If the qualifying work of similar nature is done by a joint venture/, then Value shall be considered as per percentage participation by the member(s) in that joint venture/.

1.3 Value of similar nature of work completed shall be updated to 2023-24 price level as per table given below.

Financial year	2019-20	2020-21	2021-22	2022-23	2023-24
Indian Currency					

Financial year	2019-20	2020-21	2021-22	2022-23	2023-24
Foreign Currency					

For completed works, the value of work done shall be updated to FY 2023-24 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 submission 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 OF THE BIDDER)

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

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 Contract no., Award Date, Completion Date, Role in Contract, Total Contract Amount, JV Participation Proportion)
			Civil/ structural construction works of RCC box construction	Completed Design and Approval of RUB/Underpass	Deleted	Deleted	
2019-2020							
2020-2021							
2021-2022							
2022-2023							
2023-2024							

Note:

- 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 OF THE BIDDER)

- 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 (₹. in Crores)	Stipulated Period of Completion	Value of Works Remaining to be Completed (₹. In Crores) (Attach Certificate from	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 (₹. In Crores)	Stipulated Period of Completion	Date when Decision is Expected	Remarks if Any
(1)	(2)	(3)	(4)	(5)	(6)	(7)

- 1.6 The 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 no's/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 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)

- 1.12 Information on litigations in which the Tenderer is involved:

Litigation History

(This has reference to Eligibility cum Qualification Criteria document.)

Name of Tenderer or member of Joint Venture: -

Sl. No.	Name of the Employer/ Client	Name of the Work	No. of Cases in the Work	Cause of Litigation/ Arbitration/ Details of Disputes	Year	Litigation/ Arbitration Initiated by	Award in Favor of Tenderer/ Client	Disputed Amount	Remarks Showing Present Status

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 05 years and ending last day of the month previous to the month of bid submission. A separate sheet should be used for each partner of a Joint Venture.

- 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 shall be precise and relevant to the assignment. Bar charts shall be included.

B) ADDITIONAL QUALIFICATION INFORMATION / BIDDING FORMS

Form: PS1

LETTER OF TECHNICAL BID

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 Bengaluru and also the project offices and site offices fully furnished for Employer and Engineer within the time limits and as per the conditions specified in the bid document.
- (w) We have submitted the Statement of Integrity, Eligibility, Social, and Environmental Responsibility signed and abides 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 and that the courts at Bengaluru 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 on the Letter head of the Firm)

(Centre of E-governance has disabled submission of documents pertaining to financial proposal in e-portal. Bidders are requested to enter the Financial Proposal in the respective cell provided in the e-portal. This format of Financial Proposal is only for reference).

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 Clause no. 9, Section 2 Instructions to Bidders (ITBT).
- (b) We offer to execute the Work in conformity with the Bidding Documents.
- (c) 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
- (d) The total price of our Bid is indicated in the price schedule in e-procurement portal.
- (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: _____

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 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) 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 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 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 IBN 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 along with 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 years in K-RIDE.

(SEALAND 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

FORMAT OF BID SECURITY (BANK GUARANTEE)

WHEREAS _____ having its registered office at _____ (hereinafter called the Bidder) has submitted his bid dated for the "Package- "Design & Construction of Single Cell Closed RCC Box at Channasandra Station location from ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore." (hereinafter called "the Works") KNOW ALL PEOPLE by these presents that we, _____ having its registered office at _____ (hereinafter called the Bank) are bound unto the Managing Director, Rail Infrastructure Development Company Karnataka Ltd (K-RIDE), Bengaluru (hereinafter called "the Employer") in the sum of ₹. _____ (Rupees _____) for which payment well and truly to be made to the said Employer the Bank binds itself, his successors and assigns by these presents; SEALED with the Common Seal of the said Bank this day

THE CONDITIONS OF THIS OBLIGATION ARE:

- (1) If after Bid opening the Bidder withdraws his Bid during the period of Bids validity specified in the Form of Bid.
OR
- (2) If the Bidder having been notified of the acceptance of his Bid by the Employer during the period of Bid Validity.
 - a. Fails or refuses to execute the form of Agreement in accordance with the instructions to Bidders, if required; or
 - b. Fails or refuse to furnish the Performance Security, in accordance with the instruction to Bidders; or
 - c. Does not accept the correction of the Bid Price pursuant to clause 24.

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the conditions of one or both of the two conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date 180 days after the deadline for submission of bids as such deadline is stated in the instructions to Bidders of as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date

DATE _____
 SIGNATURE OF THE BANK _____
 WITNESS _____
 SEAL _____

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

(On each Firm's Letter Head)

No _____

Dated: _____

From,

To,

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

Gentlemen,

Ref: _____ "[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/ by name of _____ with for the purposes associated with IFB referred to above.
(Members who are not the lead partner of the JV should add the following paragraph) *
2. 'The JV 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/.'

OR

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

3. 'In this group we act as leader and, for the purposes of applying for qualification, represent the Joint Venture/.'
4. In the event of our group being awarded the contract, we agree to be jointly with _____ (names of other members of our JV) _____ and severally liable to the (K-RIDE) Rail Infrastructure Development Company (Karnataka) Limited, Bengaluru, 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, Bengaluru and our JV.
5. *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

**FORMAT FOR POWER OF ATTORNEY FOR AUTHORISED
SIGNATORY OF JOINT VENTURE (JV) 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. / Mrs./ 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 _____ 2024

(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/ .
- 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.

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

(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/ 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/ 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/ , all acts, deeds and things as may be necessary in connection with the Joint Venture's/ 's bid for the project, as may be necessary in connection the Joint Venture's/ '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/ , as the lead partner of the Joint Venture/ , to do on behalf of the Joint Venture/ , all or any of the acts, deeds or things necessary or incidental to the Joint Venture's/ '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/ 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

Dated this _____ Day of _____ 2024.

(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 accept 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.

DRAFT FORMAT OF JOINT VENTURE/ 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 _____
 _____ (hereinafter 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/ as under and have agreed to participate.
3. M/s _____ shall be the lead member of the JV for all intents and purpose and shall represent the Joint Venture/ 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 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 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 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 partner then indicate the breakup of that Item/Bill no. for each JV partner.

6. 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.

7. 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.

8. EXECUTIVE AUTHORITY

The said Joint Venture/ 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.

9. GUARANTEES AND BONDS

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

10. 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.

11. 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/ .

12. 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.

13. 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.

14. 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 Bengaluru.

15. VALIDITY

This Agreement shall remain in force till the DLP (Defect Liability Period) is over and Securities are released.

16. 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 _____ & _____

_____ and a copy submitted with the Bid.

17. This AGREEMENT shall be construed under the laws of India.
18. NOTICES BETWEEN JV 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.

(Seal)

Witness

1.

 (Name & Address)2.

 (Name & Address)M/s.

(Seal)

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 named in above, in accordance with ITT clause 14.
3. In case of JV, JV agreement, in accordance with ITT clause 2.

(SEAL AND SIGNATURE OF THE BIDDER)

FORM ELI - 2: JV INFORMATION SHEET

Each member of a JV must fill in this form separately

JV / Information	
Bidder's legal name	
JV Partner's Legal Name	
JV Partner's Country of Constitution	
JV Partner's Year of Constitution	
JV Partner's Legal Address in Country of Constitution	
JV 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 Authorized Signatory of bidder to sign the bid.

(SEAL AND SIGNATURE OF THE BIDDER)

FORM FIN-1: FINANCIAL SITUATION

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

NAME OF BIDDER/JV PARTNER

Sl. No.	Description	Financial Data for 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					
4	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 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 , 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 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 five years (from FY 2019-20 to FY 2023-24) 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 year 2023-24 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 '4' audited financial years (i.e. 2019-20, 2020-21, 2021-22, 2022-23) will be taken into consideration for evaluation. If audited balance sheet of any year other than the year 2023-24 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 5 FINANCIAL YEARS.

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

NAME OF BIDDER/JV PARTNER:

Sl. No.	Year	Annual Turnover	Multiplying Factor	Updated Annual Turnover
		INR	INR	INR
1	2019-2020			
2	2020-2021			
3	2021-2022			
4	2022-2023			
5	2023-2024			

Annual Turnover Data for the 5 Financial Years. (Construction Only)			
Year	Amount Currency	Exchange Rate	Indian National Rupees Equivalent
Average Annual Construction Turnover for 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 OF THE BIDDER)

FORM FIN-3: CURRENT CONTRACT COMMITMENTS / WORKS IN PROGRESS

Bidders and each partner to a JV 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	6	7	8
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.

1. Bidder should provide information on their current commitments on 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.
2. 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) In charge (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 OF THE BIDDER)

DELETED

**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 under mentioned clauses:

ITT Clause No. Section 2	Reason for Summary Rejection	Form No.
2.5	Non-submission of Affidavit	Form PS-3
11.5 & 22	Non-submission of immediate information to the Employer in case Bidder ceases to fulfill eligibility in terms of ITT.	-
ITT	Letter of Technical Bid	Form PS-1
11.5	Quoting more than one Lump sum Amount for any Schedule	Price schedule- Section:9
11.5	Non-Submission of the Letter of Price Bid (LPB)	(Form:PS-2)
13	Bid not Accompanied with bid Security	(BDF/1)
14	Bid not Accompanied with Power of Attorney / General Power of Attorney to Sign on Behalf of the Bidders	JV/1/2/3

(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 _____, 2024

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 _____, 2024

For- _____

Authorized Signatory Signature _____

Full Name: _____

Place: _____

(SEAL AND SIGNATURE OF THE BIDDER)



DELETED

FORM 5**KEY PERSONNEL FOR THE WORK**

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

The Tenderer must demonstrate that it will have a suitably qualified Project Manager and suitably qualified (and in adequate numbers) Key Personnel and Non-Key Personnel, as described in the table below.

The Tenderer shall provide details of the Project Manager and Key Personnel and Non- Key Personnel that the Tenderer considers appropriate to perform the Contract, together with their academic qualifications and work experience.

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

Note:

- 1) 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: _____

**POWER OF ATTORNEY (POA) FOR SUBMITTING BID
(FOR SINGLE ENTITY/SOLE BIDDER ONLY)**

Know all men by these presents, we _____. (name and address of the registered office) do hereby constitute, appoint and authorize Mr./Ms. _____ (name and residential address) who is presently employed with us and holding the position of _____ as 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 Project, including signing and submission of all documents and providing information/responses to K-RIDE, representing us in all matters before K-RIDE, and generally dealing with K-RIDE in all matters in connection with our Bid for the Project.

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 always be deemed to have been done by us.

_____ (Signature)
(Name, Title and address) of the Person issuing the POA.

Notes:

- (i) The bidder should submit the notarized Power of Attorney.
- (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) The bidder should submit following additional document in support of the POA as case-to-case basis:
 - a) Proprietorship Affidavit in case of Proprietary bidder.
 - b) Partnership deed in case of partnership bidder.
 - c) Board Resolution in case of a Public/Private limited company.
 - d) Memorandum & Article of Association in case of a Public/Private limited company.
 - e) Board Resolution in case of a Limited Liability Partnership.

FORM CL-2**UNDERTAKING FROM NOMINATED / IDENTIFIED SUB-CONTRACTOR****(REFER CLAUSE OF 3.2 (C) / (D) OF ITT)**

(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 CONTRACTORSTAMP & SIGNATURE OF AUTHORISED
SIGNATORY OF BIDDER

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		

To 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 ` _____ 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 ₹. _____ 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: _____

SECTION-4

**FORM OF TENDER,
LETTER OF ACCEPTANCE,
AND AGREEMENT FORM ETC.**

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K-RIDE

FORM OF TENDER (DELETED)

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

K-RIDE

FORM-1

LETTER OF ACCEPTANCE(On the Letter head of the Employer)

[Date]_____

To: _____[name and address of the Contractor]

Dear Sirs,

This is to notify you that your Bid dated _____ for the execution of PACKAGE "Design & Construction of Cast in Situ RCC Box at Channasandra Station location from ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore." vide Tender No: KRIDE/2025-26/OW/WORK_INDENT34, Dated: 09.05.2025 for the Accepted Contract Amount of Rupees _____ [amount in words and figures], as corrected and modified in accordance with the Instructions to Tenderers is hereby accepted by the Competent Authority of K RIDE.

You are hereby requested to furnish Performance Security plus additional security for unbalanced tenders in accordance with of Clause 25.6 of ITT, in the form detailed in Clause 29.1 of ITT and clause 43 of the conditions of contract for an amount of ₹. _____ (As defined in contract data) within 28 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.

You are hereby instructed to proceed with the execution of the said works in accordance with the contract documents. From date of issuance of this letter.

Yours faithfully,

Authorized Signature

Name and Title of Signatory

Name of Agency.

DELETED

K-RIDE

AGREEMENT FORM

This agreement is made on 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 PACKAGE : "Design & Construction of Cast in Situ RCC Box at Channasandra Station location from ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore." (BSRP) vide Tender No: ----- (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,

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

- i. This Contract Agreement and the Appendices hereto.
- ii. Letter of Acceptance
- iii. Notice to proceed
- iv. Letter of Bid and the Price Schedule submitted by the Contractor.
- v. Addendums, Corrigendum and Pre-bid clarifications to the Tender
- vi. Contract Data, Special provisions (if any)
- vii. Particular Conditions of Contract (PCC)
- viii. General Conditions of Contract (GCC) / Conditions of Contract (CC)
- ix. Employers Requirements including scope of works, the Schedules.
- x. Technical specification, Safety, Health & Environment Manual
- xi. Design and Drawings
- xii. Any other documents pertaining to tender, issued by the Employer
- xiii. Contractor's Technical Proposal
- xiv. Any other documents pertaining to tender, submitted by the contractor

If an ambiguity or discrepancy is found in the documents, the Engineer will bring the same to the notice of the Employer and the Employer will issue necessary clarification or instruction, as per the need.

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 _____

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SECTION – 5

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K-RIDE

General Conditions (GC)

RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED (K-RIDE)

K-RIDE

General Conditions

1. General Provisions

- 1.1 Definitions** In the Conditions of Contract (“these Conditions”), which include Particular Conditions, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.
- 1.1.1 The Contract**
- 1.1.1.1 **“Contract”** means the Contract Agreement, the Letter of Acceptance, the Letter of Tender, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.
 - 1.1.1.2 **“Contract Agreement”** means the contract agreement referred to in Sub-Clause 1.6 [Contract Agreement].
 - 1.1.1.3 **“Letter of Acceptance”** means the letter of formal acceptance, signed by the Employer, of the Letter of Tender, 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.
 - 1.1.1.4 **“Letter of Tender”** means the document entitled letter of tender or letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.
 - 1.1.1.5 **“Specification”** means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.
 - 1.1.1.6 **“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.
 - 1.1.1.7 **“Schedules”** means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Tender, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.
 - 1.1.1.8 **“Tender”** means the Letter of Tender and all other documents which the Contractor submitted with the Letter of Tender, as included in the Contract.
 - 1.1.1.9 **“Bill of Quantities”, “Daywork Schedule” and “Schedule of Payment Currencies”** mean the documents so named (if any) which are comprised in the Schedules.
 - 1.1.1.10 **“Contract Data”** means the pages completed by the Employer entitled contract data which constitute Part A of the Particular Conditions.
- 1.1.2 Parties and Persons**
- 1.1.2.1 **“Party”** means the Employer or the Contractor, as the context requires.
 - 1.1.2.2 **“Employer”** means the person named as employer in the Contract Data and the legal successors in title to this person.
 - 1.1.2.3 **“Contractor”** means the person(s) named as contractor in the Letter of Tender accepted by the Employer and the legal successors in title to this person(s).
 - 1.1.2.4 **“Engineer”** means the person appointed 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 Sub-Clause 3.4 [Replacement of the Engineer].
 - 1.1.2.5 **“Contractor’s Representative”** means the person named by the Contractor in the Contract or appointed from time to time by the

- Contractor under Sub-Clause 4.3 [Contractor's Representative], who acts on behalf of the Contractor.
- 1.1.2.6 **"Employer's Personnel"** means the Engineer, the assistants referred to in Sub-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.
- 1.1.2.7 **"Contractor's Personnel"** means the Contractor's Representative and all personnel whom the Contractor utilizes 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.
- 1.1.2.8 **"Subcontractor"** means any person named in the Contract as a subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.
- 1.1.2.9 **"DB"** means the person or three persons appointed under Sub-Clause 20.2 [Appointment of the Dispute Board] or Sub-Clause 20.3 [Failure to Agree on the Composition of the Dispute Board]
- 1.1.2.10 Deleted
- 1.1.2.11 **"Bank"** means the financing institution (if any) named in the Contract Data.
- 1.1.2.12 **"Borrower"** means the person (if any) named as the borrower in the Contract Data.
- 1.1.3 Dates, Tests, Periods and Completion**
- 1.1.3.1 **"Base Date"** means the date 28 days prior to the latest date for submission of the Tender.
- 1.1.3.2 **"Commencement Date"** means the date notified under Sub-Clause 8.1 [Commencement of Works].
- 1.1.3.3 **"Time for Completion"** means the time for completing the Works or a Section (as the case may be) under Sub-Clause 8.2 [Time for Completion], as stated in the Contract Data (with any extension under Sub-Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.
- 1.1.3.4 **"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 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.
- 1.1.3.5 **"Taking-Over Certificate"** means a certificate issued under Clause 10 [Employer's Taking Over].
- 1.1.3.6 **"Tests after Completion"** means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.
- 1.1.3.7 **"Defects Notification Period"** means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects], which extends over 365 days except if otherwise stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].
- 1.1.3.8 **"Performance Certificate"** means the certificate issued under Sub-Clause 11.9 [Performance Certificate].
- 1.1.3.9 **"Day"** means a calendar day and "year" means 365 days.

1.1.4 Money and Payments

- 1.1.4.1 **“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.
- 1.1.4.2 **“Contract Price”** means the price defined in Sub-Clause 14.1 [The Contract Price] and includes adjustments in accordance with the Contract.
- 1.1.4.3 **“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.
- 1.1.4.4 **“Final Payment Certificate”** means the payment certificate issued under Sub-Clause 14.13 [Issue of Final Payment Certificate].
- 1.1.4.5 **“Final Statement”** means the statement defined in Sub-Clause 14.11 [Application for Final Payment Certificate].
- 1.1.4.6 **“Foreign Currency”** means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.
- 1.1.4.7 **“Interim Payment Certificate”** means a payment certificate issued under Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.
- 1.1.4.8 **“Local Currency”** means the currency of the Country.
- 1.1.4.9 **“Payment Certificate”** means a payment certificate issued under Clause 14 [Contract Price and Payment].
- 1.1.4.10 **“Provisional Sum”** means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.5 [Provisional Sums].
- 1.1.4.11 **“Retention Money”** means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause 14.9 [Payment of Retention Money].
- 1.1.4.12 **“Statement”** means a statement submitted by the Contractor as part of an application, under Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5 Works and Goods

- 1.1.5.1 **“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.
- 1.1.5.2 **“Goods”** means Contractor’s Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.
- 1.1.5.3 **“Materials”** means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.
- 1.1.5.4 **“Permanent Works”** means the permanent works to be executed by the Contractor under the Contract.
- 1.1.5.5 **“Plant”** means the apparatus, machinery and other equipment intended to form or forming part of the Permanent Works, including vehicles purchased for the Employer and relating to the construction or operation of the Works.
- 1.1.5.6 **“Section”** means a part of the Works specified in the Contract Data as a Section (if any).
- 1.1.5.7 **“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.

	1.1.5.8	"Works" mean the Permanent Works and the Temporary Works, or either of them as appropriate.
1.1.6 Other Definitions	1.1.6.1	"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.
	1.1.6.2	"Country" means the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.
	1.1.6.3	"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.
	1.1.6.4	"Force Majeure" is defined in Clause 19 [Force Majeure].
	1.1.6.5	"Laws" means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.
	1.1.6.6	"Performance Security" means the security (or securities, if any) under Sub-Clause 4.2 [Performance Security].
	1.1.6.7	"Site" means the places where the Permanent Works are to be executed, including storage and working areas, 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.
	1.1.6.8	"Unforeseeable" means not reasonably foreseeable by an experienced contractor by the Base Date.
	1.1.6.9	"Variation" means any change to the Works, which is instructed or approved as a variation under Clause 13 [Variations and Adjustments].
	1.1.6.10	"Notice of Dissatisfaction" means the notice given by either Party to the other under Sub-Clause 20.4 [Obtaining Dispute Board's Decision] indicating its dissatisfaction and intention to commence arbitration.
1.2 Interpretation		In the Contract, except where the context requires otherwise:
	(a) (b) (c) (d) (e)	(a) Words indicating one gender include all genders; (b) Words indicating the singular also include the plural and words indicating the plural also include the singular; (c) Provisions including the word "agree", "agreed" or "agreement" require the agreement to be recorded in writing; (d) "Written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and (e) The word "tender" is synonymous with "bid" and "tenderer" with "Bidder" and the words "tender documents" with "bidding documents."
		The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.
		In these Conditions, provisions including the expression "Cost plus profit" require this profit to be one-twentieth (5%) of this Cost unless otherwise indicated in the Contract Data.
1.3 Communi-cations		Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:
	(a)	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
	(b)	Delivered, sent or transmitted to the address for the recipient's communications as stated in the Contract Data. However:
	(i)	If the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

- (ii) If the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

1.4 Law and Language

The Contract shall be governed by the law of the country or other jurisdiction stated in the Contract Data.

The ruling language of the Contract shall be that stated in the Contract Data.

The language for communications shall be that stated in the Contract Data. If no language is stated there, the language for communications shall be the ruling language of the Contract.

1.5 Priority of Documents

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:

- (a) The Contract Agreement (if any);
- (b) The Letter of Acceptance;
- (c) The Letter of Tender;
- (d) The Particular Conditions – Part A;
- (e) The Particular Conditions – Part B;
- (f) These General Conditions;
- (g) The Specifications;
- (h) The Drawings; and
- (i) The Schedules and any other documents forming part of the Contract.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

1.6 Contract Agreement

The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless the Particular Conditions establish otherwise. The Contract Agreement shall be based upon the form annexed to the Particular Conditions. The costs of stamp duties and similar charges (if any) imposed by law in connection with entry into the Contract Agreement shall be borne by the Employer.

1.7 Assignment

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:

- (a) May assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party, and
- (b) 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.

1.8 Care and Supply of Documents

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.

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.

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.

1.9 Delayed Drawings or Instructions

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.

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 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 Sub-Clause 20.1 [Contractor's Claims] to:

- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and
- (b) Payment of any such Cost plus profit, which shall be included in the Contract Price.

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

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.

1.10 Employer's Use of Contractor's Documents

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 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:

- (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.

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.

1.11 Contractor's Use of Employer's Documents

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 copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.

- 1.12 Confidential Details** The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify compliance with the Contract and allow its proper implementation. Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. 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.
- 1.13 Compliance with Laws** The Contractor shall, in performing the Contract, comply with applicable Laws. Unless otherwise stated in the Particular Conditions:
- (a) The Employer shall have obtained (or shall obtain) the planning, zoning, building permit or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or to be) 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
 - (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, unless the Contractor is impeded to accomplish these actions and shows evidence of its diligence.
- 1.14 Joint and Several Liability** If the Contractor constitutes (under applicable Laws) a joint venture grouping of two or more persons:
- (a) These persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;
 - (b) These persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and
 - (c) The Contractor shall not alter its composition or legal status without the prior consent of the Employer.
- 1.15 Inspections and Audit by the Bank** The Contractor shall permit the Bank and/or persons appointed by the Bank to inspect the Site and/or the Contractor's accounts and records relating to the performance of the Contract and to have such accounts and records audited by auditors appointed by the Bank if required by the Bank.

2. The Employer

- 2.1 Right of Access to the Site** 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. 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 required to enable the Contractor to proceed without disruption in accordance with the programme submitted under Sub-Clause 8.3 [Programme]. If the Contractor suffers delay and/or incurs Cost 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 subject to Sub-Clause 20.1 [Contractor's Claims] to:
- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and

		<p>(b) Payment of any such Cost plus profit, which shall be included in the Contract Price.</p> <p>After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [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, Cost or profit.</p>
2.2	Permits, Licenses or Approvals	<p>The Employer shall provide, at the request of the Contractor, such reasonable assistance as to allow the Contractor to obtain properly:</p> <p>(a) Copies of the Laws of the Country which are relevant to the Contract but are not readily available, and</p> <p>(b) Any permits, licenses or approvals required by the Laws of the Country:</p> <p>(i) Which the Contractor is required to obtain under Sub-Clause 1.13 [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>
2.3	Employer's Personnel	<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 Sub-Clause 4.6 [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 Sub-Clause 4.8 [Safety Procedures] and under Sub-Clause 4.18 [Protection of the Environment].</p>
2.4	Employer's Financial Arrangements	<p>The Employer shall submit, before the Commencement Date and thereafter within 28 days after receiving any request from the Contractor, reasonable evidence that financial arrangements have been made and are being maintained which will enable the Employer to pay the Contract Price punctually (as estimated at that time) in accordance with Clause 14 [Contract Price and Payment]. Before the Employer makes any material change to his financial arrangements, the Employer shall give notice to the Contractor with detailed particulars.</p> <p>In addition, if the Bank has notified to the Borrower that the Bank has suspended disbursements under its loan, which finances in whole or in part the execution of the Works, the Employer shall give notice of such suspension to the Contractor with detailed particulars, including the date of such notification, with a copy to the Engineer, within 7 days of the Borrower having received the suspension notification from the Bank. If alternative funds will be available in appropriate currencies to the Employer to continue making payments to the Contractor beyond a date 60 days after the date of Bank notification of the suspension, the Employer shall provide reasonable evidence in his notice of the extent to which such funds will be available.</p>
2.5	Employer's Claims	<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 Sub-Clause 4.19 [Electricity, Water and Gas], under Sub-Clause 4.20 [Employer's Equipment and Free-Issue Materials], or for other services requested by the Contractor.</p> <p>The notice shall be given as soon as practicable and no longer than 28 days 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</p>

himself to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with Sub-Clause 3.5 [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 Sub-Clause 11.3 [Extension of Defects Notification Period].

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.

3. The Engineer

3.1 Engineer's Duties and Authority

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.

The Engineer shall have no authority to amend the Contract.

The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract. If the Engineer is required to obtain the approval of the Employer before exercising a specified authority, the requirements shall be as stated in the Particular Conditions. The Employer shall promptly inform the Contractor of any change to the authority attributed to the Engineer.

However, whenever the Engineer exercises a specified authority for which the Employer's approval is required, then (for the purposes of the Contract) the Employer shall be deemed to have given approval.

Except as otherwise stated in these Conditions:

- (a) Whenever carrying out duties or exercising authority, specified in or implied by the Contract, the Engineer shall be deemed to act for the Employer;
- (b) The Engineer has no authority to relieve either Party of any duties, obligations or responsibilities under the Contract;
- (c) Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Engineer (including absence of disapproval) shall not relieve the Contractor from any responsibility he has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances; and
- (d) Any act by the Engineer in response to a Contractor's request except as otherwise expressly specified shall be notified in writing to the Contractor within 28 days of receipt.

The following provisions shall apply:

The Engineer shall obtain the specific approval of the Employer before taking action under the following Sub-Clauses of these Conditions:

- (a) Sub-Clause 4.12: agreeing or determining an extension of time and/or additional cost;
- (b) Sub-Clause 13.1: instructing a Variation, except;
 - (i) In an emergency situation as determined by the Engineer, or
 - (ii) If such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Contract Data;
- (c) Sub-Clause 13.3: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 13.1 or 13.2;
- (d) Sub-Clause 13.4: Specifying the amount payable in each of the applicable currencies

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 13 and shall notify the Contractor accordingly, with a copy to the Employer.
- 3.2 Delegation by the Engineer** 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. However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with Sub-Clause 3.5 [Determinations].
- 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:
- 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;
 - 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.
- 3.3 Instructions of the Engineer** 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 13 [Variations and Adjustments] shall apply.
- 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:
- Gives an oral instruction;
 - Receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction; and
 - Does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation;
- then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be).
- 3.4 Replacement of the Engineer** 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 intended replacement Engineer. If the Contractor considers the intended replacement Engineer to be unsuitable, he has the right to raise objection against him by notice to the Employer, with supporting particulars, and the Employer shall give full and fair consideration to this objection.
- 3.5 Determinations** Whenever these Conditions provide that the Engineer shall proceed in accordance with this Sub-Clause 3.5 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.

The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars, within 28 days from the receipt of the corresponding claim or request except when otherwise specified. Each Party shall give effect to each agreement or determination unless and until revised under Clause 20 [Claims, Disputes and Arbitration].

4. The Contractor

4.1 Contractor's General Obligations

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, material, and services to be incorporated in or required for the Works shall have their origin in any eligible source country as defined by the Bank.

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 Contractor's 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, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer..

If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Particular Conditions:

- (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 1.4 [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, if applicable, 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 10.1 [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer.

4.2 Performance Security

The Contractor shall obtain (at his cost) a Performance Security for proper performance, in the amount stated in the Contract Data and denominated in the currency(ies) of the Contract or in a freely convertible currency acceptable to the Employer. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

The Contractor shall deliver the Performance Security to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer. The Performance Security shall be issued by a reputable bank or financial institution

selected by the Contractor, and shall be in the form annexed to the Particular Conditions, as stipulated by the Employer in the Contract Data, or in another form approved by the Employer.

The Contractor shall ensure that the Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects. If the terms of the 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 extend the validity of the Performance Security until the Works have been completed and any defects have been remedied.

The Employer shall not make a claim under the Performance Security, except for amounts to which the Employer is entitled under the Contract.

The Employer shall indemnify and hold the Contractor harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from a claim under the Performance Security to the extent to which the Employer was not entitled to make the claim.

The Employer shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate.

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 increase, or may decrease, as the case may be, the value of the Performance Security in that currency by an equal percentage.

4.3 Contractor's Representative

The Contractor shall appoint the Contractor's Representative and shall give him all authority necessary to act on the Contractor's behalf under the Contract.

Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the Engineer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked in terms of Sub-Clause 6.9 [Contractor's Personnel], or if the appointed person fails to act as Contractor's Representative, the Contractor shall similarly submit the name and particulars of another suitable person for such appointment.

The Contractor shall not, without the prior consent of the Engineer, revoke the appointment of the Contractor's Representative or appoint a replacement.

The whole time of the Contractor's Representative shall be given to directing the Contractor's performance of the Contract. If the Contractor's Representative is to be temporarily absent from the Site during the execution of the Works, a suitable replacement person shall be appointed, subject to the Engineer's prior consent, and the Engineer shall be notified accordingly.

The Contractor's Representative shall, on behalf of the Contractor, receive instructions under Sub-Clause 3.3 [Instructions of the Engineer].

The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Engineer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.

The Contractor's Representative shall be fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language]. If the Contractor's Representative's delegates are not fluent in the said language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

4.4 Subcontractors

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. Unless otherwise stated in the Particular Conditions:

- (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;
- (b) The prior consent of the Engineer shall be obtained to other proposed Subcontractors;
- (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; and
- (d) Each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under Sub-Clause 4.5 [Assignment of Benefit of Subcontract] (if or when applicable) or in the event of termination under Sub-Clause 15.2 [Termination by Employer].

The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidential Details] apply equally to each Subcontractor.

Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.

4.5 Assignment of Benefit of Subcontract

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.

4.6 Co-operation

The Contractor shall, as specified in the Contract or as instructed by the Engineer, allow appropriate opportunities for carrying out work to:

- (a) The Employer's Personnel;
- (b) Any other contractors employed by the Employer; and
- (c) The personnel of any legally constituted public authorities;

who may be employed in the execution on or near the Site of any work not included in the Contract.

Any such instruction shall constitute a Variation if and to the extent that it causes the Contractor to suffer delays and/or 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.

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.

4.7 Setting Out

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.

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.

If the Contractor suffers delay and/or incurs Cost from executing work which was necessitated by an error in these items of reference, and an experienced contractor could not reasonably have discovered such error and avoided this delay and/or Cost, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

	<p>(a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and</p> <p>(b) Payment of any such Cost plus profit, which shall be included in the Contract Price.</p> <p>After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent the error could not reasonably have been discovered, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.</p>
4.8 Safety Procedures	<p>The Contractor shall:</p> <p>(a) Comply with all applicable safety regulations;</p> <p>(b) Take care for the safety of all persons entitled to be on the Site;</p> <p>(c) Use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons;</p> <p>(d) Provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 10 [Employer's Taking Over]; and</p> <p>(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>
4.9 Quality Assurance	<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>
4.10 Site Data	<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 Tender 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 Tender as to all relevant matters, including (without limitation):</p> <p>(a) The form and nature of the Site, including sub-surface conditions;</p> <p>(b) The hydrological and climatic conditions;</p> <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>
4.11 Sufficiency of the Accepted Contract Amount	<p>The Contractor shall be deemed to:</p> <p>(a) Have satisfied himself as to the correctness and sufficiency of the Accepted Contract Amount; and</p>

- (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 Sub-Clause 4.10 [Site Data].

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.

4.12 Unforeseeable Physical Conditions

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.

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.

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 13 [Variations and Adjustments] shall apply.

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 notice under Sub-Clause 20.1 [Contractor's Claims] to:

- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and
- (b) Payment of any such Cost, which shall be included in the Contract Price.

Upon receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.5 [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.

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 Tender. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with Sub-Clause 3.5 [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.

The Engineer shall take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Tender, which shall be made available by the Contractor, but shall not be bound by the Contractor's interpretation of any such evidence.

4.13 Rights of Way and Facilities

Unless otherwise specified in the Contract the Employer shall provide effective access to and possession of the Site including special and/or temporary rights-of-way which are necessary for the Works. The Contractor shall obtain, at his risk and cost, any additional rights of way or facilities outside the Site which he may require for the purposes of the Works.

4.14 Avoidance of Interference	<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. <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>
4.15 Access Route	<p>The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site at Base Date. 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.
4.16 Transport of Goods	<p>Unless otherwise stated in the Particular Conditions:</p> <ul style="list-style-type: none"> (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; (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 (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.
4.17 Contractor's Equipment	<p>The Contractor shall be responsible for all Contractor's 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>
4.18 Protection of the Environment	<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>
4.19 Electricity, Water and Gas	<p>The Contractor shall, except as stated below, be responsible for the provision of all power, water and other services he may require for his construction activities and to the extent defined in the Specifications, for the tests.</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</p>

- cost, provide any apparatus necessary for his use of these services and for measuring the quantities consumed.
- The quantities consumed and the amounts due (at these prices) for such services shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.
- 4.20 Employer's Equipment and Free-Issue Materials**
- 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:
- (a) The Employer shall be responsible for the Employer's Equipment; except that
 - (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.
- 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 Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.
- The Employer shall supply, free of charge, the "free-issue materials" (if any) in accordance with the details stated in the Specification. 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.
- After this visual inspection, the free-issue materials shall come under the care, custody and control of the Contractor. The Contractor's obligations of inspection, care, custody and control shall not relieve the Employer of liability for any shortage, defect or default not apparent from a visual inspection.
- 4.21 Progress Reports**
- Unless otherwise stated in the Particular Conditions, 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.
- 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.
- Each report shall include:
- (a) 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 5 [Nominated Subcontractors]);
 - (b) Photographs showing the status of manufacture and of progress on the Site;
 - (c) 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:
 - (i) Commencement of manufacture;
 - (ii) Contractor's inspections;
 - (iii) Tests; and
 - (iv) Shipment and arrival at the Site;
 - (d) The details described in Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment];

	<ul style="list-style-type: none"> (e) Copies of quality assurance documents, test results and certificates of Materials; (f) List of notices given under Sub-Clause 2.5 [Employer's Claims] and notices given under Sub-Clause 20.1 [Contractor's Claims]; (g) Safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and (h) Comparisons of actual and planned progress, 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.
4.22 Security of the Site	<p>Unless otherwise stated in the Particular Conditions:</p> <ul style="list-style-type: none"> (a) The Contractor shall be responsible for keeping unauthorised persons off the Site, and (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.
4.23 Contractor's Operations on Site	<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 additional 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. However, the Contractor may retain on Site, during the Defects Notification Period, such Goods as are required for the Contractor to fulfil obligations under the Contract.</p>
4.24 Fossils	<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 20.1 [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 8.4 [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 Sub-Clause 3.5 [Determinations] to agree or determine these matters.</p>

5. Nominated Subcontractors

5.1 Definition of "nominated Subcontractor"	<p>In the Contract, "nominated Subcontractor" means a Subcontractor:</p> <ul style="list-style-type: none"> (a) Who is stated in the Contract as being a nominated Subcontractor; or
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- (b) Whom the Engineer, under Clause 13 [Variations and Adjustments], instructs the Contractor to employ as a Subcontractor subject to Sub-Clause 5.2 [Objection to Notification].
- 5.2 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 in writing 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 nominated Subcontractor does not accept to indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, his agents and employees; or
 - (c) The nominated Subcontractor does not accept to enter into a subcontract which specifies 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;
 - (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; and
 - (iii) Be paid only if and when the Contractor has received from the Employer payments for sums due under the Subcontract referred to under Sub-Clause 5.3 [Payment to nominated Subcontractors].
- 5.3 Payments to nominated Subcontractors**
- The Contractor shall pay to the nominated Subcontractor the amounts shown on the nominated Subcontractor's invoices approved by the Contractor 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 sub-paragraph (b) of Sub-Clause 13.5 [Provisional Sums], except as stated in Sub-Clause 5.4 [Evidence of Payments].
- 5.4 Evidence of Payments**
- 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 all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:
- (a) Submits this reasonable evidence to the Engineer, or
 - (b)
 - (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,
- 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.

6. Staff and Labour

6.1 Engagement of Staff and Labour	<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, feeding, transport, and, when appropriate, housing.</p> <p>The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour with appropriate qualifications and experience from sources within the Country.</p>
6.2 Rates of Wages and Conditions of Labour	<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>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 tax 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.</p>
6.3 Persons in the Service of Employer	<p>The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst the Employer's Personnel.</p>
6.4 Labour Laws	<p>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.</p> <p>The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.</p>
6.5 Working Hours	<p>No work shall be carried out on the Site on locally recognised days of rest, or outside the normal working hours stated in the Contract Data, unless:</p> <ul style="list-style-type: none"> (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.
6.6 Facilities for Staff and Labour	<p>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.</p> <p>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.</p>
6.7 Health and Safety	<p>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 ambulance service are available 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. 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.</p> <p>The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make</p>

reports concerning health, safety and welfare of persons, and damage to property, as the Engineer may reasonably require.

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.

The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labour (including all the Contractor's employees, all Subcontractors and any other Contractor's or Employer's personnel 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 behaviour 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 labour as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counselling and referral to a dedicated national STI and HIV/AIDS programme, (unless otherwise agreed) of all Site staff and labour.

The Contractor shall include in the programme to be submitted for the execution of the Works under Sub-Clause 8.3 an alleviation programme 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 programme 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 programme shall detail the resources to be provided or utilised and any related sub-contracting proposed. The programme shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this programme shall not exceed the Provisional Sum dedicated for this purpose.

6.8 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 1.4 [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.

6.9 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 appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

6.10 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.
6.11	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.
6.12	Foreign Personnel	<p>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, 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.</p> <p>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.</p>
6.13	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.
6.14	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.
6.15	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 the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.
6.16	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 thereof by Contractor's Personnel.
6.17	Arms and Ammunition	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.
6.18	Festivals and Religious Customs	The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.
6.19	Funeral Arrangements	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.
6.20	Prohibition of Forced or Compulsory Labour	The Contractor shall not employ forced labour, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.
6.21	Prohibition of Harmful Child Labour	The Contractor shall not employ children in a manner that is economically exploitative, or is likely to be hazardous, 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. Where the relevant labour laws of the Country have provisions for employment of minors, the Contractor shall follow those laws applicable to the Contractor. Children below the age of 18 years shall not be employed in dangerous work.

- 6.22 Employment Records of Workers** 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 submitted to the Engineer. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment].
- 6.23 Workers' Organisations** In countries where the relevant labour laws recognise workers' rights to form and to join workers' organisations of their choosing without interference and to bargain collectively, the Contractor shall comply with such laws. Where the relevant labour laws substantially restrict workers' organisations, the Contractor shall enable alternative means for the Contractor's Personnel to express their grievances and protect their rights regarding working conditions and terms of employment. In either case described above, and where the relevant labour laws are silent, the Contractor shall not discourage the Contractor's Personnel from forming or joining workers' organisations of their choosing or from bargaining collectively, and shall not discriminate or retaliate against the Contractor's Personnel who participate, or seek to participate, in such organisations and bargain collectively. The Contractor shall engage with such workers' representatives. Workers' organisations are expected to fairly represent the workers in the workforce
- 6.24 Non-Discrimination and Equal Opportunity** The Contractor shall not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment relationship on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. In countries where the relevant labour laws provide for non-discrimination in employment, the Contractor shall comply with such laws. When the relevant labour laws are silent on non-discrimination in employment, the Contractor shall meet this Sub-Clause's requirements. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination.

7. Plant, Materials and Workmanship

- 7.1 Manner of Execution** The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works:
- In the manner (if any) specified in the Contract;
 - In a proper workmanlike and careful manner, in accordance with recognised good practice; and
 - With properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.
- 7.2 Samples** 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:
- Manufacturer's standard samples of Materials and samples specified in the Contract, all at the Contractor's cost; and
 - Additional samples instructed by the Engineer as a Variation.
- Each sample shall be labelled as to origin and intended use in the Works.
- 7.3 Inspection** The Employer's Personnel shall at all reasonable times:
- Have full access to all parts of the Site and to all places from which natural Materials are being obtained; and
 - 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.

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.

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.

7.4 Testing

This Sub-Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any).

Except as otherwise specified in the Contract, 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 13 [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 20.1 [Contractor's Claims] to:

- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and
- (b) Payment of any such Cost plus profit, which shall be included in the Contract Price.

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

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.

7.5 Rejection

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.

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 Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer.
- 7.6 Remedial Work** Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to:
- Remove from the Site and replace any Plant or Materials which is not in accordance with the Contract;
 - Remove and re-execute any other work which is not in accordance with the Contract; and
 - Execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise.
- 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 (c).
- 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 Sub-Clause 2.5 [Employer's Claims] pay to the Employer all costs arising from this failure.
- 7.7 Ownership of Plant and Materials** Except as otherwise provided in the Contract, 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:
- When it is incorporated in the Works;
 - When the Contractor is paid the corresponding value of the Plant and Materials under Sub-Clause 8.10 [Payment for Plant and Materials in Event of Suspension].
- 7.8 Royalties** Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:
- Natural Materials obtained from outside the Site, and
 - 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.
- 8. Commencement, Delays and Suspension**
- 8.1 Commencement of Works** Except as otherwise specified in the Particular Conditions of Contract, the Commencement Date shall be the date at which the following precedent conditions have all been fulfilled and the Engineer's notification recording the agreement of both Parties on such fulfilment and instructing to commence the Work is received by the Contractor:
- Signature of the Contract Agreement by both Parties, and if required, approval of the Contract by relevant authorities of the Country;
 - Delivery to the Contractor of reasonable evidence of the Employer's financial arrangements (under Sub-Clause 2.4 [Employer's Financial Arrangements]);
 - Except if otherwise specified in the Contract Data, effective access to and possession of the Site given to the Contractor together with such permission(s) under (a) of Sub-Clause 1.13 [Compliance with Laws] as required for the commencement of the Works,
 - Receipt by the Contractor of the Advance Payment under Sub-Clause 14.2 [Advance Payment] provided that the corresponding bank guarantee has been delivered by the Contractor.
- If the said Engineer's instruction is not received by the Contractor within 180 days from his receipt of the Letter of Acceptance, the Contractor shall be entitled to terminate the Contract under Sub-Clause 16.2 [Termination by Contractor].

		<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>
8.2	Time for Completion	<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 the Works or Section to be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections].
8.3	Programme	<p>The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under Sub-Clause 8.1 [Commencement of Works]. 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 5 [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 13.3 [Variation Procedure].</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 in accordance with this Sub-Clause.</p>
8.4	Extension of Time for Completion	<p>The Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 10.1 [Taking Over of the Works and Sections] is or will be delayed by any of the following causes:</p>

- (a) A Variation (unless an adjustment to the Time for Completion has been agreed under Sub-Clause 13.3 [Variation Procedure]) or other substantial change in the quantity of an item of work included in the Contract;
- (b) A cause of delay giving an entitlement to extension of time under a Sub-Clause of these Conditions;
- (c) Exceptionally adverse climatic conditions;
- (d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions; or
- (e) 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 20.1 [Contractor's Claims]. When determining each extension of time under Sub-Clause 20.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

8.5 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 subparagraph (b) of Sub-Clause 8.4 [Extension of Time for Completion].

8.6 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 8.3 [Programme];

other than as a result of a cause listed in Sub-Clause 8.4 [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under Sub-Clause 8.3 [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 notice under Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under Sub-Clause 8.7 below.

Additional costs of revised methods including acceleration measures, instructed by the Engineer to reduce delays resulting from causes listed under Sub-Clause 8.4 [Extension of Time for Completion] shall be paid by the Employer, without generating, however, any other additional payment benefit to the Contractor.

8.7 Delay Damages

If the Contractor fails to comply with Sub-Clause 8.2 [Time for Completion], the Contractor shall subject to notice under Sub-Clause 2.5 [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.

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 15.2 [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.

8.8 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 8.9, 8.10 and 8.11 shall not apply.
8.9 Consequences of Suspension	<p>If the Contractor suffers delay and/or incurs Cost from complying with the Engineer's instructions under Sub-Clause 8.8 [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 20.1 [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 8.4 [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 Sub-Clause 3.5 [Determinations] to agree or determine these matters.</p> <p>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 8.8 [Suspension of Work].</p>
8.10 Payment for Plant and Materials in Event of Suspension	<p>The Contractor shall be entitled to payment of the value (as at the date of suspension) of Plant and/or Materials which have not been delivered to Site, if:</p> <ul style="list-style-type: none"> (a) The work on Plant or delivery of Plant and/or Materials has been suspended for more than 28 days; and (b) The Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Engineer's instructions.
8.11 Prolonged Suspension	If the suspension under Sub-Clause 8.8 [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 13 [Variations and Adjustments] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under Sub-Clause 16.2 [Termination by Contractor].
8.12 Resumption of Work	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 after receiving from the Engineer an instruction to this effect under Clause 13 [Variations and Adjustments].
9. Tests on Completion	
9.1 Contractor's Obligations	<p>The Contractor shall carry out the Tests on Completion in accordance with this Clause and Sub-Clause 7.4 [Testing], after providing the documents in accordance with sub-paragraph (d) of Sub-Clause 4.1 [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>

9.2 Delayed Tests

If the Tests on Completion are being unduly delayed by the Employer, Sub-Clause 7.4 [Testing] (fifth paragraph) and/or Sub-Clause 10.3 [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.

9.3 Retesting

If the Works, or a Section, fail to pass the Tests on Completion, Sub-Clause 7.5 [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.

9.4 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated under Sub-Clause 9.3 [Retesting], the Engineer shall be entitled to:

- (a) Order further repetition of Tests on Completion under Sub-Clause 9.3 [Retesting];
- (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 Sub-Clause 11.4 [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 Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations].

10. Employer's Taking Over**10.1 Taking Over of the Works and Sections**

Except as stated in Sub-Clause 9.4 [Failure to Pass Tests on Completion], the Works shall be taken over by the Employer when (i) the Works have been completed in accordance with the Contract, including the matters described in Sub-Clause 8.2 [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.

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.

The Engineer shall, within 28 days after receiving the Contractor's application:

- (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
- (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

	<p>Contractor shall then complete this work before issuing a further notice under this Sub-Clause.</p> <p>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.</p>
10.2 Taking Over of Parts of the Works	<p>The Engineer may, at the sole discretion of the Employer, issue a Taking-Over Certificate for any part of the Permanent Works.</p> <p>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:</p> <ol style="list-style-type: none"> The part which is used shall be deemed to have been taken over as from the date on which it is used; 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 If requested by the Contractor, the Engineer shall issue a Taking-Over Certificate for this part. <p>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.</p> <p>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 20.1 [Contractor's Claims] to payment of any such Cost plus profit, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this Cost and profit.</p> <p>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 Sub-Clause 3.5 [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 8.7 [Delay Damages] and shall not affect the maximum amount of these damages.</p>
10.3 Interference with Tests on Completion	<p>If the Contractor is prevented, for more than 14 days, from carrying out the Tests on Completion by a cause for which the Employer is 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 20.1 [Contractor's Claims] to:</p>

- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and
- (b) Payment of any such Cost plus profit, which shall be included in the Contract Price.

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

10.4 Surfaces Requiring Reinstatement

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.

11. Defects Liability

11.1 Completion of Outstanding Work and Remedying Defects

In order that the Works and Contractor's Documents, and each Section, shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the relevant Defects Notification Period or as soon as practicable thereafter, the Contractor shall:

- (a) Complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is instructed by the Engineer; and
- (b) Execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of the Defects Notification Period for the Works or Section (as the case may be).

If a defect appears or damage occurs, the Contractor shall be notified accordingly, by (or on behalf of) the Employer.

11.2 Cost of Remedying Defects

All work referred to in sub-paragraph (b) of Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects] shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to:

- (a) Any design for which the Contractor is responsible;
- (b) Plant, Materials or workmanship not being in accordance with the Contract; or
- (c) Failure by the Contractor to comply with any other obligation.

If and to the extent that such work is attributable to any other cause, the Contractor shall be notified promptly by (or on behalf of) the Employer, and Sub-Clause 13.3 [Variation Procedure] shall apply.

11.3 Extension of Defects Notification Period

The Employer shall be entitled subject to Sub-Clause 2.5 [Employer's Claims] to an extension of the Defects Notification Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or by reason of damage attributable to the Contractor. However, a Defects Notification Period shall not be extended by more than two years.

If delivery and/or erection of Plant and/or Materials was suspended under Sub-Clause 8.8 [Suspension of Work] or Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work], the Contractor's obligations under this Clause shall not apply to any defects or damage occurring more than two years after the Defects Notification Period for the Plant and/or Materials would otherwise have expired.

11.4 Failure to Remedy Defects

If the Contractor fails to remedy any defect or damage within a reasonable time, a date may be fixed by (or on behalf of) the Employer, on or by which the defect or damage is to be remedied. The Contractor shall be given reasonable notice of this date.

If the Contractor fails to remedy the defect or damage by this notified date and this remedial work was to be executed at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Employer may (at his option):

- (a) Carry out the work himself or by others, in a reasonable manner and at the Contractor's cost, but the Contractor shall have no responsibility for this work; and the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to

	the Employer the costs reasonably incurred by the Employer in remedying the defect or damage;
	(b) Require the Engineer to agree or determine a reasonable reduction in the Contract Price in accordance with Sub-Clause 3.5 [Determinations]; or
	(c) If the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works, terminate the Contract as a whole, or in respect of such major part which cannot be put to the intended use. Without prejudice to any other rights, under the Contract or otherwise, the Employer shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), plus financing costs and the cost of dismantling the same, clearing the Site and returning Plant and Materials to the Contractor.
11.5 Removal of Defective Work	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.
11.6 Further Tests	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. 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 Sub-Clause 11.2 [Cost of Remedying Defects], for the cost of the remedial work.
11.7 Right of Access	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.
11.8 Contractor to Search	The Contractor shall, if required by the Engineer, search for the cause of any defect, under the direction of the Engineer. Unless the defect is to be remedied at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Cost of the search plus profit shall be agreed or determined by the Engineer in accordance with Sub-Clause 3.5 [Determinations] and shall be included in the Contract Price.
11.9 Performance Certificate	Performance of the Contractor's obligations shall not be considered to have been completed until the Engineer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract. The Engineer 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. A copy of the Performance Certificate shall be issued to the Employer. Only the Performance Certificate shall be deemed to constitute acceptance of the Works.
11.10 Unfulfilled Obligations	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 determining the nature and extent of unperformed obligations, the Contract shall be deemed to remain in force.
11.11 Clearance of Site	Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site. If all these items have not been removed within 28 days after receipt by the Contractor 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. 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.

12. Measurement and Evaluation

12.1 Works to be Measured

The Works shall be measured, and valued for payment, in accordance with this Clause. The Contractor shall show in each application under Sub-Clauses 14.3 [Application for Interim Payment Certificates], 14.10 [Statement on Completion] and 14.11 [Application for Final Payment Certificate] the quantities and other particulars detailing the amounts which he considers to be entitled under the Contract.

Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:

- (a) Promptly either attend or send another qualified representative to assist the Engineer in making the measurement; and
- (b) Supply any particulars requested by the Engineer.

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.

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.

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 and certify the payment of the undisputed part. 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.

12.2 Method of Measurement

Except as otherwise stated in the Contract and notwithstanding local practice:

- (a) Measurement shall be made of the net actual quantity of each item of the Permanent Works; and
- (b) The method of measurement shall be in accordance with the Bill of Quantities or other applicable Schedules.

12.3 Evaluation

Except as otherwise stated in the Contract, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the Contract Price by evaluating each item of work, applying the measurement agreed or determined in accordance with the above Sub-Clauses 12.1 and 12.2 and the appropriate rate or price for the item.

For each item of work, the appropriate rate or price for the item shall be the rate or price specified for such item in the Contract or, if there is no such item, specified for similar work.

Any item of work included in the Bill of Quantities for which no rate or price was specified shall be considered as included in other rates and prices in the Bill of Quantities and will not be paid for separately.

However, a new rate or price shall be appropriate for an item of work if:

- (a)
 - (i) The measured quantity of the item is changed by more than 25% from the quantity of this item in the Bill of Quantities or other Schedule;
 - (ii) This change in quantity multiplied by such specified rate for this item exceeds 0.25% of the Accepted Contract Amount;
 - (iii) This change in quantity directly changes the Cost per unit quantity of this item by more than 1%; and

- (iv) This item is not specified in the Contract as a "fixed rate item";
- or
- (b)
- (i) The work is instructed under Clause 13 [Variations and Adjustments];
 - (ii) No rate or price is specified in the Contract for this item; and
 - (iii) No specified rate or price is appropriate because the item of work is not of similar character, or is not executed under similar conditions, as any item in the Contract.

Each new rate or price shall be derived from any relevant rates or prices in the Contract, with reasonable adjustments to take account of the matters described in subparagraph (a) and/or (b), as applicable. If no rates or prices are relevant for the derivation of a new rate or price, it shall be derived from the reasonable Cost of executing the work, together with profit, taking account of any other relevant matters. Until such time as an appropriate rate or price is agreed or determined, the Engineer shall determine a provisional rate or price for the purposes of Interim Payment Certificates as soon as the concerned work commences.

12.4 Omissions

Whenever the omission of any work forms part (or all) of a Variation, the value of which has not been agreed, if:

- (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;
- (b) The omission of the work will result (or has resulted) in this sum not forming part of the Contract Price; and
- (c) This cost is not deemed to be included in the evaluation of any substituted work; then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this cost, which shall be included in the Contract Price.

13. Variations and Adjustments

13.1 Right to Vary

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

The Contractor shall execute and be bound by each Variation, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that (i) the Contractor cannot readily obtain the Goods required for the Variation, or (ii) such Variation triggers a substantial change in the sequence or progress of the Works. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

Each Variation may include:

- (a) Changes to the quantities of any item of work included in the Contract (however, such changes do not necessarily constitute a Variation);
- (b) Changes to the quality and other characteristics of any item of work;
- (c) Changes to the levels, positions and/or dimensions of any part of the Works;
- (d) Omission of any work unless it is to be carried out by others;
- (e) Any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work; or
- (f) Changes to the sequence or timing of the execution of the Works.

The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation.

13.2 Value Engineering

The Contractor may, at any time, submit to the Engineer a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer of executing, maintaining or operating the Works, (iii) improve the

efficiency or value to the Employer of the completed Works, or (iv) otherwise be of benefit to the Employer.

The proposal shall be prepared at the cost of the Contractor and shall include the items listed in Sub-Clause 13.3 [Variation Procedure].

If a proposal, which is approved by the Engineer, includes a change in the design of part of the Permanent Works, then unless otherwise agreed by both Parties:

- (a) The Contractor shall design this part;
- (b) Sub-paragraphs (a) to (d) of Sub-Clause 4.1 [Contractor's General Obligations] shall apply; and
- (c) If this change results in a reduction in the contract value of this part, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine a fee, which shall be included in the Contract Price. This fee shall be half (50%) of the difference between the following amounts:
 - (i) Such reduction in contract value, resulting from the change, excluding adjustments under Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost]; and
 - (ii) The reduction (if any) in the value to the Employer of the varied works, taking account of any reductions in quality, anticipated life or operational efficiencies.

However, if amount (i) is less than amount (ii), there shall not be a fee.

13.3 Variation Procedure

If the Engineer requests a proposal, prior to instructing a Variation, the Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

- (a) A description of the proposed work to be performed and a programme for its execution;
- (b) The Contractor's proposal for any necessary modifications to the programme according to Sub-Clause 8.3 [Programme] and to the Time for Completion; and
- (c) The Contractor's proposal for evaluation of the Variation.

The Engineer shall, as soon as practicable after receiving such proposal (under Sub-Clause 13.2 [Value Engineering] or otherwise), respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.

Each instruction to execute a Variation, with any requirements for the recording of Costs, shall be issued by the Engineer to the Contractor, who shall acknowledge receipt.

Each Variation shall be evaluated in accordance with Clause 12 [Measurement and Evaluation], unless the Engineer instructs or approves otherwise in accordance with this Clause.

13.4 Payment in Applicable Currencies

If the Contract provides for payment of the Contract Price in more than one currency, then whenever an adjustment is agreed, approved or determined as stated above, the amount payable in each of the applicable currencies shall be specified. For this purpose, reference shall be made to the actual or expected currency proportions of the Cost of the varied work, and to the proportions of various currencies specified for payment of the Contract Price.

13.5 Provisional Sums

Each Provisional Sum shall only be used, in whole or in part, in accordance with the Engineer's instructions, and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Engineer shall have instructed. For each Provisional Sum, the Engineer may instruct:

- (a) Work to be executed (including Plant, Materials or services to be supplied) by the Contractor and valued under Sub-Clause 13.3 [Variation Procedure]; and/or
- (b) Plant, Materials or services to be purchased by the Contractor, from a nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]) or otherwise; and for which there shall be included in the Contract Price:

- (i) The actual amounts paid (or due to be paid) by the Contractor; and
- (ii) A sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant percentage rate (if any) stated in the appropriate Schedule. If there is no such rate, the percentage rate stated in the Contract Data shall be applied.
- The Contractor shall, when required by the Engineer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.
- 13.6 Day-work** For work of a minor or incidental nature, the Engineer may instruct that a Variation shall be executed on a daywork basis. The work shall then be valued in accordance with the Daywork Schedule included in the Contract, and the following procedure shall apply. If a Daywork Schedule is not included in the Contract, this Sub-Clause shall not apply. Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.
- Except for any items for which the Daywork Schedule specifies that payment is not due, the Contractor shall deliver each day to the Engineer accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:
- (a) The names, occupations and time of Contractor's Personnel;
- (b) The identification, type and time of Contractor's Equipment and Temporary Works; and
- (c) The quantities and types of Plant and Materials used.
- One copy of each statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Engineer, prior to their inclusion in the next Statement under Sub-Clause 14.3 [Application for Interim Payment Certificates].
- 13.7 Adjustments for Changes in Legislation** The 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 20.1 [Contractor's Claims] to:
- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [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 Sub-Clause 3.5 [Determinations] to agree or determine these matters.
- Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in the determination of a previous extension of time 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 13.8 [Adjustments for Changes in Cost].
- 13.8 Adjustments for Changes in Cost** In this Sub-Clause, "table of adjustment data" means the completed table of adjustment data for local and foreign currencies included in the Schedules. If there is no such table of adjustment data, this Sub-Clause shall not apply.
- If this Sub-Clause applies, 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.

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 for each of the currencies 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 general type:

$P_n = a + b \frac{L_n}{L_o} + c \frac{E_n}{E_o} + d \frac{M_n}{M_o} + \dots$ where:

" P_n " is the adjustment multiplier to be applied to the estimated contract value in the relevant currency of the work carried out in period " n ", this period being a month unless otherwise stated in the Contract Data;

" a " is a fixed coefficient, stated in the relevant table of adjustment data, representing the non-adjustable portion in contractual payments;

" b ", " c ", " d ", ... are coefficients representing the estimated proportion of each cost element related to the execution of the Works, as stated in the relevant table of adjustment data; such tabulated cost elements may be indicative of resources such as labour, equipment and materials;

" L_n ", " E_n ", " M_n ", ... are the current cost indices or reference prices for period " n ", expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 49 days prior to the last day of the period (to which the particular Payment Certificate relates); and

" L_o ", " E_o ", " M_o ", ... are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

The cost indices or reference prices stated in the table of adjustment data shall be used. If their source is in doubt, it shall be determined by the Engineer. For this purpose, reference shall be made to the values of the indices at stated dates for the purposes of clarification of the source; although these dates (and thus these values) may not correspond to the base cost indices.

In cases where the "currency of index" is not the relevant currency of payment, each index shall be converted into the relevant currency of payment at the selling rate, established by the central bank of the Country, of this relevant currency on the above date for which the index is required to be applicable.

Until such time as each current cost index is available, the Engineer shall determine a provisional index for the issue of Interim Payment Certificates. When a current cost index is available, the adjustment shall be recalculated accordingly.

If the Contractor fails to complete the Works within the Time for Completion, adjustment of prices thereafter shall be made using either (i) each index or price applicable on the date 49 days prior to the expiry of the Time for Completion of the Works, or (ii) the current index or price, whichever is more favourable to the Employer.

The weightings (coefficients) for each of the factors of cost stated in the table(s) of adjustment data shall only be adjusted if they have been rendered unreasonable, unbalanced or inapplicable, as a result of Variations.

14. Contract Price and Payment

14.1 The Contract Price

Unless otherwise stated in the Particular Conditions:

- (a) The Contract Price shall be agreed or determined under Sub-Clause 12.3 [Evaluation] 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 13.7 [Adjustments for Changes in Legislation];

- (c) Any quantities which may be set out in the Bill of Quantities or other Schedule are estimated quantities and are not to be taken as the actual and correct quantities:
 - (i) Of the Works which the Contractor is required to execute, or
 - (ii) For the purposes of Clause 12 [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. The Engineer may take account of the breakdown when preparing Payment Certificates, but shall not be bound by it.

Notwithstanding the provisions of subparagraph (b), Contractor's Equipment, including essential spare parts therefor, imported by the Contractor for the sole purpose of executing the Contract shall be exempt from the payment of import duties and taxes upon importation.

14.2 Advance Payment

The Employer shall make an advance payment, as an interest-free loan for mobilisation and cash flow support, 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.

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.

The Engineer shall deliver to the Employer and to the Contractor an Interim Payment Certificate for the advance payment or its first instalment after receiving a Statement (under Sub-Clause 14.3 [Application for Interim Payment Certificates]) and after the Employer receives (i) the Performance Security in accordance with Sub-Clause 4.2 [Performance Security] and (ii) a guarantee in amounts and currencies equal to the advance payment. This guarantee shall be issued by a reputable bank or financial institution selected by the Contractor and shall be in the form annexed to the Particular Conditions or in another form approved by the Employer.

The Contractor shall ensure that the guarantee is valid and enforceable until the advance payment has been repaid, but its amount shall 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.

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 14.6 [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 and deductions and repayments of retention) exceeds 30 percent (30%) of the Accepted Contract Amount less Provisional Sums; and
- (b) Deductions shall be made at the amortisation rate stated in the Contract Data of the amount of each Interim Payment Certificate (excluding the advance payment and deductions for its repayments as well as deductions for retention money) in the currencies and proportions of the advance payment until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid prior to the time when 90 percent (90%) of the Accepted Contract Amount less Provisional Sums has been certified for payment.

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 15 [Termination by Employer], Clause 16 [Suspension and Termination by Contractor] or Clause 19 [Force Majeure] (as the case may be), the whole of the balance then outstanding shall immediately become due and in case of termination under Clause 15 [Termination by

14.3 Application for Interim Payment Certificates

Employer], except for Sub-Clause 15.5 [Employer's Entitlement to Termination for Convenience], payable by the Contractor to the Employer.

The Contractor shall submit a Statement in six copies to 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 Sub-Clause 4.21 [Progress Reports].

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 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [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 for the advance payment and (if more than one instalment) and to be deducted for its repayments in accordance with Sub-Clause 14.2 [Advance Payment];
- (e) Any amounts to be added and deducted for Plant and Materials in accordance with Sub-Clause 14.5 [Plant and 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 20 [Claims, Disputes and Arbitration]; and
- (g) The deduction of amounts certified in all previous Payment Certificates.

14.4 Schedule of Payments

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

- (a) The instalments quoted in this schedule of payments shall be the estimated contract values for the purposes of sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates];
- (b) Sub-Clause 14.5 [Plant and Materials intended for the Works] shall not apply; and
- (c) If these instalments are not defined by reference to the actual progress achieved in executing the Works, and if actual progress is found to be less or more than that on which this schedule of payments was based, then the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine revised instalments, which shall take account of the extent to which progress is less or more than that on which the instalments 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.

14.5 Plant and Materials intended for the Works

If this Sub-Clause applies, Interim Payment Certificates shall include, under sub-paragraph (e) of Sub-Clause 14.3, (i) an amount for Plant and Materials which have been sent to the Site for incorporation in the Permanent Works, and (ii) a reduction when the contract value of such Plant and Materials is included as part of the Permanent Works under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates].

If the lists referred to in sub-paragraphs (b)(i) or (c)(i) below are not included in the Schedules, this Sub-Clause shall not apply.

The Engineer shall determine and certify each addition if the following conditions are satisfied:

(a) The Contractor has:

- (i) Kept satisfactory records (including the orders, receipts, Costs and use of Plant and Materials) which are available for inspection; and
- (ii) Submitted a statement of the Cost of acquiring and delivering the Plant and Materials to the Site, supported by satisfactory evidence;

and either:

(b) The relevant Plant and Materials:

- (i) Are those listed in the Schedules for payment when shipped;
- (ii) Have been shipped to the Country, en route to the Site, in accordance with the Contract; and
- (iii) Are described in a clean shipped bill of lading or other evidence of shipment, which has been submitted to the Engineer together with evidence of payment of freight and insurance, any other documents reasonably required, and a bank guarantee in a form and issued by an entity approved by the Employer in amounts and currencies equal to the amount due under this Sub-Clause: this guarantee may be in a similar form to the form referred to in Sub-Clause 14.2 [Advance Payment] and shall be valid until the Plant and Materials are properly stored on Site and protected against loss, damage or deterioration;

or

(c) The relevant Plant and Materials:

- (i) Are those listed in the Schedules for payment when delivered to the Site; and
- (ii) Have been delivered to and are properly stored on the Site, are protected against loss, damage or deterioration, and appear to be in accordance with the Contract.

The additional amount to be certified shall be the equivalent of eighty percent (80%) of the Engineer's determination of the cost of the Plant and Materials (including delivery to Site), taking account of the documents mentioned in this Sub-Clause and of the contract value of the Plant and Materials.

The currencies for this additional amount shall be the same as those in which payment will become due when the contract value is included under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates]. At that time, the Payment Certificate shall include the applicable reduction which shall be equivalent to, and in the same currencies and proportions as, this additional amount for the relevant Plant and Materials.

14.6 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 28 days after receiving a Statement and supporting documents, deliver to the Employer and to the Contractor an Interim Payment Certificate which shall state the amount which the Engineer fairly determines to be due, with all supporting particulars for any reduction or withholding made by the Engineer on the Statement if any.

However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue an 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 any thing 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.

14.7 Payment

The Employer shall pay to the Contractor:

- (a) The first instalment of the advance payment within 42 days after issuing the Letter of Acceptance or within 21 days after receiving the documents in accordance with Sub-Clause 4.2 [Performance Security] and Sub-Clause 14.2 [Advance Payment], whichever is later;
- (b) The amount certified in each Interim Payment Certificate within 56 days after the Engineer receives the Statement and supporting documents; or, at a time when the Bank's loan or credit (from which part of the payments to the Contractor is being made) is suspended, the amount shown on any statement submitted by the Contractor within 14 days after such statement is submitted, any discrepancy being 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, at a time when the Bank's loan or credit (from which part of the payments to the Contractor is being made) is suspended, the undisputed amount shown in the Final Statement within 56 days after the date of notification of the suspension in accordance with Sub-Clause 16.2 [Termination by Contractor].

Payment of the amount due in each currency shall be made into the bank account, nominated by the Contractor, in the payment country (for this currency) specified in the Contract.

14.8 Delayed Payment

If the Contractor does not receive payment in accordance with Sub-Clause 14.7 [Payment], the Contractor shall be entitled to receive financing charges 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 14.7 [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 Particular Conditions, these financing charges shall be calculated at the annual rate of three percentage points above the discount rate of the central bank in the country of the currency of payment, or if not available, the interbank offered rate, and shall be paid in such currency.

The Contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy.

14.9 Payment of Retention Money

When the Taking-Over Certificate has been issued for the Works, the first half of the Retention Money shall be certified by the Engineer for payment to the Contractor. If a Taking-Over Certificate is issued for a Section or part of the Works, a proportion of the Retention Money shall be certified and paid. This proportion shall be half (50%) of the proportion calculated by dividing the estimated contract value of the Section or part, by the estimated final Contract Price.

Promptly after the latest of the expiry dates of the Defects Notification Periods, the outstanding balance of the Retention Money shall be certified by the Engineer for payment to the Contractor. If a Taking-Over Certificate was issued for a Section, a proportion of the second half of the Retention Money shall be certified and paid promptly

after the expiry date of the Defects Notification Period for the Section. This proportion shall be half (50%) of the proportion calculated by dividing the estimated contract value of the Section by the estimated final Contract Price.

However, if any work remains to be executed under Clause 11 [Defects Liability], the Engineer shall be entitled to withhold certification of the estimated cost of this work until it has been executed.

When calculating these proportions, no account shall be taken of any adjustments under Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost].

Unless otherwise stated in the Particular Conditions, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment by the Engineer, the Contractor shall be entitled to substitute a guarantee, in the form annexed to the Particular Conditions or in another form approved by the Employer and issued by a reputable bank or financial institution selected by the Contractor, for the second half of the Retention Money. The Contractor shall ensure that the guarantee is in the amounts and currencies of the second half of the Retention Money and is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects, as specified for the Performance Security in Sub-Clause 4.2. On receipt by the Employer of the required guarantee, the Engineer shall certify and the Employer shall pay the second half of the Retention Money. The release of the second half of the Retention Money against a guarantee shall then be in lieu of the release under the second paragraph of this Sub-Clause. The Employer shall return the guarantee to the Contractor within 21 days after receiving a copy of the Performance Certificate.

If the Performance Security required under Sub-Clause 4.2 is in the form of a demand guarantee, and the amount guaranteed under it when the Taking-Over Certificate is issued is more than half of the Retention Money, then the Retention Money guarantee will not be required. If the amount guaranteed under the Performance Security when the Taking-Over Certificate is issued is less than half of the Retention Money, the Retention Money guarantee will only be required for the difference between half of the Retention Money and the amount guaranteed under the Performance Security.

14.10 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 14.3 [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 14.6 [Issue of Interim Payment Certificates].

14.11 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 with supporting documents 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, the Contractor shall submit such further information as the Engineer may reasonably require within 28 days from receipt of said draft 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 20.4 [Obtaining Dispute Board's Decision] or Sub-Clause 20.5 [Amicable Settlement], the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.
- 14.12 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.
- 14.13 Issue of Final Payment Certificate** Within 28 days after receiving the Final Statement and discharge in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall deliver, to the Employer and to the Contractor, 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 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [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.
- 14.14 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 14.10 [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.
- 14.15 Currencies of Payment** The Contract Price shall be paid in the currency or currencies named in the Schedule of Payment Currencies. If more than one currency is so named, payments shall be made as follows:
- (a) If the Accepted Contract Amount was expressed in Local Currency only:
 - (i) The proportions or amounts of the Local and Foreign Currencies, and the fixed rates of exchange to be used for calculating the payments, shall be as stated in the Schedule of Payment Currencies, except as otherwise agreed by both Parties;
 - (ii) Payments and deductions under Sub-Clause 13.5 [Provisional Sums] and Sub-Clause 13.7 [Adjustments for Changes in Legislation] shall be made in the applicable currencies and proportions; and
 - (iii) Other payments and deductions under sub-paragraphs (a) to (d) of Sub-Clause 14.3 [Application for Interim Payment Certificates] shall be made in the currencies and proportions specified in sub-paragraph (a)(i) above;

- (b) Payment of the damages specified in the Contract Data, shall be made in the currencies and proportions specified in the Schedule of Payment Currencies;
- (c) Other payments to the Employer by the Contractor shall be made in the currency in which the sum was expended by the Employer, or in such currency as may be agreed by both Parties;
- (d) If any amount payable by the Contractor to the Employer in a particular currency exceeds the sum payable by the Employer to the Contractor in that currency, the Employer may recover the balance of this amount from the sums otherwise payable to the Contractor in other currencies; and
- (e) If no rates of exchange are stated in the Schedule of Payment Currencies, they shall be those prevailing on the Base Date and determined by the central bank of the Country.

15. Termination by Employer

15.1 Notice to Correct If the Contractor fails to carry out any obligation under the Contract, the Engineer may by notice require the Contractor to make good the failure and to remedy it within a specified reasonable time.

15.2 Termination by Employer The Employer shall be entitled to terminate the Contract if the Contractor:

- (a) Fails to comply with Sub-Clause 4.2 [Performance Security] or with a notice under Sub-Clause 15.1 [Notice to Correct];
- (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:
 - (i) To proceed with the Works in accordance with Clause 8 [Commencement, Delays and Suspension]; or
 - (ii) To comply with a notice issued under Sub-Clause 7.5 [Rejection] or Sub-Clause 7.6 [Remedial Work], within 28 days after receiving it;
- (d) Subcontracts the whole of the Works or assigns the Contract without the required agreement;
- (e) Becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against 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
- (f) 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 (f). However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination.

In any of these events or circumstances, the Employer may, upon giving 14 days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site. However, in the case of sub-paragraph (e) or (f), the Employer may by notice terminate the Contract immediately.

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 then leave the Site and deliver any required Goods, all Contractor's Documents, and other design documents made by or for him, to the Engineer. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice (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.
- The Employer shall then give notice that the Contractor's Equipment and Temporary Works will be released to the Contractor at or near the Site. The Contractor shall promptly arrange their removal, at the risk and cost of the Contractor. However, if by this time the Contractor has failed to make a payment due to the Employer, these items may be sold by the Employer in order to recover this payment. Any balance of the proceeds shall then be paid to the Contractor.
- 15.3 Valuation at Date of Termination** As soon as practicable after a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Engineer shall proceed in accordance with Sub-Clause 3.5 [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.
- 15.4 Payment after Termination** After a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Employer may:
- (a) Proceed in accordance with Sub-Clause 2.5 [Employer's Claims];
 - (b) Withhold further payments to the Contractor until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any), and all other costs incurred by the Employer, have been established; and/or
 - (c) Recover from the Contractor any losses and damages incurred by the Employer and any extra costs of completing the Works, after allowing for any sum due to the Contractor under Sub-Clause 15.3 [Valuation at Date of Termination]. After recovering any such losses, damages and extra costs, the Employer shall pay any balance to the Contractor.
- 15.5 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 under Clause 16.2 [Termination by Contractor]. After this termination, the Contractor shall proceed in accordance with Sub-Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment] and shall be paid in accordance with Sub-Clause 16.4 [Payment on Termination].
- 15.6 Corrupt or Fraudulent Practices** If the Employer determines, based on reasonable evidence, 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 Contract and expel him from the Site, and the provisions of Clause 15 shall apply as if such termination had been made under Sub-Clause 15.2 [Termination by Employer].
- Should any employee of the Contractor be determined, based on reasonable evidence, to have engaged in corrupt, fraudulent or coercive practice during the execution of the work then that employee shall be removed in accordance with Sub-Clause 6.9 [Contractor's Personnel].
- For the purposes of this Sub-Clause:
- (i) "Corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;
 - (ii) "Fraudulent practice" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

- (iii) "Collusive practice" is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;
- (iv) "Coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;
- (v) "Obstructive practice" is
 - (i) Deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or
 - (ii) Acts intended to materially impede the exercise of the Bank's inspection and audit rights provided for under Sub-Clause 1.15 [Inspections and Audits by the Bank].

16. Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

If the Engineer fails to certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates] or the Employer fails to comply with Sub-Clause 2.4 [Employer's Financial Arrangements] or Sub-Clause 14.7 [Payment], the Contractor may, after giving not less than 21 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment, as the case may be and as described in the notice.

Notwithstanding the above, if the Bank has suspended disbursements under the loan or credit from which payments to the Contractor are being made, in whole or in part, for the execution of the Works, and no alternative funds are available as provided for in Sub-Clause 2.4 [Employer's Financial Arrangements], the Contractor may by notice suspend work or reduce the rate of work at any time, but not less than 7 days after the Borrower having received the suspension notification from the Bank.

The Contractor's action shall not prejudice his entitlements to financing charges under Sub-Clause 14.8 [Delayed Payment] and to termination under Sub-Clause 16.2 [Termination by Contractor].

If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in the relevant Sub-Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.

If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Sub-Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and
- (b) Payment of any such Cost plus profit, which shall be included in the Contract Price.

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

16.2 Termination by Contractor

The Contractor shall be entitled to terminate the Contract if:

- (a) The Contractor does not receive the reasonable evidence within 42 days after giving notice under Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work] in respect of a failure to comply with Sub-Clause 2.4 [Employer's Financial Arrangements];

- (b) The Engineer fails, within 56 days after receiving a Statement and supporting documents, to issue the relevant Payment Certificate;
- (c) The Contractor does not receive the amount due under an Interim Payment Certificate within 42 days after the expiry of the time stated in Sub-Clause 14.7 [Payment] within which payment is to be made (except for deductions in accordance with Sub-Clause 2.5 [Employer's Claims]);
- (d) The Employer substantially fails to perform his obligations under the Contract in such manner as to materially and adversely affect the economic balance of the Contract and/or the ability of the Contractor to perform the Contract;
- (e) The Employer fails to comply with Sub-Clause 1.6 [Contract Agreement] or Sub-Clause 1.7 [Assignment];
- (f) A prolonged suspension affects the whole of the Works as described in Sub-Clause 8.11 [Prolonged Suspension]; or
- (g) The Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against 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;
- (h) The Contractor does not receive the Engineer's instruction recording the agreement of both Parties on the fulfilment of the conditions for the Commencement of Works under Sub-Clause 8.1 [Commencement of Works].

In any of these events or circumstances, the Contractor may, upon giving 14 days' notice to the Employer, terminate the Contract. However, in the case of sub-paragraph (f) or (g), the Contractor may by notice terminate the Contract immediately.

In the event the Bank suspends the loan or credit from which part or whole of the payments to the Contractor are being made, if the Contractor has not received the sums due to him upon expiration of the 14 days referred to in Sub-Clause 14.7 [Payment] for payments under Interim Payment Certificates, the Contractor may, without prejudice to the Contractor's entitlement to financing charges under Sub-Clause 14.8 [Delayed Payment], take one of the following actions, namely (i) suspend work or reduce the rate of work under Sub-Clause 16.1 above, or (ii) terminate the Contract by giving notice to the Employer, with a copy to the Engineer, such termination to take effect 14 days after the giving of the notice.

The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.

16.3 Cessation of Work and Removal of Contractor's Equipment

After a notice of termination under Sub-Clause 15.5 [Employer's Entitlement to Termination for Convenience], Sub-Clause 16.2 [Termination by Contractor] or Sub-Clause 19.6 [Optional Termination, Payment and Release] has taken effect, the Contractor shall promptly:

- (a) Cease all further work, except for such work as may have been instructed by the Engineer for the protection of life or property or for the safety of the Works;
- (b) Hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment; and
- (c) Remove all other Goods from the Site, except as necessary for safety, and leave the Site.

16.4 Payment on Termination

After a notice of termination under Sub-Clause 16.2 [Termination by Contractor] has taken effect, the Employer shall promptly:

- (a) Return the Performance Security to the Contractor;
- (b) Pay the Contractor in accordance with Sub-Clause 19.6 [Optional Termination, Payment and Release]; and
- (c) Pay to the Contractor the amount of any loss or damage sustained by the Contractor as a result of this termination.

17. Risk and Responsibility

17.1 Indemnities

The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

- (a) Bodily injury, sickness, disease or death, of any person 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 18.3 [Insurance Against Injury to Persons and Damage to Property].

17.2 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 10.1 [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 17.3 [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 to 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.

17.3 Employer's Risks

The risks referred to in Sub-Clause 17.4 [Consequences of Employer's Risks] below, insofar 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;
- (g) Design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible; and
- (h) Any operation of the forces of nature which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventive precautions.

17.4 Consequences of Employer's Risks

If and to the extent that any of the risks listed in Sub-Clause 17.3 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 20.1 [Contractor's Claims] to:

- (a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and
- (b) Payment of any such Cost, which shall be included in the Contract Price. In the case of sub-paragraphs (f) and (g) of Sub-Clause 17.3 [Employer's Risks], Cost plus profit shall be payable.

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

17.5 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.

17.6 Limitation of Liability	<p>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, other than as specifically provided in Sub-Clause 8.7 [Delay Damages]; Sub-Clause 11.2 [Cost of Remedying Defects]; Sub-Clause 15.4 [Payment after Termination]; Sub-Clause 16.4 [Payment on Termination]; Sub-Clause 17.1 [Indemnities]; Sub-Clause 17.4(b) [Consequences of Employer's Risks] and Sub-Clause 17.5 [Intellectual and Industrial Property Rights].</p> <p>The total liability of the Contractor to the Employer, under or in connection with the Contract other than under Sub-Clause 4.19 [Electricity, Water and Gas], Sub-Clause 4.20 [Employer's Equipment and Free-Issue Materials], Sub-Clause 17.1 [Indemnities] and Sub-Clause 17.5 [Intellectual and Industrial Property Rights], shall not exceed the sum resulting from the application of a multiplier (less or greater than one) to the Accepted Contract Amount, as stated in the Contract Data, or (if such multiplier or other sum is not so stated) the Accepted Contract Amount.</p> <p>This Sub-Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.</p>
17.7 Use of Employer's Accommodation / Facilities	<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 style="text-align: center;">18. Insurance</p> <p>18.1 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>Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms acceptable to the Contractor. 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>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.</p> <p>The relevant insuring Party shall, within the respective periods stated in the Contract Data (calculated from the Commencement Date), submit to the other Party:</p> <p>(a) Evidence that the insurances described in this Clause have been effected; and</p>

- (b) Copies of the policies for the insurances described in Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment] and Sub-Clause 18.3 [Insurance against Injury to Persons and Damage to Property].

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 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 Sub-Clause 2.5 [Employer's Claims] or Sub-Clause 20.1 [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 18) with insurers from any eligible source country.

18.2 Insurance for Works and Contractor's Equipment

The 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 by which the evidence is to be submitted under sub-paragraph (a) of Sub-Clause 18.1 [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 Clause 11 [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 Particular Conditions, 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 to the Party actually bearing the costs of rectifying the loss or damage,

- (c) Shall cover all loss and damage from any cause not listed in Sub-Clause 17.3 [Employer's Risks];
- (d) Shall also cover, to the extent specifically required in the bidding documents of the Contract, 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 17.3 [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) 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 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) Goods while they are not in the Country, subject to Sub-Clause 14.5 [Plant and Materials intended for the Works].

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 Sub-Clause 2.5 [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 18.1 [General Requirements for Insurances].

18.3 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 18.2 [Insurance for Works and Contractor's Equipment]) or to any person (except persons insured under Sub-Clause 18.4 [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 Particular Conditions, 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 (except things insured under Sub-Clause 18.2) 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 17.3 [Employer's Risks], except to the extent that cover is available at commercially reasonable terms.
- 18.4 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.
The insurance shall cover the Employer and the Engineer 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, 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.
- 19. Force Majeure**
- 19.1 Definition of Force Majeure** In this Clause, "Force Majeure" means an exceptional event or circumstance:
- (a) Which is beyond a Party's control;
 - (b) Which such Party could not reasonably have provided against before entering into the Contract
 - (c) Which, having arisen, such Party could not reasonably have avoided or overcome; and
 - (d) Which is not substantially attributable to the other Party.
- Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied:
- (i) War, hostilities (whether war be declared or not), invasion, act of foreign enemies;
 - (ii) Rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war;
 - (iii) Riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel;
 - (iv) Munitions of war, explosive materials, ionising radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity; and
 - (v) Natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity.
- 19.2 Notice of Force Majeure** If a Party is or will be prevented from performing its substantial obligations under the Contract by Force Majeure, then it shall give notice to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 14 days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.
The Party shall, having given notice, be excused performance of its obligations for so long as such Force Majeure prevents it from performing them.
Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.
- 19.3 Duty to Minimise Delay** Each Party shall at all times use all reasonable endeavours to minimise any delay in the performance of the Contract as a result of Force Majeure.
A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.
- 19.4 Consequences of** If the Contractor is prevented from performing his substantial obligations under the Contract by Force Majeure of which notice has been given under Sub-Clause 19.2

Force Majeure	[Notice of Force Majeure], and suffers delay and/or incurs Cost by reason of such Force Majeure, the Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:
	(a) An extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion]; and
	(b) If the event or circumstance is of the kind described in sub-paragraphs (i) to (iv) of Sub-Clause 19.1 [Definition of Force Majeure] and, in sub-paragraphs (ii) to (iv), occurs in the Country, payment of any such Cost, including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Force Majeure, to the extent they are not indemnified through the insurance policy referred to in Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment].
	After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.
19.5 Force Majeure Affecting Subcontractor	If any Subcontractor is entitled under any contract or agreement relating to the Works to relief from force majeure on terms additional to or broader than those specified in this Clause, such additional or broader force majeure events or circumstances shall not excuse the Contractor's non-performance or entitle him to relief under this Clause.
19.6 Optional Termination, Payment and Release	If the execution of substantially all the Works in progress is prevented for a continuous period of 84 days by reason of Force Majeure of which notice has been given under Sub-Clause 19.2 [Notice of Force Majeure], or for multiple periods which total more than 140 days due to the same notified Force Majeure, then either Party may give to the other Party a notice of termination of the Contract. In this event, the termination shall take effect 7 days after the notice is given, and the Contractor shall proceed in accordance with Sub-Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment].
	Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include:
	(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, and the Contractor shall place the same at the Employer's disposal;
	(c) Other Cost or liabilities which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works;
	(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); and
	(e) The Cost of repatriation of the Contractor's staff and labour employed wholly in connection with the Works at the date of termination.
19.7 Release from Performance	Notwithstanding any other provision of this Clause, if any event or circumstance outside the control of the Parties (including, but not limited to, Force Majeure) arises which makes it impossible or unlawful for either or both Parties to fulfil its or their contractual obligations or which, under the law governing the Contract, entitles the Parties to be released from further performance of the Contract, then upon notice by either Party to the other Party of such event or circumstance:
	(a) The Parties shall be discharged from further performance, without prejudice to the rights of either Party in respect of any previous breach of the Contract; and

- (b) The sum payable by the Employer to the Contractor shall be the same as would have been payable under Sub-Clause 19.6 [Optional Termination, Payment and Release] if the Contract had been terminated under Sub-Clause 19.6.

20. Claims, Disputes and Arbitration

20.1 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 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 further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

Within 42 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 42 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 the above defined time period.

Within the above defined period of 42 days, the Engineer shall proceed in accordance with Sub-Clause 3.5 [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 8.4 [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

Each Payment Certificate shall include such additional payment for any claim as has 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.

If the Engineer does not respond within the timeframe defined in this Clause, either Party may consider that the claim is rejected by the Engineer and any of the Parties

20.2 Appointment of the Dispute Board

may refer to the Dispute Board in accordance with Sub-Clause 20.4 [Obtaining Dispute Board's Decision].

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.

Disputes shall be referred to a DB for decision in accordance with Sub-Clause 20.4 [Obtaining Dispute Board's Decision]. The Parties shall appoint a DB by the date stated in the Contract Data.

The DB shall comprise, as stated in the Contract Data, either one or three suitably qualified persons ("the members"), each of whom shall be fluent in the language for communication defined in the Contract and shall be a professional experienced in the type of construction involved in the Works and with the interpretation of contractual documents. If the number is not so stated and the Parties do not agree otherwise, the DB shall comprise three persons.

If the Parties have not jointly appointed the DB 21 days before the date stated in the Contract Data and the DB is to comprise three persons, each Party shall nominate one member for the approval of the other Party. The first two members shall recommend and the Parties shall agree upon the third member, who shall act as chairman.

However, if a list of potential members has been agreed by the Parties and is included in the Contract, the members shall be selected from those on the list, other than anyone who is unable or unwilling to accept appointment to the DB.

The agreement between the Parties and either the sole member or each of the three members shall incorporate by reference the General Conditions of Dispute Board Agreement contained in the Appendix to these General Conditions, with such amendments as are agreed between them.

The terms of the remuneration of either the sole member or each of the three members, including the remuneration of any expert whom the DB consults, shall be mutually agreed upon by the Parties when agreeing the terms of appointment. Each Party shall be responsible for paying one-half of this remuneration.

If at any time the Parties so agree, they may jointly refer a matter to the DB for it to give its opinion. Neither Party shall consult the DB on any matter without the agreement of the other Party.

If a member declines to act or is unable to act as a result of death, disability, resignation or termination of appointment, a replacement shall be appointed in the same manner as the replaced person was required to have been nominated or agreed upon, as described in this Sub-Clause.

The appointment of any member may be terminated by mutual agreement of both Parties, but not by the Employer or the Contractor acting alone. Unless otherwise agreed by both Parties, the appointment of the DB (including each member) shall expire when the discharge referred to in Sub-Clause 14.12 [Discharge] shall have become effective.

20.3 Failure to Agree on the Composition of the Dispute Board

If any of the following conditions apply, namely:

- (a) The Parties fail to agree upon the appointment of the sole member of the DB by the date stated in the first paragraph of Sub-Clause 20.2 [Appointment of the Dispute Board];
- (b) Either Party fails to nominate a member (for approval by the other Party), or fails to approve a member nominated by the other Party, of a DB of three persons by such date;
- (c) The Parties fail to agree upon the appointment of the third member (to act as chairman) of the DB by such date; or

- (d) The Parties fail to agree upon the appointment of a replacement person within 42 days after the date on which the sole member or one of the three members declines to act or is unable to act as a result of death, disability, resignation or termination of appointment;

then the appointing entity or official named in the Contract Data shall, upon the request of either or both of the Parties and after due consultation with both Parties, appoint this member of the DB. This appointment shall be final and conclusive. Each Party shall be responsible for paying one-half of the remuneration of the appointing entity or official.

20.4 Obtaining Dispute Board's Decision

If a dispute (of any kind whatsoever) arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works, including any dispute as to any certificate, determination, instruction, opinion or valuation of the Engineer, either Party may refer the dispute in writing to the DB for its decision, with copies to the other Party and the Engineer. Such reference shall state that it is given under this Sub-Clause.

For a DB of three persons, the DB shall be deemed to have received such reference on the date when it is received by the chairman of the DB.

Both Parties shall promptly make available to the DB all such additional information, further access to the Site, and appropriate facilities, as the DB may require for the purposes of making a decision on such dispute. The DB shall be deemed to be not acting as arbitrator(s).

Within 84 days after receiving such reference, or within such other period as may be proposed by the DB and approved by both Parties, the DB shall give its decision, which shall be reasoned and shall state that it is given under this Sub-Clause. The decision shall be binding on both Parties, who shall promptly give effect to it unless and until it shall be revised in an amicable settlement or an arbitral award as described below. Unless the Contract has already been abandoned, repudiated or terminated, the Contractor shall continue to proceed with the Works in accordance with the Contract.

If either Party is dissatisfied with the DB's decision, then either Party may, within 28 days after receiving the decision, give a Notice of Dissatisfaction to the other Party indicating its dissatisfaction and intention to commence arbitration. If the DB fails to give its decision within the period of 84 days (or as otherwise approved) after receiving such reference, then either Party may, within 28 days after this period has expired, give a Notice of Dissatisfaction to the other Party.

In either event, this Notice of Dissatisfaction shall state that it is given under this Sub-Clause, and shall set out the matter in dispute and the reason(s) for dissatisfaction. Except as stated in Sub-Clause 20.7 [Failure to Comply with Dispute Board's Decision] and Sub-Clause 20.8 [Expiry of Dispute Board's Appointment], neither Party shall be entitled to commence arbitration of a dispute unless a Notice of Dissatisfaction has been given in accordance with this Sub-Clause.

If the DB has given its decision as to a matter in dispute to both Parties, and no Notice of Dissatisfaction has been given by either Party within 28 days after it received the DB's decision, then the decision shall become final and binding upon both Parties.

20.5 Amicable Settlement

Where a Notice of Dissatisfaction has been given under Sub-Clause 20.4 above, both Parties shall attempt to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, the Party giving a Notice of Dissatisfaction in accordance with Sub-Clause 20.4 above should move to commence arbitration after the fifty-sixth day from the day on which a Notice of Dissatisfaction was given, even if no attempt at an amicable settlement has been made.

20.6 Arbitration

Any dispute between the Parties arising out of or in connection with the Contract not settled amicably in accordance with Sub-Clause 20.5 above and in respect of which the DB's decision (if any) has not become final and binding shall be finally settled by arbitration. Arbitration shall be conducted as follows:

- (a) If the contract is with foreign contractors,

	<p>International arbitration (1) with proceedings administered by the arbitration institution designated in the Contract Data, and conducted under the rules of arbitration of such institution; or, if so specified in the Contract Data, (2) international arbitration in accordance with the arbitration rules of the United Nations Commission on International Trade Law (UNCITRAL); or (3) if neither an arbitration institution nor UNCITRAL arbitration rules are specified in the Contract Data, with proceedings administered by the International Chamber of Commerce (ICC) and conducted under the ICC Rules of Arbitration; by one or more arbitrators appointed in accordance with said arbitration rules;</p> <p>(b) If the Contract is with domestic contractors, arbitration with proceedings conducted in accordance with the laws of the Employer's country.</p> <p>The place of arbitration shall be the neutral location specified in the Contract Data; and the arbitration shall be conducted in the language for communications defined in Sub-Clause 1.4 [Law and Language].</p> <p>The arbitrators shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Engineer, and any decision of the DB, relevant to the dispute. Nothing shall disqualify representatives of the Parties and the Engineer from being called as a witness and giving evidence before the arbitrators on any matter whatsoever relevant to the dispute.</p> <p>Neither Party shall be limited in the proceedings before the arbitrators to the evidence or arguments previously put before the DB to obtain its decision, or to the reasons for dissatisfaction given in its Notice of Dissatisfaction. Any decision of the DB shall be admissible in evidence in the arbitration.</p> <p>Arbitration may be commenced prior to or after completion of the Works. The obligations of the Parties, the Engineer and the DB shall not be altered by reason of any arbitration being conducted during the progress of the Works.</p>
20.7 Failure to Comply with Dispute Board's Decision	<p>In the event that a Party fails to comply with a final and binding DB decision, then the other Party may, without prejudice to any other rights it may have, refer the failure itself to arbitration under Sub-Clause 20.6 [Arbitration]. Sub-Clause 20.4 [Obtaining Dispute Board's Decision] and Sub-Clause 20.5 [Amicable Settlement] shall not apply to this reference.</p>
20.8 Expiry of Dispute Board's Appointment	<p>If a dispute arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works and there is no DB in place, whether by reason of the expiry of the DB's appointment or otherwise:</p> <p>(a) Sub-Clause 20.4 [Obtaining Dispute Board's Decision] and Sub-Clause 20.5 [Amicable Settlement] shall not apply; and</p> <p>(b) The dispute may be referred directly to arbitration under Sub-Clause 20.6 [Arbitration].</p>

APPENDIX

A General Conditions of Dispute Board Agreement

1. Definitions

Each "Dispute Board Agreement" is a tripartite agreement by and between:

- (a) The "Employer";
- (b) The "Contractor"; and
- (c) The "Member" who is defined in the Dispute Board Agreement as being:
 - (i) The sole member of the "DB" and, where this is the case, all references to the "Other Members" do not apply, or
 - (ii) One of the three persons who are jointly called the "DB" (or "Dispute Board") and, where this is the case, the other two persons are called the "Other Members".

The Employer and the Contractor have entered (or intend to enter) into a contract, which is called the "Contract" and is defined in the Dispute Board Agreement, which incorporates this Appendix. In the Dispute Board Agreement, words and expressions which are not otherwise defined shall have the meanings assigned to them in the Contract.

2. General Provisions

Unless otherwise stated in the Dispute Board Agreement, it shall take effect on the latest of the following dates:

- (a) The Commencement Date defined in the Contract;
- (b) When the Employer, the Contractor and the Member have each signed the Dispute Board Agreement; or
- (c) When the Employer, the Contractor and each of the Other Members (if any) have respectively each signed a dispute board agreement.

This employment of the Member is a personal appointment. At any time, the Member may give not less than 70 days' notice of resignation to the Employer and to the Contractor, and the Dispute Board Agreement shall terminate upon the expiry of this period.

3. Warranties

The Member warrants and agrees that he/she is and shall be impartial and independent of the Employer, the Contractor and the Engineer. The Member shall promptly disclose, to each of them and to the Other Members (if any), any fact or circumstance which might appear inconsistent with his/her warranty and agreement of impartiality and independence.

When appointing the Member, the Employer and the Contractor relied upon the Member's representations that he/she is:

- (a) Experienced in the work which the Contractor is to carry out under the Contract;
- (b) Experienced in the interpretation of contract documentation; and
- (c) Fluent in the language for communications defined in the Contract.

4. General Obligations of the Member

The Member shall:

- (a) Have no interest financial or otherwise in the Employer, the Contractor or Engineer, nor any financial interest in the Contract except for payment under the Dispute Board Agreement;
- (b) Not previously have been employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except in such circumstances as were disclosed in writing to the Employer and the Contractor before they signed the Dispute Board Agreement;
- (c) Have disclosed in writing to the Employer, the Contractor and the Other Members (if any), before entering into the Dispute Board Agreement and to his/her best knowledge and recollection, any professional or personal relationships with any director, officer or employee of the Employer, the Contractor or the Engineer, and any previous involvement in the overall project of which the Contract forms part;

- (d) Not, for the duration of the Dispute Board Agreement, be employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except as may be agreed in writing by the Employer, the Contractor and the Other Members (if any);
- (e) Comply with the annexed procedural rules and with Sub-Clause 20.4 of the Conditions of Contract;
- (f) Not give advice to the Employer, the Contractor, the Employer's Personnel or the Contractor's Personnel concerning the conduct of the Contract, other than in accordance with the annexed procedural rules;
- (g) Not while a Member enter into discussions or make any agreement with the Employer, the Contractor or the Engineer regarding employment by any of them, whether as a consultant or otherwise, after ceasing to act under the Dispute Board Agreement;
- (h) Ensure his/her availability for all site visits and hearings as are necessary;
- (i) Become conversant with the Contract and with the progress of the Works (and of any other parts of the project of which the Contract forms part) by studying all documents received which shall be maintained in a current working file;
- (j) Treat the details of the Contract and all the DB's activities and hearings as private and confidential, and not publish or disclose them without the prior written consent of the Employer, the Contractor and the Other Members (if any); and
- (k) Be available to give advice and opinions, on any matter relevant to the Contract when requested by both the Employer and the Contractor, subject to the agreement of the Other Members (if any).

5. General Obligations of the Employer and the Contractor

The Employer, the Contractor, the Employer's Personnel and the Contractor's Personnel shall not request advice from or consultation with the Member regarding the Contract, otherwise than in the normal course of the DB's activities under the Contract and the Dispute Board Agreement. The Employer and the Contractor shall be responsible for compliance with this provision, by the Employer's Personnel and the Contractor's Personnel respectively.

The Employer and the Contractor undertake to each other and to the Member that the Member shall not, except as otherwise agreed in writing by the Employer, the Contractor, the Member and the Other Members (if any):

- (a) Be appointed as an arbitrator in any arbitration under the Contract;
- (b) Be called as a witness to give evidence concerning any dispute before arbitrator(s) appointed for any arbitration under the Contract; or
- (c) Be liable for any claims for anything done or omitted in the discharge or purported discharge of the Member's functions, unless the act or omission is shown to have been in bad faith.

The Employer and the Contractor hereby jointly and severally indemnify and hold the Member harmless against and from claims from which he is relieved from liability under the preceding paragraph.

Whenever the Employer or the Contractor refers a dispute to the DB under Sub-Clause 20.4 of the Conditions of Contract, which will require the Member to make a site visit and attend a hearing, the Employer or the Contractor shall provide appropriate security for a sum equivalent to the reasonable expenses to be incurred by the Member. No account shall be taken of any other payments due or paid to the Member.

6. Payment

The Member shall be paid as follows, in the currency named in the Dispute Board Agreement:

- (a) A retainer fee per calendar month, which shall be considered as payment in full for:
 - (i) Being available on 28 days' notice for all site visits and hearings;

- (ii) Becoming and remaining conversant with all project developments and maintaining relevant files;
- (iii) All office and overhead expenses including secretarial services, photocopying and office supplies incurred in connection with his duties; and
- (iv) All services performed hereunder except those referred to in sub-paragraphs (b) and (c) of this Clause.

The retainer fee shall be paid with effect from the last day of the calendar month in which the Dispute Board Agreement becomes effective; until the last day of the calendar month in which the Taking-Over Certificate is issued for the whole of the Works.

With effect from the first day of the calendar month following the month in which the Taking-Over Certificate is issued for the whole of the Works, the retainer fee shall be reduced by one third. This reduced fee shall be paid until the first day of the calendar month in which the Member resigns or the Dispute Board Agreement is otherwise terminated.

- (b) A daily fee which shall be considered as payment in full for:
 - (i) Each day or part of a day up to a maximum of two days' travel time in each direction for the journey between the Member's home and the Site, or another location of a meeting with the Other Members (if any);
 - (ii) Each working day on Site visits, hearings or preparing decisions; and
 - (iii) Each day spent reading submissions in preparation for a hearing;
- (c) All reasonable expenses including necessary travel expenses (air fare in less than first class, hotel and subsistence and other direct travel expenses) incurred in connection with the Member's duties, as well as the cost of telephone calls, courier charges, faxes and telexes: a receipt shall be required for each item in excess of five percent of the daily fee referred to in sub-paragraph (b) of this Clause;
- (d) Any taxes properly levied in the Country on payments made to the Member (unless a national or permanent resident of the Country) under this Clause 6.

The retainer and daily fees shall be as specified in the Dispute Board Agreement. Unless it specifies otherwise, these fees shall remain fixed for the first 24 calendar months, and shall thereafter be adjusted by agreement between the Employer, the Contractor and the Member, at each anniversary of the date on which the Dispute Board Agreement became effective.

If the parties fail to agree on the retainer fee or the daily fee, the appointing entity or official named in the Contract Data shall determine the amount of the fees to be used.

The Member shall submit invoices for payment of the monthly retainer and air fares quarterly in advance. Invoices for other expenses and for daily fees shall be submitted following the conclusion of a Site visit or hearing. All invoices shall be accompanied by a brief description of activities performed during the relevant period and shall be addressed to the Contractor.

The Contractor shall pay each of the Member's invoices in full within 56 calendar days after receiving each invoice and shall apply to the Employer (in the Statements under the Contract) for reimbursement of one-half of the amounts of these invoices. The Employer shall then pay the Contractor in accordance with the Contract.

If the Contractor fails to pay to the Member the amount to which he/she is entitled under the Dispute Board Agreement, the Employer shall pay the amount due to the Member and any other amount which may be required to maintain the operation of the DB; and without prejudice to the Employer's rights or remedies. In addition to all other rights arising from this default, the Employer shall be entitled

- to reimbursement of all sums paid in excess of one-half of these payments, plus all costs of recovering these sums and financing charges calculated at the rate specified in Sub-Clause 14.8 of the Conditions of Contract.
- If the Member does not receive payment of the amount due within 70 days after submitting a valid invoice, the Member may (i) suspend his/her services (without notice) until the payment is received, and/or (ii) resign his/her appointment by giving notice under Clause 7.
- 7. Termination**
- At any time: (i) the Employer and the Contractor may jointly terminate the Dispute Board Agreement by giving 42 days' notice to the Member; or (ii) the Member may resign as provided for in Clause 2.
- If the Member fails to comply with the Dispute Board Agreement, the Employer and the Contractor may, without prejudice to their other rights, terminate it by notice to the Member. The notice shall take effect when received by the Member. If the Employer or the Contractor fails to comply with the Dispute Board Agreement, the Member may, without prejudice to his other rights, terminate it by notice to the Employer and the Contractor. The notice shall take effect when received by them both.
- Any such notice, resignation and termination shall be final and binding on the Employer, the Contractor and the Member. However, a notice by the Employer or the Contractor, but not by both, shall be of no effect.
- 8. Default of the Member**
- If the Member fails to comply with any of his obligations under Clause 4 (a) - (d) above, he shall not be entitled to any fees or expenses hereunder and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses received by the Member and the Other Members (if any), for proceedings or decisions (if any) of the DB which are rendered void or ineffective by the said failure to comply.
- If the Member fails to comply with any of his obligations under Clause 4 (e) - (k) above, he shall not be entitled to any fees or expenses hereunder from the date and to the extent of the non-compliance and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses already received by the Member, for proceedings or decisions (if any) of the DB which are rendered void or ineffective by the said failure to comply.
- 9. Disputes**
- Any dispute or claim arising out of or in connection with this Dispute Board Agreement, or the breach, termination or invalidity thereof, shall be finally settled by institutional arbitration. If no other arbitration institute is agreed, the arbitration shall be conducted under the Rules of Arbitration of the International Chamber of Commerce by one arbitrator appointed in accordance with these Rules of Arbitration.

PROCEDURAL RULES

Unless otherwise agreed by the Employer and the Contractor, the DB shall visit the Site at intervals of not more than 140 days, including times of critical construction events, at the request of either the Employer or the Contractor. Unless otherwise agreed by the Employer, the Contractor and the DB, the period between consecutive visits shall not be less than 70 days, except as required to convene a hearing as described below. The timing of and agenda for each Site visit shall be as agreed jointly by the DB, the Employer and the Contractor, or in the absence of agreement, shall be decided by the DB. The purpose of Site visits is to enable the DB to become and remain acquainted with the progress of the Works and of any actual or potential problems or claims, and, as far as reasonable, to endeavour to prevent potential problems or claims from becoming disputes.

Site visits shall be attended by the Employer, the Contractor and the Engineer and shall be coordinated by the Employer in co-operation with the Contractor. The Employer shall ensure the provision of appropriate conference facilities and secretarial and copying services. At the conclusion of each Site visit and before leaving the site, the DB shall prepare a report on its activities during the visit and shall send copies to the Employer and the Contractor.

The Employer and the Contractor shall furnish to the DB one copy of all documents which the DB may request, including Contract documents, progress reports, variation instructions, certificates and other documents pertinent to the performance of the Contract. All communications between the DB and the Employer or the Contractor shall be copied to the other Party. If the DB comprises three persons, the Employer and the Contractor shall send copies of these requested documents and these communications to each of these persons.

If any dispute is referred to the DB in accordance with Sub-Clause 20.4 of the Conditions of Contract, the DB shall proceed in accordance with Sub-Clause 20.4 and these Rules. Subject to the time allowed to give notice of a decision and other relevant factors, the DB shall:

- (a) Act fairly and impartially as between the Employer and the Contractor, giving each of them a reasonable opportunity of putting his case and responding to the other's case; and
- (b) Adopt procedures suitable to the dispute, avoiding unnecessary delay or expense.

The DB may conduct a hearing on the dispute, in which event it will decide on the date and place for the hearing and may request that written documentation and arguments from the Employer and the Contractor be presented to it prior to or at the hearing.

Except as otherwise agreed in writing by the Employer and the Contractor, the DB shall have power to adopt an inquisitorial procedure, to refuse admission to hearings or audience at hearings to any persons other than representatives of the Employer, the Contractor and the Engineer, and to proceed in the absence of any party who the DB is satisfied received notice of the hearing; but shall have discretion to decide whether and to what extent this power may be exercised.

The Employer and the Contractor empower the DB, among other things, to:

- (a) Establish the procedure to be applied in deciding a dispute;
- (b) Decide upon the DB's own jurisdiction, and as to the scope of any dispute referred to it;
- (c) Conduct any hearing as it thinks fit, not being bound by any rules or procedures other than those contained in the Contract and these Rules;
- (d) Take the initiative in ascertaining the facts and matters required for a decision;
- (e) Make use of its own specialist knowledge, if any;
- (f) Decide upon the payment of financing charges in accordance with the Contract;
- (g) Decide upon any provisional relief such as interim or conservatory measures; and
- (h) Open up, review and revise any certificate, decision, determination, instruction, opinion or valuation of the Engineer, relevant to the dispute.

The DB shall not express any opinions during any hearing concerning the merits of any arguments advanced by the Parties. Thereafter, the DB shall make and give its decision in accordance with Sub-Clause 20.4, or as otherwise agreed by the Employer and the Contractor in writing. If the DB comprises three persons:

- (a) It shall convene in private after a hearing, in order to have discussions and prepare its decision;
- (b) It shall endeavour to reach a unanimous decision: if this proves impossible the applicable decision shall be made by a majority of the Members, who may require the minority Member to prepare a written report for submission to the Employer and the Contractor; and
- (c) If a Member fails to attend a meeting or hearing, or to fulfil any required function, the other two Members may nevertheless proceed to make a decision; unless:
 - (i) Either the Employer or the Contractor does not agree that they do so; or
 - (ii) The absent Member is the chairman and he/she instructs the other Members not to make a decision.

SECTION-7

PARTICULAR CONDITIONS OF CONTRACT (PCC)

K-
RIDE

Particular Conditions of Contract (PCC)

The following Particular Conditions shall supplement the GC. Whenever there is a conflict, the provisions herein shall prevail over those in the GC.



Part A - Contract Data

Conditions	Sub-Clause	Data
Employer's name and address	1.1.2.2 & 1.3	Rail Infrastructure Development Company (Karnataka) Limited (K-RIDE) Samparka Soudha, 1 st Floor, Dr. Rajkumar Road Opposite Orion Mall, Rajajinagar 1 st Block Bengaluru-560010 Email: gmpurchasement@kride.in
Engineer's name and address	1.1.2.4 & 1.3	Project Director, General Consultant (EGIS-AECOM-LBI(WSP) JV), #11/23, Suryadev Building, Rajajinagar, 1 st Block, Bengaluru-560010.
Bank's name	1.1.2.11	Deleted
Borrower's name	1.1.2.12	Deleted
Time for Completion of the Works	1.1.3.3	12 Months
Defects Notification Period	1.1.3.7	730 days. (24 Months)
Sections	1.1.5.6	Bangalore Sub-urban Rail Project (BSRP) Corridor 4
Electronic transmission systems	1.3	Electronic transmission shall be in the form of scanned copy of original documents, Letters, Mail, Post communicated through authorized E-Mail IDs of Parties.
Contractor's name and address	1.3	<i>Bidder to submit along with the bid)</i>
Governing Law	1.4	Acts and laws of India
Ruling language	1.4	English
Language for communications	1.4	English
Time for the Parties entering into a Contract Agreement	1.6	The Parties shall enter into an Contract Agreement within 28 days after the Contractor receives of Letter of Acceptance.
Care and Supply of Documents	1.8	Five (5) soft (digital) copy(ies); and
No. of copies of Contractor's Documents		Five (5) hard (paper) copy(ies)

Conditions	Sub-Clause	Data
Time for Access to the Site	2.1	<p>The Construction Right of Access will be handed over as below:</p> <ol style="list-style-type: none"> 1. Railway Land: within 60 (Sixty) days from the commencement date. 2. Other Govt land and Private Land: Will be given progressively in line with the requirement of the approved contractor programme and commensurate with the physical progress. <p>Such right and possession may not be exclusive to the Contractor. The Contractor will draw / modify the schedule for completion of Works according to progressive possession / right of such sites.</p> <p>If the Contractor suffers delay from failure on the part of the Employer to grant right of access to, or possession of the Site, the Contractor shall give notice to the Engineer in a period of 28 days of such occurrence.</p> <p>After receipt of such notice the Engineer shall proceed to determine any extension of time to which the Contractor is entitled and shall notify the Contractor accordingly.</p> <p>For any such delay in handing over of site, Contractors will be entitled to only reasonable extension of time Sub-Clause 8.4 [Extension of Time for Completion] and no monetary claims whatsoever shall be paid or entertained on this account.</p> <p>The Engineer reserves the right to make each site available to the Contractor any time before or after the Access Dates. The Engineer will notify the Contractor of the actual Access Dates in advance for each part of the works. This Notice will specify the area to which it refers is accessible and in a sufficient state of completion to permit the Contractor to begin installation and testing therein. It shall not imply that the Contractor will enjoy exclusive use of the area or that the work of other Contractor's therein is complete. The Contractor shall begin installation in each area by the actual Access Date and shall complete all installation and testing in each area by the relevant Key Date (If any).</p> <p>Notwithstanding the actual Access Date, whether before or after the stipulated Access Dates, the Employer shall not accept any increase in cost to the Employer.</p>
Performance Security	4.2	<p>The performance security will be in the form of a Bank guarantee of the amount(s) at 3% (three percent) of the Accepted Contract Price and in the same currency (ies) of the Accepted Contract Price, issued from scheduled commercial bank of Indian or Foreign origin (Except Cooperative Bank) having business office in India.</p>
Subcontractors	4.4	<p>No Direct payment of Sub-Contractors is allowed.</p> <p>The value of a sub-contract excluding design work and the items in the Schedule of Miscellaneous works shall be limited to 50% of the contract price. The contract or any agreement between the contractor and subcontractor shall be in accordance with the "Contract".</p>
Progress reports	4.4.1	Monthly / Five (5) copies
Normal working hours	6.	Normal working hours are 00.00 HRS to 24.00 HRS in two Shifts. The Contractor, if required, shall carry out work during

Conditions	Sub-Clause	Data
		night hours or in shifts. The Contractor shall carry out work during Sundays / Holidays., for all site works.
		The Contractor shall not be entitled to any claim in addition to the Accepted Contract Price on account of night/ shift working.
Commencement of work	8.1	Date of signing of the Contract Agreement.
Effective access to the Site	8.1(c)	After award of the work, The Employer / Engineer 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 Works according to progressive possession / right of such sites.
Delay damages for the Works	8.7 & 14.15 (b)	Please refer Annexure-1 of Part `A` (Contract Key dates and Completion Date in this section).
Maximum amount of delay damages	8.7	10% of the Contract Price
Provisional Sums	13.5 (b) (ii)	Please refer relevant provisions in PCC
Adjustments for Changes in Cost	13.8	Please refer relevant provisions in PCC
Contract Price	14.1 (b) 14.1 (e)	Please refer relevant provisions in PCC Please refer relevant provisions in PCC
Total advance payment	14.2	10% Percentage of the Accepted Contract Amount payable in the currencies (INR Only) and proportions in which the Accepted Contract Amount is payable. Number and timing of instalments, currencies (INR Only) and proportions and start repayment of advance payment – refer relevant provisions in PCC.
Repayment amortization rate of advance payment	14.2(b)	Please refer relevant provisions in PCC
Application for Interim Payment Certificates Copies of Statement	14.3	Five (5) soft (digital) copy(ies) and Five (5) hard (paper) copy(ies)
Percentage of Retention	14.3(c)	Retention money equal to 10 percent of the amount due to the Contractor in IPC's/ Running bills from time to time will be retained, so as to maintain a reserve in the hands of the Employer equal to 5 percent of the Contract Price. If the Contractor submits the Bank Guarantee of 5% of Contract Price then the Security deposit shall not be deducted and the validity of the BG shall be till Defect liability period.
Limit of Retention Money	14.3(c)	Five percent (5%) of the Accepted Contract Price
Plant and Materials	14.5(b)(i) 14.5(c)(i)	NIL NIL
Minimum Amount of Interim Payment Certificates	14.6	Gross Bill Amount: 1% of the Accepted Contract Price
Time for Payment of Interim Payment Certificates	14.7	Please refer relevant provisions in PCC.
Contractor's Bank Account	14.7	_____ [insert bank account details at the time of contract signing]
Publishing source of commercial interest rates for financial charges in case of delayed payment	14.8	Not Applicable
Delayed Payment	14.8	No financing charges shall be payable due to delayed payment under Cl. 14.8
Statement at Completion No. of Copies	14.10	Five (5) soft (digital) copy(ies) and Five (5) hard (paper) copy(ies)
Application for Final Payment Certificate	14.11	Five (5) soft (digital) copy(ies) and Five (5) hard (paper) copy(ies)

Conditions	Sub-Clause	Data
No. of Copies		
Currency / Currencies of Payment	14.15	INR Only
Maximum total liability of the Contractor to the Employer	17.6	100% of the Contract Price.
Periods for submission of insurance: a. evidence of insurance b. relevant policies	18.1	Evidence(s): Within twenty-eight (28) days from the date of receipt of Letter of Acceptance Policy(ies): Within forty-five (45) days from the date of receipt of the Letter of Acceptance If the Contractor is insuring party & fails to submit the policy of insurance within forty five (45) days or submit the policy for lesser period or does not extend adequately, a penalty for such uninsured period as well as delay beyond forty five (45) days, shall be recovered at "per day basis", proportionate to amount of premium payable for the work from any monies due to the Contractor or if the amount is not sufficient the Performance Guarantee shall be retained by Employer till Contractor pays the dues towards renewal of these insurances.
Maximum amount of deductibles for insurance of the Employer's risks	18.2(d)	NIL
Minimum amount of third party insurance per occurrence	18.3	Up to INR 20 Lakhs per occurrence, with number of occurrences unlimited.
Date by which the DB shall be appointed	20.2	28 days after the Commencement date.
The DB shall be comprised of	20.2	Please refer relevant provisions in PCC.
List of potential DB sole members	20.2	Please refer relevant provisions in PCC.
Appointment (if not agreed) to be made by	20.3	Please refer relevant provisions in PCC.
Arbitration institution	20.6(a)	Please refer relevant provisions in PCC.
Arbitration rules	20.6(a)	Please refer relevant provisions in PCC
Place of arbitration	20.6	Bengaluru, India

Part B - Specific Provisions

Conditions	Sub-Clause	Specific Provisions
1.1.3.7 Defects Notification Period	1.1.3.7	Add, at the end of the Sub-Clause “or taken over under Sub-Clause 10.2 [Taking Over of Parts of the Works]”
1.1.6.11 Exceptionally Adverse Climatic Conditions	1.1.6.11	<p><i>Additional Sub-Clause</i></p> <p>“Exceptionally Adverse Climatic Conditions” means: at the Site which are Unforeseeable having regard to climatic data made available by the Employer under Sub-Clause 4.1 [Site Data] and/or climatic data published in the Country for the geographical location of the Site;</p> <p><i>[The exceptionally adverse climatic conditions referred to under Sub-Clause 8.4 item c) must be defined for each and every Site.</i></p> <p><i>In order to establish whether such climatic conditions occurred, it may be appropriate to compare the adverse climatic conditions with the frequency with which events of similar adversity have previously occurred at or near the Site. An exceptional degree of adversity might, for example, be regarded as one which has a probability of occurrence of four or five times the Time for Completion of the Works (for example, once every eight to ten years for a two-year contract).</i></p>
1.2 Communications	1.3	<p><i>Add the following at the end of item (a), after “Contract Data” and before “;”:</i></p> <p>“In case of electronic transmission, these communications shall be in the form of an un-editable record attached to an electronic mail, such as a PDF document for instance, and any other communication transmitted in a different manner, such as the email body text, shall not be construed as communication under the Contract”.</p>
1.15 Inspections and Audit	1.15	<p><i>This Sub-Clause is deleted in its entirety and replaced by:</i></p> <p>“The Contractor shall permit, and shall cause its agents (whether declared or not), sub-contractors, sub-consultants, service providers, or suppliers and any personnel thereof, to permit, Employer and/or persons appointed by the Employer and/or to inspect the Site and all accounts and records relating to the performance of the Contract and the submission of the Bid, and to have such accounts and records audited by auditors appointed by Employer.</p> <p>The Contractor’s attention is drawn to Sub-Clause 15.6 [Corrupt or Fraudulent Practices] which provides, inter alia, that acts intended to materially impede the exercise of Employer’s inspection and audit rights provided for under Sub-Clause 1.15 constitute a prohibited practice subject to contract termination.”</p>
1.5 Priority of Documents	1.5	<p><i>Replace sub-clause 1.5 with the following:</i></p> <p>The priority of the documents shall be as follows:</p> <ul style="list-style-type: none"> (a) the Contract Agreement (On appropriate Stamp Paper). (b) the Letter of Acceptance (LOA) (c) Accepted Financial Bid & Bill of Quantities (d) Corrigendum / Addendum/ Clarifications (e) the Particular Condition of Contract PCC)- Part-A

Conditions	Sub-Clause	Specific Provisions
		<p>(f) the Particular Condition of Contract PCC)- Part-B (g) the General Conditions (GC) (h) the Work Specification & Employer's Requirement, (i) the Drawings, (j) Contractor's Submissions (k) and any other reference documents forming part of the Contract.</p> <p>If an ambiguity or discrepancy is found in the documents, the Employer shall issue any necessary clarification or instruction by approval of Competent Authority.</p>
2.5 The Employer's Claims	2.5	<p><i>In the first line of the second paragraph delete the words:</i></p> <p><i>"28 days" and replace with the words "42 days".</i></p>
3.4 Replacement of the Engineer	3.4	Not applicable.
4.2 Performance Security	4.2	<p><i>Delete last sentence of second paragraph and replace by the sentence:</i></p> <p>"The Performance Security shall be issued by a reputable bank or financial institution selected by the Contractor and requiring the Bank's non-objection and shall be in the form annexed to the Particular Conditions."</p> <p>Once the variation approved under Cl. 13.3 (GCC) exceeds beyond 25% of the Contract Price, contractor shall submit the additional Performance Security to cover entire amount of approved variation at the rate stated above.</p>
4.4 Subcontractors	4.4	<p><i>Add the following at the end of the Sub-Clause:</i></p> <p>"Unless explicitly agreed to by the Engineer, the SHE Manual apply to all Subcontractors and Suppliers used for the execution of the Works. The Contractor is fully liable for all actions, non-compliance and negligence by Subcontractors and Suppliers their representatives, employees and workers, to the same degree as it would be held liable for its own actions, non-compliance or negligence or that of its own representatives, employees or workers."</p>
4.8 Safety Procedures	4.8	<p><i>Add the following at the end of the Sub-Clause:</i></p> <p>f) The Contractor shall ensure compliance with the SHE Manual.</p>
4.13 Rights of Way and Facilities	4.13	<p><i>Add the following to sub clause 4.13:</i></p> <p>The Employer reserves the right to make use of these service roads / rights of way for itself or for other contractors working in the area, as and when necessary without any payment to the Contractor</p>
4.17 Contractor's Equipment	4.17	<p><i>Add the following to sub clause 4.17:</i></p> <p>Upon completion of the Works the Contractor shall remove from the Site the entire said Contractor's Equipment, Temporary works and his unused materials within 42 days after the Issuing of taking over certificate, failing which the employer may remove them at contractor's cost</p>
4.18 Protection of the Environment	4.18	<p><i>Add the following after the last paragraph:</i></p>

Conditions	Sub-Clause	Specific Provisions
		"These provisions are complemented by those listed under the SHE Manual which the Contractor must ensure compliance with."
4.19 Temporary Utilities	4.19	<p>Add the following to sub clause 4.19:</p> <p>The Contractor shall be responsible for making his own arrangements at his own cost to obtain supply of water, electricity or gas for the Works. The Employer where feasible may at his discretion assist the Contractor in giving recommendatory letters etc.</p>
4.17 Progress reports	4.21	<p>Add the following new item at the end of the Sub-Clause:</p> <p>i) "matters requested under the SHE Manual."</p>
4.22 Security of the Site	4.22	<p>Add the following to sub clause 4.22:</p> <p>(c) The Contractor shall ensure proper security of all his assets along with Employer's assets by proper barricading / fencing (wherever required) and by deploying adequate security personnel and Security Equipment at his own cost.</p> <p>(d) The Contractor shall throughout the execution of the Works including the carrying out of any testing, commissioning (including Integrated Testing and Commissioning), or remedying of any defect which includes the following:</p> <p>(i) take full responsibility for the adequacy, stability, safety and security of the Works, Plant, Contractor's Equipment, Temporary Works, operations on Site and methods of manufacture, installation, construction and transportation;</p> <p>(ii) provide 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 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>(iii) The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer and the Employer to carry out surveillance, by installing CCTV Cameras with backup system to verify that the Safety & security Plans are being properly and fully implemented.</p>
4.24 New Clause - Assignment of Contractor's and Sub-contractor's Obligations	4.1	<p>Add the following after the last paragraph:</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> <p>a. charge in favour of the Contractor's bankers of any money due or to become due under the Contract, or</p> <p>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.</p> <p>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.</p>

Conditions	Sub-Clause	Specific Provisions
		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 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.
4.25 New Clause - Temporary Works	4.25	<p>Add a new sub-clause 4.25:</p> <p>All temporary works necessary for the proper execution of the Works shall be provided and maintained by the Contractor at his cost and subject to the consent of the Employer/Engineer shall be removed by Contractor at his own expense when they are no longer required and in such manner as the Employer/Engineer shall direct. In case the Contractor fails to remove the temporary works on completion the Employer/Engineer is authorized to get the same removed and recover the cost thereof from the Contractor.</p>
4.26 New Clause - Access for Engineer (New Clause)	4.26	<p>Add a new sub-clause 4.26:</p> <p>The Contractor shall allow at all times the Employer / Engineer, or any other person authorized by the Employer/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 subcontracts if any shall contain provisions entitling the Employer/Engineer or any person authorised by him to have such access.</p>
4.27 New Clause - Contractor to keep Site Clear	4.27	<p>Add a new sub-clause 4.27:</p> <p>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 Employer / 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 Employer/Engineer will be recovered from the Payments due to the Contractor.</p> <p>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 clearance of labour camps etc. shall have been effected by him.</p>
4.28 New Clause - Publicity	4.28	<p>Add a new sub-clause 4.28:</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</p>

Conditions	Sub-Clause	Specific Provisions
		of manufacture, or storage except with the permission, in writing, of the Employer
4.29 New Clause-Disclosure of Relationship	4.29	<p>Add a new sub-clause 4.29:</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>
4.30 New Clause -Use of Explosives	4.30	<p>Add a new sub-clause 4.30 Use of Explosives:</p> <p>Explosives shall not be used on the Works or on the Site by the Contractor without the consent of the Employer/Engineer and shall be used in the manner and to the extent permitted by the Employer/Engineer.</p> <p>The explosives shall be handled and used under the strict supervision of persons licensed for this purpose under the requisite statutory rules and regulations. When explosives are required for the Works they shall be stored in a special magazine to be provided at the cost of the Contractor in accordance with 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 All operations, in which or for which the explosives are employed shall be at the sole risk and responsibility of the Contractor and the Contractor shall hold the Employer harmless and shall indemnify the Employer in respect thereof. The Contractor shall follow all extant rules and regulations regarding the procurement, storage, transport etc. of explosives</p>
4.31 New Clause - Work by Persons Other than Contractor	4.31	<p>Add a new sub-clause 4.31:</p> <p>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, be urgently necessary and the Contractor is unable or unwilling at once to do such remedial or other work, the Employer/Engineer may authorise the carrying out of such remedial or other work by a person other than the Contractor. All expenses properly incurred in carrying out the same shall be recoverable by the Employer from the Contractor. Provided that the Employer/Engineer shall, as soon after the occurrence of any such emergency as may be reasonably practicable, notify the Contractor thereof in writing</p>

Conditions	Sub-Clause	Specific Provisions
4.32 New Clause - Confidentiality of Information	4.32	<p>Add a new sub-clause 4.32:</p> <p>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</p>
6.6 Facilities for Staff and Labour	6.6	<p>The last paragraph is deleted in its entirety and replaced by the following:</p> <p>“The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the Site, except with the prior and express Engineer's consent after consultation with the Employer. The Employer and/or the Engineer may inspect the living quarters from time to time in order to verify their compliance with the Laws and the Contract. The Contractor shall accordingly grant the Employer and/or the Engineer full access to the living quarters as and when they require.”</p>
6.7 Health and Safety	6.7	<p>Add the following at the end of the Sub-Clause:</p> <p>“These provisions are complemented by those listed under the SHE Manual which the Contractor must ensure compliance with.”</p>
8.1 Commencement of Works	8.1	<p>Add the following at the end of the Sub-Clause:</p> <p>“As defined in the SHE Manual, no physical work may commence on any Project Area until such time the Contractor has prepared and submitted to the Engineer's approval.”</p>
8.3 Programme	8.3	<p>Add sub clause 8.3 with the following:</p> <p>In the event of a programme being rejected, or deemed to have been rejected, the Contractor shall, within 21 days thereafter, submit a revised programme taking account of the reasons given for the rejection or incorporating further information requested by the Engineer, as the case may be.</p> <p>The Contractor, following receipt of consent to the Works Programme, may submit to the Engineer the approved version immediately. In the event that the Engineer grants an extension of time, instructs an Employer's Variation, or on the occurrence of any event or happening or situation, which could materially affect the progress of the Works, the Contractor shall submit a revised programme to the Engineer for his consent.</p> <p>If the Engineer feels that there is a significant deviation between the actual or anticipated progress of the Works and the Works programme, the Engineer may require the Contractor to submit a revised/modified programme to ensure timely completion of Whole of Works or a Key Date. The Contractor shall submit such revised programme within 14 days of the instruction or within such other time as the Engineer will allow in writing.</p>

Conditions	Sub-Clause	Specific Provisions
		<p>Unless and until an amended version has the consent of the Engineer, the existing programme shall remain as the Works Programme for all purposes of the Contract.</p> <p>Consent by the Engineer to a Works Programme shall not relieve the Contractor of any of his duties or responsibilities under the Contract, nor in the event that a Works Programme indicates that a Key Date has not or will not be met, constitute any form of acknowledgement that the Contractor is or may be entitled to an extension of time in relation to such Key Date.</p> <p>Add sub clause 8.3 with the following</p> <p>8.3.1 Design Submission Programme</p> <p>The Contractor shall submit to the Engineer, the Design Submission Programme and updated versions thereof in the form and content and at the times prescribed in the Employer's Requirements - Design, including the dates on which major decisions should be made.</p> <p>In the second and subsequent submissions of the Design Submission Programme, the Contractor shall not, without the prior written consent of the Engineer:</p> <ul style="list-style-type: none"> (a) revise the description or content of any design package (as referred to in the Employer's Requirements - Design) identified in the initial version of Design Submission Programme (b) reduce the periods provided for review by the Engineer of any submission of Design Data as set out in the initial version of the Design Submission Programme; (c) revise the sequence of submissions of Design Data shown in the initial version of the Design Submission Programme. <p>Any amendment of the Design Submission Programme in breach of the above requirements shall have no effect whatsoever under the Contract</p> <p>8.3.2 Manufacture, Installation and Construction Methods</p> <p>The Contractor shall submit complete documents and information pertaining to the methods of manufacture, installation and construction which the Contractor proposes to adopt or use, (and if applicable such calculations of stresses, strains and deflections and the like that will or may arise in the Works or to the other works comprising the Project or any parts thereof during installation from the use of such methods). The Engineer will then check to see whether, if such methods are adhered to, the Works can be executed in accordance with the Contract and without detriment to the Works (when completed) and to other works comprising the Project and in a manner which minimises disruption to road and pedestrian traffic.</p>

Conditions	Sub-Clause	Specific Provisions
		<p>The Engineer shall inform the Contractor in writing within 21 days after receipt of the above information</p> <p>(a) that the Contractor's proposed methods of manufacture, installation and construction have the consent of the Engineer; or</p> <p>(b) in what respects, in the opinion of the Engineer the Contractor's proposed methods of manufacture, installation and construction</p> <p>a. fail to comply with the Employer's Requirements and/or the Definitive Design and/or the Final Design;</p> <p>b. would be detrimental to the Works and/or to the other works comprising the Project;</p> <p>c. do not comply with the other requirements of the Contract;</p> <p style="text-align: center;">Or</p> <p>c) as to the further documents or information which are required to enable the Engineer to properly assess the proposed methods of manufacture, installation and construction.</p> <p>In the event that the Engineer does not give his consent, the Contractor shall take such steps or make such changes in the said methods or supply such further documents or information as may be necessary to meet the Employer's requirements and to obtain his consent. The Contractor shall not change the methods of manufacture, installation and construction which have received the Engineer's consent without further review and consent in writing of the Engineer.</p> <p>Notwithstanding the foregoing provisions of this Clause, or that certain of the Contractor's proposed methods of manufacture, installation and construction may be the subject of the consent of the Engineer, the Contractor shall not be relieved of any liability or obligation under the Contract.</p> <p>8.3.3 Monthly Payment Curves:</p> <p>Within 30 days of the date of LOA, the Contractor shall, submit to the Engineer Monthly Payment Curves, for each Item of Payment mentioned in Price Schedule together with for all Items of Payment put together on the basis of Letter of Acceptance. The Monthly Payment Curves shall be consistent with the Work Programme. The Monthly Payment Curves shall be revised from time to time as the Works Programme will be revised in accordance with the above provision.</p> <p>8.3.4 Three Month Rolling Programme</p> <p>Within 30 days of the date of LOA, and thereafter at the end of each calendar month, the Contractor shall submit to the Engineer his Monthly Rolling Programme for each agreed major section of Works in the Contract, in the form and detail prescribed in the Employer's</p>

Conditions	Sub-Clause	Specific Provisions
		Requirements, setting out the work to be carried out during the following three months.
8.4 Extension of Time for Completion	8.4	<p>Sub-Clause 8.4 is replaced with the following in its entirety:</p> <p>8.4.1 The Contractor may apply for an extension of the Time for Completion if the Work is or will be delayed either before or after the Time for Completion by any of the following causes:</p> <ul style="list-style-type: none"> a. "Force Majeure" referred to in Clause 19 b. The Contractor's work held up for not being given possession of or access to the Site in accordance with the Contract c. Instruction of the Engineer to suspend the Works and the Contractor not being in default as to reasons of suspension. d. Acts or omissions of other Designated Contractors in executing work not forming part of this Contract and on whose performance, the performance of the Contractor necessarily depends. e. Any act of prevention or Breach of Contract by the Employer and not mentioned in this Clause f. Any order of Court restraining the performance of the Contract in full or in any part thereof g. Any other event or occurrence which, according to the Employer is not due to the Contractor's failure or fault, and is beyond his control without Employer being responsible for the same. h. An Employer's Variation <p>However, the Contractor shall not be entitled to any extension of time where the instructions or acts of the Employer or the Engineer are necessitated by or intended to cure any default of or breach of Contract by the Contractor or where any delay is due to</p> <ul style="list-style-type: none"> a. the failure of sub-contractor, to commence or to carry out work in due time, b. non-availability, or shortage of Contractor's equipment, labour, utility services, Plant and Materials, c. inclement weather conditions, and d. the Contractor not fulfilling his obligations under Sub-Clause 4.1. e. the contractor not fulfilling the obligations on Detailed Design and Engineering (DDC & Proof Check). <p>If the Contractor considers himself to be entitled to an extension of time for Completion, he shall give notice to the Engineer of such intention as soon as possible and in any event within 28 days of the start of the event giving rise to the delay and full and final supporting details of his application within 21 days of the last day of delay, together with any notice required by the Contract and relevant to such Clause.</p> <p>The Engineer shall proceed or determine either prospectively or retrospectively such extension of the Time for Completion as may be due. The Engineer shall notify the Contractor accordingly. The extension of time including that of key date shall not entitle the contractor to retain the advance which shall be governed by Clause 14.2.</p> <p>8.4.2 Extension of time for completion for other reasons: The Contractor shall not be entitled to an extension of time by reason of any delay to any activity in the carrying out of the Works unless in the opinion of the Engineer such delay results</p>

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		<p>in or may be expected to result in a delay to completion of the Works, or achievement of any Stage by the relevant Key Date. Whether or not the Contractor fails to achieve any Milestone by reason of any delay shall not by itself be material to the Contractor's entitlement to an extension of time.</p> <p>Any extension to a Key Date shall not by itself entitle the Contractor to an extension to any other Key Date.</p> <p>8.4.3 Extension of time for completion for other reason for delay due to Contractor : If the delay in the completion of the whole Works or a portion of the Works, for which an earlier completion period is stipulated, is due to the Contractor's failure or fault, and the Engineer is of the view that the remaining Works or the portions of Works can be completed by the Contractor in a reasonable and acceptable short time, then, the Engineer may allow the Contractor extension or further extension of time at its discretion with or without liquidated damages, for completion, as he may decide.</p>
8.7 Delay Damages	8.7	<p>Add the following to sub clause 8.7:</p> <p>Liquidated damages shall be levied as per the rates given in Contract Key Dates & Completion Date /Annexure-1 of Contract Data, Part-A</p>
8.8 Suspension of Work	8.8	<p>Add the following after the last sentence of the Sub-Clause:</p> <p>"As an example, and without limitation to other possible causes, any suspension of work caused by any failure from the Contractor to comply with the obligations stated:</p> <ul style="list-style-type: none"> (a) Under the SHE Manual (if any) (b) Under Sub-Clause 4.8 as to safety procedures; (c) Under Sub-Clause 4.9 as to the quality assurance; (d) Under Sub-Clause 4.18 as to the protection of the environment; or (e) Under Sub-Clause 6.7 as to health and safety; <p>shall be considered as cause of suspension which is the responsibility of the Contractor".</p>
13.3 Variation Procedure	13.3	<p>Replace the Sub-Clause 13.3 of GCC with the following:</p> <p>If the Engineer requests a proposal, prior to instructing a Variation, the Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:</p> <ul style="list-style-type: none"> (a) a description of the proposed work to be performed and a programme for its execution, (b) the Contractor's proposal for any necessary modifications to the programme according to Sub-Clause 8.3 [Programme] and to the Time for Completion, and (c) the Contractor's proposal for evaluation of the Variation. (d) The Engineer shall, as soon as practicable after receiving such proposal (under Sub-Clause 13.2 [Value Engineering] or otherwise), respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response. (e) Consent of the Engineer & approval of Employer is required on any proposed Variation issued for substantial technical modifications, additional cost or extension of

Conditions	Sub-Clause	Specific Provisions
		<p>time. Such Variation shall be consolidated in a signed Amendment to Contract agreed by both Parties.</p> <p>(f) Each instruction to execute a Variation, with any requirements for the recording of Costs, shall be issued by the Engineer to the Contractor (with the approval from Employer), who shall acknowledge receipt.</p> <p>Each Variation shall be processed in accordance with detailed procedures Described in Particular Conditions, unless the Engineer instructs or approves otherwise in accordance with this Clause.</p> <p>"Employer's Variation" means a change in the Works Requirements which makes necessary alteration or modification of the Design, quality or scope of Works as described by or referred to in the Works/Employer's Requirements. Changes to any sequence, method or timing of manufacture, testing and Commissioning including Integrated Testing and Commissioning and changes to any part of the Site or access thereto will not constitute Employer's Variation.</p> <p>For any change is scope/ new item/variation which may arise during the execution of works the Engineer shall evaluate the proposal of the Contractor. The Engineer & contractor shall ensure that approval from Employer shall be obtained before taking up such works.</p> <p>An Employer's Variation shall be requested and implemented in accordance with and subject to the following provisions:</p> <p>within 14 days (or such other period as the Engineer may allow) of the Engineer informing the Contractor in writing of the intention to request an Employer's Variation, the Contractor shall notify the Engineer in writing whether in his opinion the Employer's Variation would, if ordered:</p> <ul style="list-style-type: none"> (i) give rise to any entitlement to an extension of time; or (ii) affect the achievement of any Milestone; or (iii) give rise to any entitlement to additional payment; or (iv) affect the warranties of the Contractor set out in Conditions of Contract. <p>and shall submit his proposals as to the terms upon which he would agree to implement the Employer's Variation.</p> <p>The Engineer shall, as soon as practicable after receipt of proposals under sub-clauses 13.2 and / or 13.3, respond with approval, rejection or comments. If the Engineer instructs or approves a Variation, he shall proceed in accordance with Sub-Clause 3.5 to agree or determine adjustments to the Contract Price, Time for Completion and Schedule of Payments. After receipt of proposal, it will be the prerogative of the Employer, whether to Instruct and proceed ahead with the variation or drop the proposal in part or full. In that case, no cost of preparing and submitting the proposal will be payable to Contractor. In case, the design part of variation has been completed on submission of same to the Engineer, the Employer decides to abandon the</p>

Conditions	Sub-Clause	Specific Provisions
		<p>variation, only cost for design to the extent of work done will be paid to the Contractor.</p> <p>Until such time an appropriate rate or price is agreed or determined, the Engineer shall determine a provisional rate or price for the purposes of Interim Payment Certificates as soon as the concerned work commences.</p> <p><i>Procedure for Change of Scope / Variations:</i></p> <p>13.3.1 In the event of the Employer determining that a Change of Scope is necessary, it may direct the Engineer to issue to the Contractor a notice specifying in reasonable detail the works and services contemplated thereunder (the "Change of Scope Notice").</p> <p>13.3.2 Upon receipt of a Change of Scope Notice, the Contractor shall, with due diligence, provide to the Employer and the Engineer such information as is necessary, together with preliminary documentation in support of:</p> <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (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 BSRP Project. <p>For the avoidance of doubt, the Parties expressly agree that subject to the provisions of Clause 13, the Contract Price shall be increased or decreased, as the case may be, on account of Change of Scope.</p> <p>13.3.3 The Contractor's quotation of rates/costs for the Change of Scope shall be determined on the following principles:</p> <p><u>Detail Procedure for Variation in Quantities & Work under different Schedules:</u></p> <p>1. <u>Variation of Quantities (to be paid under Item rate basis) in Price Schedule / Existing BOQ items under the Contract</u></p> <p>The quantities of items shown in the Bill of Quantities are approximate, and liable to vary during the actual execution of the work. Some items / group of items may have to be altered, added or omitted. The Contractor shall be bound to carry out and complete the stipulated work as instructed by the Engineer, irrespective of the magnitude of variations including additions, alterations or omissions</p>

Conditions	Sub-Clause	Specific Provisions
		<p>in the Bill of Quantities, individual items or Group of Items, specified in the Bill of Quantities.</p> <p>i. At the accepted rates of the Contract for Positive variation in quantities to the extent of 25%, except in the case of foundation works. Unless otherwise specifically provided for in the Bill of Quantities or elsewhere in the Contract, the variation of 25% shall be applicable to a group of items (Each schedule as a whole shall be treated as a Group of Items) mentioned therein and not to individual items. In case of variation in quantities on minus side, contract rates will be payable for executed quantities.</p> <p>ii. In case of foundation work, no variation limit applies and Contractor shall carryout the Work, at rates stipulated in the Contract irrespective of any variation.</p> <p>iii. In case of earth work, the aforesaid variation limit of 25% shall apply to the gross quantity of earth work and variation in the quantity of individual classifications of soil will not be subject to this limit where any variation can take place.</p> <p>iv. For items against which the quantity given in the Bills of Quantities is "if or as required", there shall be no increase / decrease of rates whatever be the quantity finally executed.</p> <p>v. Variation in the quantity of items individually costing up to 1% of the total contract value, shall be payable at the rates stated in the Contract notwithstanding the magnitude of variation up to 2% of the original Contract Value for each item.</p> <p>(B.1) At the accepted rates of the Contract for any negative variations.</p> <p>(B.2) At the accepted rates of the Contract up to One twenty-five percent (125%) of awarded quantity.</p> <p>(B.3) In case the positive variation in quantity is more than one twenty-five percent (125%), then</p> <p>a) Schedule of Rate of KPWD at the time of last date of Tender plus or minus Tender premium is applicable OR accepted rates of the Contract whichever is lower.</p> <p>b) If any item is not available in KPWD SOR, then other department SOR's or LAR's at the time of last date of Tender is applicable OR accepted rates of the Contract whichever is lower.</p> <p>2. <u>Variation due to New Items / NS Items</u> In all cases where new items of work are involved, for which there are no items in the accepted Bill of Quantities the Contractor shall give a notice to the Engineer, at least 14 days before the need for their execution arises.</p>

Conditions	Sub-Clause	Specific Provisions
		<p>i. If Employer / Engineer finds that any extra items / NS Item, which is not included in the BOQ Schedules of this contract and is required to be executed, it may be done at:</p> <p>a. Latest Schedule of Rate of KPWD – SR with applicable guidelines and circular / amendments / correction / latest revision / latest publication at the time of execution of the work or</p> <p>b. Latest Schedule of Rate of SWR-USSOR / CPWD / BESCOM / KPTCL / BWSSB with applicable guidelines and circular / amendments / correction / latest revision / latest publication at the time of execution of the work or</p> <p>c. rate for similar items available in Bill of Quantities of the accepted tenders (LAR) duly updated to current price level at 5% Simple interest per year.</p> <p>d. The rates shall be applicable in the above sequence.</p> <p>ii. No Price Adjustment shall be applicable on rates of Items derived under "a" or "b" above. Whereas, rates derived under "c" above shall be fixed for the period of 18 months from the issue of Variation Order and shall be reviewed for further period if required.</p> <p>iii. In case, the above is not possible, following steps are to be followed to arrive rates of such items.</p> <p>a. Cost of Materials at current market price, as actually utilised in the final finished Permanent Works, including a reasonable percentage for wastage and transportation.</p> <p>b. 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.</p> <p>c. 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.</p> <p>d. 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> <p>e. An amount of 20% of items (i), (ii), (iii) and (iv) above is added as Contractor's overheads, profits and corporate taxes. This percentage shall also apply to estimated cost of Materials supplied free of cost to the Contractor.</p> <p>f. If the said Extra Items INS Item are executed / supplied by a sub- contractor / sub agencies complete in all respect on behalf of the Contractor then an amount of 8% only shall be added to the</p>

Conditions	Sub-Clause	Specific Provisions
		<p>billed rate / amount of Sub-Contractor / supplier / sub-agencies and paid to Contractor under a Sub Contract agreement with Contractor. In such case, an amount of 20% payable as per 2(ii) (e) is not applicable.</p> <p>3 (i) In the event of disagreement in respect of determination of rate, the Engineer shall fix such rates or prices as are, in his opinion appropriate and shall notify the Contractor accordingly, with the approval of the Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on account payments to the Contractor. Alternatively, in the event of disagreement, the Contractor shall have no claim to execute extra quantities / new items / NS Items and the Engineer shall be free to get such additional quantities beyond 25% and new items / NS Items executed through any other agency appointed by Employer. However, if the Engineer or the Employer so directs, the Contractor shall be bound to carry out any such additional quantities beyond the limits stated above original quantities and or new items / NS Items and the disagreement or the difference regarding rates to be paid for the same shall be settled in the manner laid down under the conditions for the settlement of dispute.</p> <p>3 (ii) The Contractor shall furnish sufficient information in terms of rates / prices of the works, equipment / components manufactured by the contractor or sourced from the Vendors / Sub-contractors such as: estimated man-hours, man-hours rates for manufactured items, design costs, basic rate of materials, sub-assemblies, taxes, duties, overheads & profits and inflation rate, so as to establish the reasonableness of the variation price. In assessing work covered by any sub-contract, the Engineer shall have, where he deems necessary, access to the original sub-contract conditions, rates, prices and details of the variation claimed and may direct the Contractor to provide a copy of the same, to assist in evaluating any Variations.</p> <p>3 (iii) Any agreement between the Engineer and the Contractor as to the terms upon which an Employer's Variation may be implemented shall have no contractual or other legal effect, until it is in writing and is signed by the Contractor and the Engineer. The Engineer before signing such agreement shall take prior approval of the Employer. The terms of this agreement will be binding upon the Contractor and the Employer. This agreement shall determine the amount which should be added to or deducted from the relevant Cost Centre Amount and / or the revisions (if any) which should be made to the Milestone Payment Schedules as a result of the Variation</p> <p>3 (iv) In the event of the Engineer and the Contractor failing to reach agreement on the revisions to be made to the Cost Centre Amounts, the Engineer shall, with the approval of the Employer, determine the amount which should be added or deducted from the relevant cost centre amount which shall</p>

Conditions	Sub-Clause	Specific Provisions
		<p>be binding on the contractor. In case the Contractor supplies part / incomplete information or refuses to supply the required information, Engineer shall determine the cost of Variation based on the information available to him from any sources which in his judgment can be used to determine the case. The Contractor shall proceed with the Work irrespective of whether an agreement between the Engineer and Contractor as to the terms and price of the variation have been reached or not but may submit his Claim if necessary, in accordance with Sub-clause 20 of GCC.</p> <p>3 (v) If the Engineer withdraws the request for an Employer's Variation, the Contractor shall have no claim of any kind whatsoever arising out of or in connection with any of the proposals made or any failure to reach agreement. In case the Employer's Variation involves omission of part of the Works, the agreement shall address the issue of reduction in the Contract Price.</p>
13.5 Provisional Sums	13.5	<p>Add the following to the Sub-Clause 13.5 of GCC with the following:</p> <p>13.5 Provisional Sums:</p> <p>The amount shown in Provisional sum Schedule are approximate, and liable to vary during the actual execution of the Works. The Contractor shall be bound to carry out and complete the stipulated work as instructed by the Engineer, irrespective of the magnitude of variations including additions or deletions in the quantities of items / amount shown in Provisional sum Schedule.</p>
13.8 Adjustments for changes in cost	13.8	Deleted
14.1 (b) Contract Price	14.1 (b)	<p>Add the following paragraph at the end of the Sub Clause (i) In the event of exemption of custom duties, GST (CGST/IGST/SGST etc.) or any other cess/levy being granted by the Government in respect of the Works, the benefit of the same shall be passed on to the Employer. The Contractor shall therefore maintain meticulous records of all the taxes and duties paid and provide the same as and when required by the Employer. Alternatively, the Employer may direct the Contractor to get the reimbursements based on exemption /concession (as applicable) as per government's order and it shall be obligatory on part of the Contractor to get the reimbursements from the statutory authorities and pass on the benefit to KRIDE.</p> <p>(ii) In case of Contractor's failure in availing the exemptions/ concession as stipulated above, the recovery of equivalent amount will be made from Contractor's dues.</p>
14.2 Advance Payment	14.2	<p>Delete last sentence of third paragraph and replace by the sentence:</p> <p>"This guarantee shall be issued by a reputable bank or financial institution selected by the Contractor and requiring the Bank's non-objection, and shall be in the form annexed to the Particular Conditions."</p> <p>At the end of the third paragraph add the sentence:</p>

Conditions	Sub-Clause	Specific Provisions
		"Guarantees are to be made payable to the Employer's account at the Bank as listed in the annexed form."
14.2 Advance Payment	14.2	<p>Replace the GC Sub-Clause 14.2 with the provisions as under:</p> <p>Mobilisation Advance:</p> <p>(a) Mobilisation Advance shall be limited to 10 % of Accepted Contract Amount payable in two equal instalments (i.e. 5% each). The first instalment shall be paid after the award of Letter of Acceptance, submission of the Performance Security, undertaking and Guarantees, Advance Payment Bank Guarantee and signing of the Contract Agreement.</p> <p>The second instalment shall be paid after utilization of the first instalment to the satisfaction of the Engineer. The Contractor shall be required to submit the 'Utilization Certificate' for all Advances received by them from the Employer under the Contract.</p> <p>(b) Mobilisation Advance shall be paid interest free against acceptable Bank Guarantee from a scheduled commercial bank in India. The value of Bank Guarantee taken towards security of "Mobilisation Advance" shall be 110% of the Advance taken by the Contractor and shall be in the form annexed to the Contract Data or in another form approved by the Employer.</p> <p>Written Request for Advances:</p> <p>All Advances as admissible, shall be payable only on Contractor's written request to the Employer and after the Employer receives</p> <p>(i) the Performance Security in accordance with Sub-Clause 4.2 [Performance Security]</p> <p>(ii) a guarantee in amounts and currencies equal to the advance payment.</p> <p>The Contractor shall ensure that the guarantee is valid and enforceable until the advance payment 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.</p> <p>The recovery of the above Mobilisation advance payments shall be done in respective currencies (INR only) and shall commence at 8th month and ends at 14th month from the date of commencement which is in 6 equal monthly instalments to recover the whole of Mobilisation advance paid.</p> <p>No advance shall be given after 40% of the Original Contract Amount has been paid.</p> <p>The contractor shall always have the option to have the recoveries commenced and / or completed earlier, and / or to have recoveries affected in instalments of higher amount and also to repay part or whole of the advance by direct payment rather than through On-account Bills.</p> <p>In case the Contract is terminated due to default of the contractor or rescinded/foreclosed due to any other reason, the contractor shall return the unrecovered amount of all advances</p>

Conditions	Sub-Clause	Specific Provisions
		<p>within 15 days of issue of notice of termination/rescission/ fore closer of the contract and if the contractor fails to do so due to any reason whatsoever, then interest at an interest rate equal to State Bank of India Base Rate plus 3% per annum or 12% per annum whichever is higher shall be charged on the unrecovered amount of such advances from 16th day onwards till the same is returned by the contractor.</p> <p>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. Employer retains the right for any other remedy prescribed for breach of Contract in this regard. The Contractor, if required by the Engineer shall provide the details of utilization of Mobilization advance.</p>
14.3 Application for Interim Payment Certificates	14.3	<p><i>In the 1st sentence of the 1st paragraph, replace “Three copies” by “in the number of copies specified in the Contract Data”</i></p>
14.5 Plant and Materials intended for the Works	14.5	<p>Replace the GC Sub-Clause 14.5 with the provisions as under:</p> <p>Provisional Payment Against Material at Site: Reinforcement & Cement.</p> <p>A provisional payment on account of materials required for the Permanent Works, shall be paid on request of the Contractor after these materials are brought to Site, against an Indemnity Bond in a form acceptable to Employer is duly executed. The payment shall be limited to 80% of the actual value or assessed value of these materials and the total of such provisional payment on account of construction materials at a time shall be limited to three percent (3%) of Accepted Contract Amount or likely average consumption of such materials for three months, whichever is less and at any time the total outstanding provisional payment against material at site shall not exceed four percent (4%) of the Accepted Contract Amount. The valuation of the average consumption of such main construction materials shall be approved by the Engineer, whose decision shall be final.</p> <p>Written Request for Provisional Payment Against Material at Site</p> <p>The Provisional payments as admissible, shall be payable only on Contractor's written request to the Employer/Engineer.</p> <p>Recovery of Advances/Provisional Payment</p> <p>In case of provisional payment against Materials, the amount consumed every month shall be recovered from the next month's on-account bill and the recovery to be completed in 2 monthly installments. In case recovery could not be made due to any reason, interest will be charged at the rate equal to State Bank of India's Marginal Cost of fund-based Lending Rate (MCLR) + 2% applicable.</p>
14.6 (c) Issue of Interim Payment Certificates	14.6 (c)	<p><i>After paragraph (b) add paragraph (c) as follows:</i></p> <p>In the event of an unresolved non-compliance specified in the SHE Manual, the Engineer shall reduce the value of the Interim Payment Certificates as follows:</p>

Conditions	Sub-Clause	Specific Provisions
		<p>(i) If Non-conformity not resolved after the first occurrence: 33.3% for the first Interim Payment Certificate</p> <p>(ii) If Non-conformity still not resolved: 66.6% for the second Interim Payment Certificate</p> <p>(iii) If Non-conformity still not resolved: 100% for the third Interim Payment Certificate</p> <p>If the Non-conformity is still not resolved after the last Interim Payment Certificate in (iii) above, then payments will be suspended indefinitely until such time as the Non-conformity has been resolved.</p> <p>Following the resolution of the Non-Conformity the reduction(s) will be included in the next Interim Payment Certificate for payment. No interest will be paid on any reductions or suspended payment amounts.</p>
14.7 Time for Payment of Interim Payment Certificates	14.7	<p><u>Add the following to sub clause 14.7:</u></p> <p>Payment procedure shall be as under:</p> <p>i) The Contractor shall submit preferably the monthly bill for payment to the Engineer.</p> <p>ii) Immediately after the submission of bill with all relevant documents / enclosures, 80 % amount of the bill shall be released within 7 working days approximately.</p> <p>iii) The remaining 20% of the bill shall be released after detail scrutiny and subsequent comments / Recommendations by Engineer within 30 days from the date of submission of bill by Contractor.</p> <p>iv) If any adverse comments regarding the workmanship or the quality of the work done in the previous bill is made by the Engineer, then appropriate and suitable amount shall be recovered from successive bills</p> <p>v) Payment of the amount due in each currency shall be made into the bank account, nominated by the Contractor, in the payment country (for this currency) specified in the Contract</p> <p>vi) The Employer shall pay to the Contractor the amount certified in each Interim Payment Certificate. Each interim payment certificate will have two components</p> <ul style="list-style-type: none"> Value of the work / goods / services (without taxes / duties levies / cess etc.). Taxes / duties levies / cess / GST etc.
14.7 Contractor's Bank Account	14.7	<p><i>In the last sentence after "Contractor" insert:</i></p> <p>"and as stated in the Contract Data"</p>
14.8 Delayed Payment Interest – local currency	14.8	<p><i>In the second paragraph after "Conditions," add:</i></p> <p>"for local currency (INR) payments only"</p>
14.9 Payment of Retention Money	14.9	<p><i>In the fifth paragraph, delete first sentence and replace by the sentence:</i></p> <p>"Unless otherwise stated in the Particular Conditions, when the Taking-Over Certificate has been issued for the Works, and the</p>

Conditions	Sub-Clause	Specific Provisions
		first half of the Retention Money has been certified for payment by the Engineer, the Contractor may substitute a guarantee issued by a reputable bank or financial institution selected by the Contractor and requiring the Bank's non-objection, for the second half of the Retention Money. The guarantee for the release of the Retention Money has to be acceptable in form and substance to the Bank."
14.10 Statement at Completion	14.10	<i>In the 1st paragraph, replace "six copies" by "the number of copies stated in the Contract Data"</i>
14.11 Application for Final Payment Certificate	14.11	<i>In the 1st paragraph, replace "six copies" by "the number of copies stated in the Contract Data"</i>
14.15 Currencies of Payment	14.15	<i>In the first sentence replace "Schedule of Payment Currencies" by "Summary of Payment Currencies of the Contract"</i>
14.16 New Clause- Production of Vouchers	14.16	<p><u>Add a new sub clause :14.16:</u></p> <p>Production of Vouchers</p> <p>i. 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.</p> <p>ii. 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</p>
14.17 New Clause - Recovery of money due to the Employer	14.17	<p><u>Add a new sub clause : 14.17:</u></p> <p>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 monies 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 monies due to the Contractor under any other contract between the Employer and the Contractor.</p>
15.2 Termination by Employer	15.2	<p>In the first paragraph, the existing sub-paragraph (f) is deleted and the following is added as (f), (g) and (h):</p> <p>"(f) based on reasonable evidence, has engaged in Corrupt or Fraudulent Practices as defined in the Appendix B to these</p>

Conditions	Sub-Clause	Specific Provisions
		<p>General Conditions, in competing for or in executing the Contract; (g) substantially fails to comply with the SHE Manual; (h) deleted;"</p> <p>Further in the second paragraph, "or (g) or (h)" are added after "or (f)".</p> <p>Add the following Paragraphs to the end of the Sub-clause:</p> <p>"On termination of contract due to Contractor's default the performance security shall be forfeited by encashing the bank guarantee and the balance work shall be got done independently without risk and cost of the failed Contractor. The failed 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 JV or partnership firm shall 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.</p> <p>In case the contractor fails to adhere to the agreed programme of work by margin of 10% of the stipulated period or 21 days, whichever is earlier, or fails to complete the Works or parts of the Works within the stipulated or extended period of completion, or is unlikely to complete the whole Work or part thereof within time because of poor record of progress, the Employer at its sole discretion may terminate only part of the contract also by taking out some part of the total scope of work and may complete or arrange for any other entity through the process of open/limited/single tender or by calling quotations, to do so at the risk and cost of the Contractor."</p>
15.2.1 New Sub-Clause - Termination for Contractor's Default	15.2.1	<p>Add the New sub clause 15.2.1:</p> <p>15.2.1 Part-Termination / De-scoping of Work</p> <p>In case the Contractor fails to adhere to the agreed programme of work by margin of 10% of the stipulated period or 21 days, whichever is earlier, or fails to complete the Works or parts of the Works within the stipulated or extended period of completion, or is unlikely to complete the whole Work or part thereof within time because of poor record of progress, the Employer at its sole discretion may terminate only part / limit the scope / de-scope part of the work of the contract also by taking out some part of the total scope of work and may complete or arrange for any other entity through the process of Open/ Limited/ Single Tender/ by calling quotations or any other manner as deemed fit at the risk and cost of the contractor. In such case, the additional financial implications (if any), shall be debited/ recovered from the any monies due to Contractor and/or performance security. The Contractor shall not be entitled for any claim in this regard whatsoever.</p>
15.6 Corrupt or Fraudulent Practices	15.6	As per GCC
15.7 New Clause - Non-exercise of	15.7	<p>Add a new sub clause :15.8</p> <p>Non-exercise of power not to constitute waiver:</p>

Conditions	Sub-Clause	Specific Provisions
power not to constitute waiver (New Clause)		Provided always that in case any of the powers conferred upon the Employer by Clause 15 (Termination by Employer), shall have become exercisable, and the same may not have been exercised, the non-exercise thereof shall not constitute waiver of any of the conditions thereof
18.5 New Sub-Clause - Liability for breach of professional duty	18.5	<p>Add New sub-clause 18.5 with the following:</p> <p>the Contractor shall effect and maintain professional indemnity insurance against liability arising out of any act, error or omission by the Contractor in carrying out the Contractor's design obligations as follows, AOA (any one accident) limit equal to 6% of the contract value against Price Bid in respect of 'design and construct' with AOY (any one year) limit of 2 incidents in a year. In the Professional Indemnity Insurance Policy, the deductible amount shall not be more than 6% AOA limit. All Policy shall be obtained within Four weeks from 'date of commencement' and shall be valid for five years after date of issue of 'Performance Certificate' or 3 years after commencement of commercial train operations whichever is later. Wherever the Contractor submits policy for shorter period / annual renewable policy, the same shall be renewed before its expiry date. In such situation, the performance guarantee shall be retained till required validity period. The Contractor's submission of such shorter period / renewable policy shall be construed as their irrevocable consent for retention of the performance guarantee.</p>
20.6 Arbitration and Conciliation	20.6	<p>Replace Sub-Clause 20.6, Arbitration with the following:</p> <p>20.6 Arbitration and Conciliation: Disputes shall be settled through two stages:</p> <ol style="list-style-type: none"> 1. Conciliation procedures as established by "The Arbitration and Conciliation Act-1996" (as amended from time to time) and in accordance with this Clause. In the event this procedure fails to resolve the Dispute then; 2. Arbitration procedures undertaken as provided by "Any dispute between the Parties arising out of or in connection with the Contract not settled amicably in respect of which the DB's decision (if any) has not become final and binding shall be finally settled by arbitration. Arbitration shall be conducted as follows: <ul style="list-style-type: none"> a) if the contract is awarded to a foreign company (not incorporated and registered in India) (or if the lead partner is a foreign company, in case of JV), international arbitration with proceedings administered by the International Chamber of Commerce (ICC) and conducted under the ICC Rules of arbitration, by one or more arbitration in accordance with said arbitration rules. The place of arbitration shall be Bengaluru, and the arbitration shall be conducted in English. b) if the Contract is awarded to a domestic company (incorporated and registered in India), arbitration with proceedings conducted in accordance with the laws of India including Arbitration and Conciliation Act, 1996 of

Conditions	Sub-Clause	Specific Provisions
		<p>India. The place of arbitration shall be a neutral location determined in accordance with the applicable rules of arbitration; and the arbitration shall be conducted in the language for communications defined in Sub-Clause 1.4 [Law and Language]."</p> <p>3. The arbitration and conciliation shall proceed in accordance with Annexure-IX-B.</p>
20.9 New Sub - Clause - Suspension of Work on Account of Arbitration	20.9	<p>Add New Sub-Clause Suspension of Work on Account of Arbitration</p> <p>The reference to Conciliation / Arbitration shall proceed notwithstanding that the works shall not then be or be alleged to be complete, provided always that the obligations of the Employer, Engineer and the Contractor shall not be altered by reasons of arbitration being conducted during the progress of the Works. Neither party shall be entitled to suspend the work or part of the work to which the dispute relates on account of arbitration and payments to the Contractor shall continue to be made in terms of the Contract.</p>

K-RIDE

SECTION 8A PART 1 EMPLOYERS REQUIREMENT

GENERAL INFORMATION & SCOPE OF WORK

NAME OF THE WORK

Design and Construction of RCC Box Cut & Cover method to cross the BSRP railway line under the existing road along with construction of drainages along the Channasandra Station location from ch:24+242 to 24+600. along the Corridor-4 Heelalige to Rajankunte. Bangalore.

I) BRIEF SCOPE

The proposed work is in between Heelalige and Rajankunte. The work mainly consists of Design and Construction of Single Cell Closed RCC Box by Cut & Cover method, Earth retaining wall approaches, drainage and footpath works etc. Upkeeping of traffic diversion road. The scope also includes interfacing and coordination with other contractors at the intersection points and with Indian railways/other agencies/authorities/local authorities, wherever required, for construction of 1nos of ROB.

Details of Cut & Cover Box			
SL No	IR Chainage	Location	Proposed structure
1	from Ch:24+242 to 24+600	Channasandra Station location, Bangalore	Single Cell Closed RCC Box

CONSTRUCTION OF SINGLE CELL CLOSED RCC BOX by Cut & Cover Method

- A. Design and Construction of single cell closed RCC box under existing road of required size for BSRP railway line from ch:24+242 to 24+600 (Channasandra Station). The work consists of Construction of single cell closed RCC box by Cut & Cover method, drainage system and Foot path. Scope also includes development of alternate roads, by making good of existing road or construction of new road, temporary traffic diversion and temporary arrangement for traffic movement during the course of construction by providing temporary RH girder or any similar means along with temporary decking sheet, the detail design and method statement for the same shall be submitted for approval.

II) DETAILED SCOPE OF WORK

1.0 OBJECTIVE

The objective of the contract is Design, Proof Checking of the Designs by a separate (not the same agency, which designed the structures) approved agency of repute, Construction & testing of permanent works, construction and removal of Temporary Works, Temporary traffic diversions wherever required and rectification of defects appearing in Permanent Works by the contractor in the manner stipulated in the Contract. Detailed design of the structures are to be carried out in line with approved GAD's. 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 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.

Below table shows the details of Road over Bridge (ROB)

Details of Cut & Cover Box			
SL No	IR Chainage	Proposed structure	Structure details
1	from ch:24+242 to 24+600	Single Cell Closed RCC Box Road over Bridge (ROB)	Single cell closed RCC Box to cross the BSRP railway line under the existing road from Ch 24+242 to 24+600 at Chennasandra metro station

A. Single cell closed RCC Box to cross the BSRP railway line under the existing road permanent works.

- i. Design & Construction of Casting situ RCC Box of required size in Cut & Cover method to cross the BSRP railway line under the existing road including the design & construction of Secant piles and beams (pile caps) as earth retaining structure (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 founding level will be decided based on the Geotechnical reports by Engineer / Employer during construction or based on the method as approved by Engineer. The construction methodology shall be adopted in a such a way that the traffic movement shall not be interrupted during the course of the construction. The Construction methodology is required to be approved by Engineer before carrying out the works.
- ii. Deleted.
- iii. Construction of Cast In situ RCC Box / Secant pile/ Wing wall, as specified or as directed.
- iv. 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.

Cast in situ RCC box shall be checked for UPV (Ultra sonic pulse velocity) test by NABL Accredited Agency. Rates for the test are included in Scope.
- v. Providing and laying M35 grade concrete using 20mm maximum nominal size aggregates, reinforced cement concrete including the cost of cement, fine aggregates, coarse aggregates and using required dosage of admixture in concrete for obtaining required workability as per specification for all structures of all size, shape & heights for RCC wall, RCC slab, crash barrier, Median, entry structure columns, beam, plinth beam, staircase, 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. Scope shall include cost of providing grooves, chamfers, mouldings, cut-outs, necessary fixtures, insert plates, sleeves for various purposes, shear connectors etc. complete as per drawings, specifications and as directed by the Engineer. The scope shall also include preparation of construction joints as per specification and providing approved wire mesh/weld mesh at such location as approved by Engineer or as shown in drawings. Form work to be designed in such a way that traffic on road / IR track is allowed during the work at all times.
- vi. Providing & laying Reinforced cement concrete M35 grade using 20mm maximum nominal size aggregates or as per approved design and drawing for 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 also to be conducted as per applicable IS code.

Scope 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 scope 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. Contractor shall ensure that during transportation, the carried material does not spill out.
- vii. Manholes with manhole covers made of Cast Iron on the deck with locking arrangement as per the drawing.

- viii. Earthing arrangement, drainage system, inserts for signaling masts in the parapets and other systems, as may be required.
- ix. Providing Retained soil/fill or Reinforced soil/fill in the approaches as per relevant code, design, drawings or as per instruction of Engineer.
- x. Providing, placing and compacting to desired density approved backfill material in layers as per approved methodology including testing for reinforced fill portion and random fill portion in the approaches between the Reinforced Soil (RS) wall panels as per approved drawings as per clause 3103 of MORTH specification. The soil should be predominately coarse grained, not more than 10% of particles should pass 75-micron sieve.
- xi. Conducting all relevant tests on, soil reinforcements, soil used in backfill etc. as per relevant code, design, drawings or as per instruction of Engineer.
- xii. Providing & laying Reinforced cement concrete M35 grade using 20mm maximum nominal size aggregates or as per approved design and drawing, Reinforced cement concrete using Portland slag cement (Directly from manufacturer or blending of OPC+GGBS for the following concrete works:
 - a. 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 etc. including excavation for all depths from lowest ground level through existing water bound macadam road / bituminous road / concrete road / soil / moorum / 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.
 - b. The Scope 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.
 - c. The contractor shall ensure that during transportation, the carried material does not spill out.
 - d. The scope shall include cost of using required dosage of admixture in concrete for obtaining required workability as per approval of Engineer, curing of concrete.
- xiii. Providing TMT-500D / 550D grade steel bar reinforcement (conforming to IS:1786, HYSD Fe 500 / 550 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.

As far as possible bars of the maximum length available shall be used. For bars having larger diameter more than 20mm mechanical couplers shall be provided as per Technical Specifications and no lap shall be permitted. Welding in lieu is not permitted unless specified in the drawings or as instructed by the Engineer. Lap joints are permitted wherever required. However, mechanical couplers in place of lap joints may be permitted by the Employer without any extra payment, with the specific approval of Employer/Engineer for the specific elements / members / works / locations on case-to-case basis.

For pile reinforcement, welding of lap joint is allowed.

The scope includes 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.

The scope includes 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. Anti-corrosive treatment / paints exposed steel surfaces and all other related operations as required to complete the work as per specifications.

- xiv. Supplying of uncoated stress-relieved low relaxation steel strands conforming to IS: 14268 (class-II), for pre-tensioning of girders, slab etc. 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.

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. Scope includes filling HDPE debonding tubes with grease as specified in ASTM.

- xv. 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 15 cm 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.
- Skin reinforcement, if necessary, shall be provided
- xvi. Providing Boulder under foundations, hand packed boulders & cobbles with smaller size boulders toward the back including all lead, lift, labour & other incidental charges as complete work in all respects.
- xvii. Providing and laying of filter media consisting of granular materials of GW, GP, SW groups as per the approved specification in required profile behind Slab bridges, RCC boxes, Abutments, wing walls / return walls etc., above bed level with all labour and material complete job as per drawing and technical specification of RDSO.
- xviii. 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.
- xix. Providing and fixing G.I. brackets with suitable covering arrangement at required locations for electric cables & Signaling and Telecom cables as per tender drawing.
- xx. 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.
- xxi. Preparation of temporary Arrangement Drawings (TAD), Launching Scheme, Fabrication/Detailed Shop Drawings including drawing office dispatch lists (DODL), and other documentation as required by Engineer.
- xxii. Preparation of Quality Assurance Plan (QAP) for super-structure including bearings.
- xxiii. Provision of integrated drainage system for ROB which includes cross drains, catch water drains at approaches with grating arrangements before hump, side drains, soak pit/collection well/injection well, etc. as per relevant IR Code or as per the relevant IR instructions.
- xxiv. 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 shall be operated for any type of launching scheme adopted.
- xxv. 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.
- xxvi. 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.
- xxvii. 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.

B. DESIGN CRITERIA & SPECIFICATIONS FOR CUT & COVER SECTION

- i. Submission Design Basis Report DBR : Design Basis report shall be prepared and submitted by the Contractor and shall get it approved from Engineer. Design Basis defines the structural design assumptions for Cut & Cover portion, as described above. The aim is to collect in a unique document for all the design input and procedures to be employed for the calculation and design of underground structures. The report gives the basis for calculations including the applicable codes and standards, the material properties, the design method, the loading to be taken into account and the considered load combinations. The present document will be used as reference for the future calculation notes and structural drawings. It should be adopted in conjunction with the Geotechnical Interpretative Report specific for each Underground structure.
- ii. CUT & COVER STRUCTURES : This section summarizes the Civil, Structural and Geotechnical design philosophy and other related parameters for Cut & cover Boxes. For geotechnical design parameters, reference shall be made to Geotechnical Interpretative Report and for geotechnical investigations related works.
- iii. General Principle:

Cut-and-cover structures include Cut & Cover Boxes, Cut & Construct Open U Ramp structures linking with Elevated Ramps and the structures other than bored tunnels that are required to be constructed below ground surface.

The cut & cover excavation shall be carried out using temporary earth retaining structures upto the level of sound rock. From this level open excavation with temporary rock supports shall be made upto the bottom of the base slab. Where rock is not met upto final excavation level temporary earth retaining structures will go upto final excavation level and further embedding below the final excavation level .

The base slab shall resist the water pressure and shall act as a raft to transfer the load from the columns and external walls. The platform slab which rests on the base slab, supports the passenger and plant loads at platform level.

The cut-and-cover structure is proposed to be a rigid box section with permanent walls as external wall support system and beam-slab & column forming the internal structural framing. The roof slab shall support the soil and vehicular LL surcharge while the passenger and plant loads are carried by the concourse slab. The track and platform loads shall be supported by the base slab. The permanent walls shall resist the lateral earth and hydrostatic pressures in addition to the LL and building surcharge (horizontal loads) from nearby road and buildings.

The completed structures shall comply with Contract water-tightness criteria.

Where temporary walls are intended as part of the Permanent Works, the Contractor shall justify the feasibility and suitability of such to the Engineer / Employers Representative. The durability criteria shall also be satisfied to ensure 100 years design life.

The Contractor shall take into account the following in the design of cut-and cover structures.

- a) Method of construction, including temporary works and construction sequence.
- b) Ground/structure interaction, including the effects of temporary works.
- c) Ground pressure, shear force and bending moment distribution during construction and in the long-term.
- d) Short- and long-term ground and groundwater response.
- e) Other static loads changes such as; excavation, surcharge, traffic loadings and the like.
- f) Long-term water table level changes
- g) dynamic (such as seismic or vibratory plant) loads and displacements.

For the purposes of assessing ground and groundwater pressures during service stage, the cut and cover structures shall be considered to be effectively impermeable rigid box structures subject to "at rest" (K_0) earth pressure and "active" (K_a) earth pressure as the case may be.

The Contractor shall design to minimize the effects (such as movement, distortion of the ground and the like) on all Existing Building Structure(EBS) that may be affected by the Works. Where necessary the Contractor shall provide additional support for these EBS. Building damage assessment reports along the zone of construction shall be prepared and the type of strengthening required may be decided based on category of building.

- iv. Design Principles

The design of all cut-and-cover structures shall take into account, but not be limited to the following:

- a) support systems to ensure their integrity and water-tightness and to provide adequate support to the ground during excavation.
 - b) Open excavation shall be carried out in good quality rock with appropriate temporary support
 - c) (e.g. rock bolts, shotcrete etc.) to stabilize rock slopes and key blocks. All live loads including train load, passenger load, road traffic loads etc.
 - d) Equipment loads in stations.
 - e) Slope instability .
 - f) The variation in ground conditions along the alignment.
 - g) The variation in engineering properties of soil or rock within the influence of the proposed works.
 - h) All dewatering and groundwater cut-off systems required to maintain dry and stable conditions within all excavations required for these Works.
 - i) Any ground treatment before, during or after construction of the Works (e.g. groundwater recharge) which is required to stabilise the ground and EBS in order to minimise adjacent ground and EBS movement and distortion.
 - j) Methods by which the completed structure shall be secured against flotation. Any temporary dewatering system shall not be turned off till the structure is safe against leakage or flotation when the ground water returns to the design levels.
 - k) Differential groundwater pressures due to inside and outside water table
 - l) Methods of waterproofing the completed structure.
 - m) Drawdown of the groundwater levels outside the cut and cover box walls shall be limited to not more than 2 metres from the existing average groundwater level in the zone of construction. Recharging pits shall be provided in case there is a danger of reduction in water table outside area of construction. This is necessary to prevent settlement of ground outside area of construction. In general, groundwater levels interior to construction excavations shall not be depressed more than 1.0m below final base slab level.
 - n) The magnitude of ground and EBS movements and distortions, and changes in loading conditions on these EBS that might be expected as a result of the works and how these will be mitigated so as to comply with any imposed constraints or so as to minimise disturbance to these EBS.
 - o) Any difficulties that the Contractor's intended plant/machinery/methods might meet with in respect clearances, working space and obstruction to excavation.
 - p) Maintenance of traffic flows along roads including access to adjoining properties and roads.
 - q) Noise levels produced during construction. m. Control of heave, swell, piping and instability of the excavations.
 - r) The effects of vibration and vibration induced movements – e.g. earthquake.
- v. Station Box Modelling
- a) The Station Box shall be analyzed for the loads and effects specified in this design manual to obtain the most severe combinations and envelopes of force resultants (moments, shear, axial force, deflection) on every component member.
 - b) Irregular or analytically complex parts of station box which do not exhibit two-dimensional behavior will be modelled as 3D centerline model using finite element plate representing slabs/walls and line elements representing beams/columns.
 - c) Other parts of structures with regular shapes (e.g. station mid), which are away from zones of three-dimensional effects, shall be analyzed as plane frames
 - d) Modelling is done in STAAD Pro./Any software should have Each node of the plate element / beam element shall have 6 degree of freedom.
 - e) Soil structure interaction at base of station has been simulated by soil springs. Soil springs is applied on the staad model as per geotechnical interpretative report.
 - f) Analysis for station box is carried out to obtain the effects of various loads during sequential excavation, backfilling, construction, traffic decking, movement of vehicles and construction equipment

- g) As per the standard engineering practice and design standards, moments are picked at the face of each structural element and shear force at section 'd' away from face of support where 'd' is the effective depth of beam/slab.
- h) For design of slab/wall element the force effects from center stress moments in STAAD/any software is obtained.
- i) Twisting/Warping moments encountered in plate elements M_{xy} & M_{yx} shall be converted using Wood-Armer's Equation (Wood, R. H. (1968). "The Reinforcement of Slabs in Accordance with a Pre-Determined Field of Moments", Concrete, Feb 1968 page. 69–76).

vi. Excavation Support:

The Contractor shall prepare and submit a detailed Design Report including calculations, schedules and drawings for each proposed excavation support wall construction, prior to the commencement of any such works. This Design Report shall take into account but not be limited to the following:

- a) Earth pressure.
- b) Hydrostatic pressure.
- c) Deck load
- d) Surcharge loads.
- e) Seismic and/or vibratory loads
- f) Support types and arrangement.
- g) Temperature loads
- h) Any other incidental/accidental load.
- i) Construction/deconstruction sequence.
- j) Calculated ground and adjacent EBS movements and distortions.
- k) Calculated fluctuations in groundwater levels both within and outside of the excavation and support walls.
- l) Calculated changes in EBS loading conditions.
- m) For Deep Excavation in rocky strata, Rock bolt and Shotcrete to be used.

vii. Method Statement

- a) The Contractor shall prepare a Method Statement giving the full details of materials, plant and operations involved in the construction of excavation support walls. This Method Statement shall be incorporated into the Design Report submission for the Employers Representatives notice and shall include but not be limited to the following details:
 - b) Formation of the joints between panels and installation of water stops.
 - c) Method of producing the workable concrete.
 - d) Methods of handling within the excavations and disposing of groundwater outside of the excavations.
 - e) Sequence of excavation and concreting of panels.
 - f) Methods of instrumenting, monitoring and reporting of the performance of all adjacent EBS that may be affected by the works.
 - g) Type and construction of permanent lining wall.
 - h) Emergency procedures to be implemented in the event that monitoring indicates tolerances associated with the excavation support wall may be exceeded.
 - i) Where temporary ground support is to be provided using bentonite slurry, the following additional information shall be provided in the Method Statement for these works.
 - j) Mixing, transporting and placing equipment for the bentonite slurry.
 - k) Type, source, chemical and physical properties of the bentonite to be used.
 - l) Method of disposal of contaminated bentonite slurry.
 - m) Stability, dimensions and details of guide walls.
 - n) Cleaning and re-use of the bentonite slurry.

- o) Calculations to show that the density of the bentonite and lowest head of slurry are sufficient to maintain the stability of the trench excavated for the support wall, in the ground conditions envisaged, to its full depth.

viii. Design Life and Serviceability:

The design life of a structure or component is that period for which the structural item is required to fulfil its intended function when maintained in accordance with agreed procedures to meet a required level of performance. The definition of a design life for a structure or component does not necessarily mean that the structure will no longer be fit for its intended purpose at the end of that period. Neither will it be expected to necessarily continue to be serviceable for that length of time without adequate maintenance to mitigate the demands of degradation.

The design life of all permanent works shall be a minimum of 100 years unless otherwise specified or agreed upon.

Adequate measures shall be taken to ensure a minimum of 100 years serviceability of civil structures by producing durable concrete structures. For achieving this suitable property enhancers / blending materials conforming to relevant BIS codes (or more stringent International Standards/Codes wherever required) may be used as deemed appropriate and subject to Notice of No Objection from the Engineer.

Durability approach and assessment report (DAAR) to ensure service life of structures shall be submitted and to be got approved before start of work on site.

ix. Material Parameters

- a) Cement: Cement shall be as defined in Construction Specifications for Civil Works.
- b) Concrete: Concrete shall be as defined in Construction Specifications for Civil Works.
The characteristic strengths (fck) and the corresponding mechanical characteristics necessary for design as per requirements for 100 years of design life of structures are indicated in Table here below: -
- 1) Characteristics of main construction Materials (structural elements in contact with non-aggressive soil of Bangalore)
- c) Ordinary Portland Cement (OPC) of 33 grade, 43 and 53 grade conforming to IS269, IS 8112-1989 and IS 12269-1987, respectively, shall be used.
- d) Portland Pozzolana Cement (PPC) conforming to IS 1489 (Part 1) may also be used.
- e) Sulphate-resistant Portland cement conforming to IS 12330 for structural elements exposed to soil may be used.
- f) For foundation and substructure, OPC substitution by Blast Furnace Slag Cement conforming to IS 455 may also be used.

Table 1

S. No.	Structural Components	Minimum Grade of concrete (cube)
1	Inner slabs, beams & Columns	M35
2	Outer slabs	M35
3	Outer cast-in-situ walls against form work	
4	Diaphragm walls	M35
5	Secant Pile, barrettes, compression piles	M35

- 2) Characteristics of main construction Materials (structural elements in contact with Drain Water, chemically aggressive environment and soils).

x. Cover Requirements for 100 years durability of structures

- 1) For Underground structural elements in contact with non-aggressive soil of Bangalore

Table 2

S. No.	Structural Components	Nominal Cover/clear cover to any reinforcement (mm)
1	Inner slabs, beams & columns	50
2	Outer slabs at roof	50
3	Outer Base slabs	75
4	Outer cast-in-situ walls against form work	50
5	Diaphragm walls	75
6	Secant pile, barrettes, compression piles	80
7	Platform slabs, internal RCC walls, vent shaft walls, staircase slabs, UPE and OTE ducts	35

2) For Underground structural elements in contact with Drain water, aggressive soil and environment:

Table 3

S. No.	Structural Components	Nominal Cover/clear cover to Outermost reinforcement (mm)
1	Outer slabs	65
2	Outer cast-in-situ walls against form work	65
3	Diaphragm walls	90
4	Tension Pile, barrettes, compression piles	80

xi. Density

Table 4

Material	Density
Reinforced Concrete (With above 2% reinforcement)	25 kN/m ³
Reinforced Concrete (With 2% or less reinforcement)	24 kN/m ³
Prestressed Concrete	24 kN/m ³
Plain Cement Concrete	23 kN/m ³
Steel	78.50 kN/m ³
Water	10 kN/m ³

Actual density to be validated as per actual mix design

Grade of Concrete and their properties

Table 5

Grade of concrete	Compressive cube strength fck (150mm Cube) N/mm ²	Coefficient of Thermal Expansion per o Celsius	Poisson's Ratio
M35	35	1.17 x 10 ⁻⁵	0.15
M40	40	1.17 x 10 ⁻⁵	0.15
M45	45	1.17 x 10 ⁻⁵	0.15
M50	50	1.17 x 10 ⁻⁵	0.15
M60	60	1.17 x 10 ⁻⁵	0.15

Notes:

- Strength of concrete given in table is the specified characteristic compressive strength of 150 millimeter cube at 28 days.
- Short term modulus of elasticity (E_c) & modular (m) should be calculated as per clause. 6.2.3.1 and B-(1.3) D of IS 456 : 2000 respectively.

xii. 3.7.5 Poisson's Ratio

Poisson's ratio for all concrete: 0.15

xiii. 3.7.6 Thermal Expansion Coefficient

As per cl. 6.2.6 of IS: 456

xiv. 3.7.7 Young's Modulus

Instantaneous modulus (E) is taken as per clause 6.2.3.1 of IS 456:2000 $E = 5000 (f_{ck})^{0.5}$
Where, f_{ck} is the Characteristic Compressive Strength of 150mm Cube at 28 days.

3.7.8 Modular Ratio

Modular ratio for all concrete grades shall be taken as per Annex B of IS:456.

Modular ratio, for cracked section $m = E_s/E_{eff}$

Where, E_s = Steel Modulus

$E_{eff} = E_{eff}$. Modulus of Concrete ($E_{eff} = E_c / (1+\mu)$)

Only thermo-mechanically treated reinforcement bars of grade Fe500D with minimum total elongation of 14.5% conforming to IS 1786 shall be adopted. However, for design of shear stirrups strength parameters of Fe415 only shall be considered.

The material properties shall be as follows:

Table 6

Young's Modulus [Mpa]	Yield Stress [Mpa]	Diameter s (mm)	Density [kN/m ³]	Poisson's Ratio	Thermal Coefficient per Degree centigrade
2,00,000	415 for Fe415 500 for Fe 500 D	8,10,12, 16,20, 25, 28,32,36 ,40	78.5	0.3	12x10 ⁻⁶

xv. Structural Steel:

General :

Design of Structural steel work shall comply with IS:800.

Two types of structural steel to be used and shall comply with the following standards:

- IS:4923 "Hollow steel sections for structural use with Yst310".
- IS: 2062 "Steel for General Structural Purposes (Grade Designation E250 BR).

(3) Hollow steel sections shall be square (SHS) or rectangular (RHS). Other traditional rolled sections like plates, angles, channels, joists can also be used where required.

(4) The connections within the steel structure shall be designed as direct welded members with or without gusset plates. The minimum thickness of metal for SHS/RHS sections for main chord members as well as bracings shall be 4 millimetres as applicable for steel tubes in cl. 6.3 of IS: 806.

(5) IS:800-2007 shall be followed and limit state method of design shall be adopted for steel structures

Material Properties shall be as follows:

Table 7

Steel Type	Young's Modulus	Tensile Strength	Yield Strength	Density [kN/m ³]	Poisson's Ratio	Thermal Expansion Coefficient
For Hollow Steel Sections (Conforming to IS: 4923)	200000 Mpa	450 Mpa	310 Mpa	78.5	0.30	1.2x10 ⁻⁵ Per °C
Structural Steel (Conforming to IS: 2062)		410 Mpa	250 Mpa (for t<20mm), 240MPa (for 20mm < t < 40 mm), 230MPa (for t > 40mm)			

xvi. Durability Criteria In carrying out structural designs

it shall be ensured that both the serviceability and ultimate limit states have been checked in accordance with the applicable Standards and Codes. To achieve durability, the design shall take into account the prevailing ground and groundwater conditions and those predicted to occur at the site within the design life of the Works.

Water permeability in concrete shall not be more than 10 millimetres (at the concrete age of 28 days) according to DIN 1048 and RCPT value (ability to resist chloride ion penetration) shall not exceed 1000 coulombs at the concrete age of 28 days according to ASTM C-1202. For all other durability requirements refer Construction Specifications for Civil Works.

xvii. Fire Resistance Period :

Minimum element sizes for 4-hours Fire Protection

All structures shall be designed for fire protection as specified by the applicable standards and codes. Materials specified for the Works shall be non-combustible and nor emit toxic fumes when subject to heat or fire, except where permitted under the Contract. In all cases where there is significant fire risk, materials shall be self-extinguishing, low flammability, low smoke and low toxicity. All the main elements of the station structures (Roof Slab, Concourse Slab, Base Slab, Outer Wall, Columns & any load bearing RCC Walls, ASS -TSS room RCC walls) and including firemen staircase & Public fire escape underground structures shall be designed for a minimum fire resistance period of 4 hours. All other element like Platform slab, vent shafts, UPE Walls, OTE Ducts, Stub Columns, other non load bearing RCC walls etc. shall be designed for 2-hour fire rating. A nominal cover shall be provided for four hours or two hours of fire resistance respectively as per IS and NBC codes.

Table 8

Element	Minimum Sizes for 4-hour FRP (mm)
RC Slab Thickness	170
RC Beam Width	280
RC Column Sizes	450
RC Wall Thickness: <1% reinforcement	240
RC Wall Thickness: >1% reinforcement	180
Blockwork Wall Thickness	150
Staircase (waists)	170

All the structural elements above ground shall be designed for a minimum fire resistance period of 2 hours.

The minimum element thicknesses for this fire resistance shall be as follows:

Minimum element sizes for 2-hours Fire Protection.

Table 9

Sl. No.	Element	Minimum Dimension (mm)
1	RC Slab	125
2	RC Beams	200
3	RC Columns	300
4	RC Walls	160
5	Block Work Wall	100

xviii. Crack Width:

All structural concrete elements shall be designed to prevent excessive cracking due to flexure, early age thermal and shrinkage. The maximum crack widths shall be as specified below.

- a) Flexural Cracking Formulae for Flexural crack width shall be as mentioned in Annex F of IS 456:2000. The limits specified shall apply irrespective of whether any additional protection, such as waterproofing membrane are provided to the members at the exposed face of the structure.
- b) Early age Thermal and Shrinkage Cracking
 - 1) Suitable reinforcement shall be designed to prevent early age thermal and shrinkage cracking for walls and slabs more than 250 millimetres thick and subjected to internal and external restraints during construction. The thermal and shrinkage strains due to early age temperature differences and shrinkage shall be accounted for in the design of reinforcement for cracking.
 - 2) It is preferred that smaller diameter bars in any direction are placed at closer intervals to prevent early age thermal and shrinkage cracks. The limits specified below shall be imposed. Guidance can be sought from CIRIA C660-latest version on Early Age Thermal Control of Concrete in this matter.
 - 3) Minimum reinforcement shall be higher of:
 - a) 0.125% of cross-sectional area of structural member on each face in each direction.
 - b) Reinforcement required as per Early Age Thermal (EAT) control of concrete.
 - c) For Underground structural elements in contact with non-aggressive soil of Bangalore

Table 10

Element	Durability Exposure Condition	Minimum Cover to be considered for Crack width Check (mm) As per Appendix -2	Nominal required cover (mm)	Max Crackwidth (mm)
Diaphragm Wall/ Secant Piles wall	Severe Moderate	45 40	75	0.2 (for ground face) 0.3 (for nonground face)
Pile cap (side and bottom faces) resting on layer of blinding concrete not less than 50mm thick	Severe	45	75	0.2
Base Slab -Top Surface	Moderate	40	45	0.3
Base Slab -Bottom Surface (cast against ground/blinding)	Severe	45	50	0.2
Basement Walls a) Face in contact with ground b) Other faces	Severe Moderate	45 40	50 45	0.2 0.3
Columns (Internal)	Moderate	40	45	0.3
Load Bearing Walls (Internal)	Moderate	40	45	0.3
Non -Load bearing Walls (Internal)	Moderate	40	45	0.3
Stairs	Moderate	40	45	0.3
Water Tank	Severe	45	50	0.2
Beams Top Surface (Contact with ground) Top Surface (No Contact with ground)	Severe Moderate	45 40	50 45	0.2 0.3
Bottom and sides Continuous Simply supported	Moderate	40 40	45 45	0.3
Slabs Top surface (contact with ground) Top Surface (No Contact with ground) Bottom surface Continuous Simply supported	Severe Moderate Moderate Moderate	45 40 40 40	50 45 45 45	0.2 0.3 0.3 0.3

The cover shall be considered as defined in sketches below. However, as per durability requirements of 100 years for design life of underground structures and minimum concrete cover, BS:8500-1-2006 has also to be followed for the exposure condition for the different members as under:

Table 11

- Corrosion by carbonation criteria**

S. No.	Structural Components	Exposure Class
1	All Structural members (outer/Inner)	XC3

- Corrosion by Carbonation criteria with hydraulic gradient more than 5 meter**

S. No.	Structural Components	Exposure Class
1	All Outer structural members	XC2 / AC-2/DC-2 (FND2)

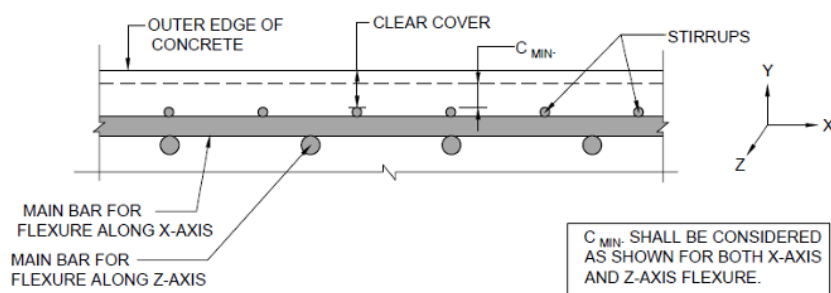
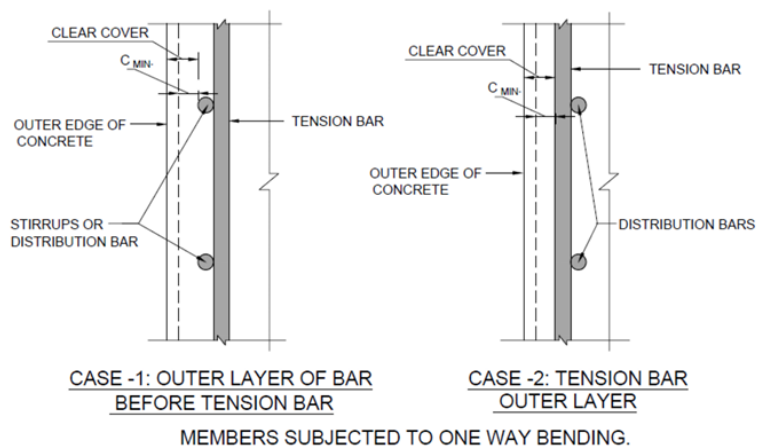
The parameters such as Grade of Concrete, Concrete cover etc. shall be provided as per worst of both as mentioned above.

Corrosion by chloride criteria for members in contact with aggressive soil/ Nallah etc.

Where soil is aggressive in addition to above criteria (given in A & B), following criteria shall also be ensured:

Table 12

S. No.	Structural Components	Exposure Class
1	All Outer structural members	XD1



Permissible crack width

1. For Members in Contact with Soil: - 0.2mm for soil face, 0.3 mm for inner face
2. For Members not in Contact with Soil: - 0.3 mm
3. For Water Tanks: - 0.2 mm

xix. **LOADS AND REQUIREMENTS**

General

Unless specified otherwise the design of concrete and steel elements shall conform to IS 456 and IS 800, respectively.

Nominal Loads

For the purpose of computing stresses and deformations, the following minimum load types and consequential effects shall be taken into account as applicable.

Dead loads (including notional loads)	DL
Superimposed Dead loads	SIDL

Imposed (Live) loads	LL
Railway loads	RL
Fatigue	FG
Dynamic	DY
Derailment	DR
Wind Loads	WL
Temperature loads	TE
Seismic Loads	EQ
Construction/Erection	ER
Shrinkage	SH
Creep	CP
Movement/ Distortion	MD
Earth Pressure	EP
Surcharge	SR
Hydrostatic	WP
Accidental	AC
Redundancy	R

xx. Design Loads

Design shall include all of the following loads: **Dead Loads**

Self-weight of the materials shall be calculated in accordance with IS 875:1987 Part 1.

Superimposed Dead Loads and Imposed (Live) Load

The minimum distributed and concentrated loads shall be in accordance with following Table, and Contract specifications.

Superimposed Dead Loads (SIDL) & Imposed (Live) Loads

KRIDE DBR 2.4.2 Clause shall be referred and 2.4.3 for live load.

Floor finish - 3.6 kN/m²

Suspension load - 2 kN/m²

Light partition wall - 1 kN/m²

Solar Panel load – 30 kg/m²

UPS Room - 25 kN/m²

ASS Room = 15 kN/m²

Other Technical Room = 10 kg/m²

The above should be verified with actual load and it's location Values are minimum load to be considered in design actual load shall be calculated on the basis of equipment and machinery which have to be installed at detail design stage. The concentrated load of 40kN for ASS/UPS room and 20 kN for other technical room shall also be considered.

All imposed load (LL) for public/ staff room to be kept kN/m² (refer clause number 2.4.3)

Loads due to platform screen door shall be considered as per actual

All imposed load (LL) for public/staff room to be kept 5 kN/m²

Wind load refer DBR Clause No 2.4.5.
Wind speed considered is 33m/s

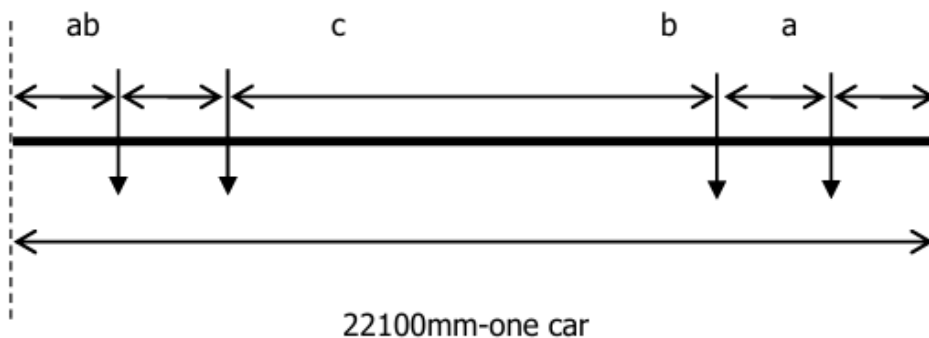
Notes:

1. Stairs and landings to be designed for the same load as the floors to which they give access with a minimum of 2.5 kN/m² and a maximum of 10 kN/m² and public area staircase with minimum 5 kN/m².
2. Concentrated loads act on a square of 300 mm each side.
3. As specified or wall loads in accordance with layout in architectural plan, whichever is greater.
4. All loads are unfactored.
5. Minimum of 100 mm thick screed on top, unit weight of 24 kN/m³.
6. As specified above or the imposed load from services fixed to the underside of floor whichever is greater.
7. The design loads shall be actual plant/equipment loads or the ones specified above, whichever is maximum.
For seismic design plate/machinery loading shall be considered as Super Imposed Dead Load.
8. Backfill / Earth Load Shall be calculated for the available soil depth for a unit weight of soil of 20 kN/m³.
9. Live Load surcharge shall be minimum as 20 kN/m² at ground level (fill depth greater than 1.3m) or from actual load dispersion in case it gets higher than 20 kN/m² for the areas under roads etc.
10. The loads due to Track :
 - a) Track work - UIC rails and other fittings and accessories.
 - b) Track bed - RCC blocks or concrete pour or precast slabs in RCC with inserts and fittings in case of unballasted track (450 to 600 mm thick). Other loads -: as per Indian Railway Standards (IRS) and Bureau of Indian Standards (BIS)
11. Construction Live Load (on c/c box): 10 kPa on concourse and 20 kPa on roof level with no finishes.
12. allowance and loads from temporary deck (dead load+ live load) shall be as per actual

xxi. **Railway Loads**

A) Vertical Train Live Load

The Train Live Load will have the following axle configuration



All axle loads = 17 tons

Maximum number of successive cars = 6

Configuration (alternative -1)

$$a = 2250 \text{ mm}$$

$$b = 2500 \text{ mm}$$

$$c = 12600 \text{ mm} \quad (2a+2b+c = 22100 \text{ mm})$$

Configuration (alternative - 2)

$$a = 2605 \text{ mm}$$

$$b = 2290 \text{ mm}$$

$$c = 12310 \text{ mm} \quad (2a+2b+c = 22100 \text{ mm})$$

Maximum number of axles shall be loaded on the station to arrive at maximum longitudinal force, max shear and max BM.

* Details shown above are indicative only. Actual details of the Rolling stock and actual axle load to be obtained from NMRC.

B) Horizontal Train Live Load

- Braking load is taken as 18% of the unfactored vertical loads.
- Traction load is taken as 20% of the unfactored vertical loads.

C) Footpath Live Load

Footpath live load shall be adopted as 5.0 kN/m².

D Derailment Loads

The Structural elements within 10m of the center line of track, which are at risk from collision by railway vehicles, shall be designed for the following collision loading. Collision loads shall be considered at ultimate limit state only:

- For Station platform edges a nominal load of 1000kN acting horizontally and normal to the platform slab edge over a length of 2.2m, shall be considered.
- For all structural elements (columns in cross over structure) other than platform edges a nominal point load of 1250kN acting horizontally in any direction at the top of the element level, or 1.2m above the adjacent rail level, whichever is less, shall be considered. Where the soffit of the structural element occurs between 1.2m and 4.0m above adjacent rail level, the load shall be applied at soffit level.

E) Vehicle Collision Load

The vehicle collision load due to highway loading on Retaining wall/ramp shall be considered as per IRC-6 Clause no. 222.

5.3.4 Wind Load

Wind Loads (longitudinal & transverse) shall be calculated as stated in IS 875: Part 3-2015.

Wind loads will be calculated in accordance with IS 875: Part 3-2015.

xxii. Temperature

For underground structure temperature shall not be used. For above ground structure: The loads shall be considered as per Clause-2.6 of IRS-Bridge Rules and Clause-215 of IRC: 6. Temperature variation of +35°C will be considered details of which are given below Maximum Temperature considered as per Annex. F of IRC 6:2017: +47.8°C Minimum Temperature considered as per Annex. F of IRC 6:2017: -0.4°C Temperature variation as per clause 215.2 of IRC 6 will be $= (47.8 - (-0.4)) / 2 + 10 = +34.1^\circ\text{C}$ say 35°C.

xxiii. 4.3.6 Seismic Loads

Seismic design for Underground structures

Seismic effects shall be considered on all structures except culverts. The project site falls within Zone II. Zone factor (Z) of 0.10 shall be taken as per IS 1893-2002 (Part 1) Zone II criteria. Other details for seismic design shall confirm to Indian Standard 13920 (1993) and other relevant code.

The underground structures seismic design shall be based on the free-field deformation of the surrounding ground and its interaction with the structure. T

The evaluation procedures for seismic response of underground structures shall be based on either simplified analytical method, or more complex numerical modelling approach, depending on the degree of complexity of the ground-structure system, subsurface conditions, the seismic hazard level, and the importance of the structures. The numerical modelling approach shall be considered in cases where simplified analysis methods are less applicable, more uncertain, or inconclusive.

The "Technical Manual for Design and Construction of Road Tunnels — Civil Elements", Publication No. FHWA-NHI-10-034 U.S. Department of Transportation, Federal Highway Administration (FHWA), December 2009, shall be adopted as the primary reference for seismic design with regard to deformation and strain demands stated in relevant Indian Codes. Other references listed below might also be used for seismic design.

Hashash, Y.M.A., Hood, J.A., Schmidt, B. and Yao, J, "Seismic Design and Analysis of Underground Structures"

Wang, J, "Seismic Design of Tunnels"

The dynamic pressure acting on the underground structures shall be evaluated based on Wood's approach published in 1973 (Report No. EE73-05, "Earthquake Induced Soil Pressure on Structures", J.H. Wood) and "Earth Retaining Structures" in the Bulletin of New Zealand National Society for Earthquake Engineering (Vol.13, No. 3).

Seismic design for above ground structure

Earthquake design shall follow the seismic requirements of IS 1893.

Design Base Shear: The design base shear shall be calculated based on recommendation given in IS: 1893. The total design lateral force or design seismic base shear (VB) along any principal direction shall be determined by the following expression.

$$VB = A_h W$$

Where A_h = Design horizontal acceleration spectrum value, using the fundamental natural period T_a calculated

according to clause 7.6 of IS 1893-2002 (part 1) in the considered direction of vibration and;

W = Seismic weight of the building calculated according to cl 7.4.2 of IS 1893 Part 1

The design horizontal seismic coefficient A_h for a structure shall be determined by the following expression:

$$A_h = Z I S_a / 2 R g$$

Provided that for any structure with $T < 0.1s$, the value of A_h will not be taken less than $Z/2$ whatever be the value

of I/R

Where,

Z = zone factor. (Shall be taken as per IS 1893 Part 1 based on the zone)

I = Importance factor shall be taken as 1.5

R = Response reduction factor shall be as per Table 7 of IS 1893

S_a/g = Average response acceleration coefficient for rock or soil sites as given by Fig 2 and Table 3 of IS 1893 based on appropriate natural periods (T_a) and damping of the structure. These curves represent free field ground motion.

Damping for the concrete structure shall be assumed as 5%.

Based on type of foundation provided for the structure and soil strata type, the appropriate spectral coefficient shall be selected from Fig 2 of IS 1893 Part-1.

The vertical seismic coefficient will be taken as two thirds of the design horizontal acceleration as per clause 6.4.5 of IS 1893 Part 1

Note:- 1.

1. Moment Magnitude (M_w) of 7 and Source to site distance of 50-100 km shall be consider calculating ratio of peak ground velocity to peak ground acceleration. Value for Magnitude (M_w) of 7 must be calculated by Interpolation between 6.5 and 7.5 magnitude (M_w) from Hashash et. al, 2001.

2. The shear wave velocity shall be co-related with N-Value in case of soil as per below correlation. The shear wave velocity for rock shall be calculated based on modulus of elasticity and Poisson's ratio as per below empirical formula. These values of soil parameters shall be considered from the approved GIR.

Shear Wave Velocity for Soil:

The following correlation shall be considered for calculation of shear wave velocity up to SPT (corrected) of 40. The shear wave velocity shall be calculated based on weighted average value of SPT ignoring top 3 m depth from GL.

$$V_s = 79 \times N^{0.434} \text{ m/s (for sand) [C Hanumantha Rao & G V Ramana, 2008]}$$

$$V_s = 86 \times N^{0.42} \text{ m/s (for silty sand/sandy silt) [C Hanumantha Rao & G V Ramana, 2008]}$$

$$V_s = 94.4 \times N^{0.379} \text{ m/s (for clayey soil) [B K Maheshwari et. al, 2016]}$$

The above co-relation are considered from the detailed study and published as follows:

1. Hanumantharao, C.; Ramana, G. V. (2008) "Dynamic soil properties for microzonation of Delhi, India" J. Earth Syst. Sci. 117, S2, pp. 719-730,

2. Kirar, B.; Maheshwari, B.K.; and Muley, P. (2016). "Correlation between Shear Wave Velocity (V_s) and SPT resistance (N) for Roorkee region." Int., J., of Geosynth., and Ground Eng., pp. 1-11

Shear Wave Velocity for Rock (Reference: Technical Manual for Design and Construction of Road Tunnels — Civil Elements):

$$\text{Effective shear modulus, } G_m = \text{Shear modulus, } G \text{ (Assuming isotropic rock)}$$

$$= E/2(1+\nu)$$

$$\text{Effective shear wave propagation velocity, } C_{se} = (G_m/\rho)^{1/2}$$

Where ρ = Mass density of ground, E = Elastic Modulus of rock and ν = Poisson's ratio

The design shear wave velocity shall be considered as weighted average values of different layers of rocks.

4.3.7 Construction/Erection

The weight of all permanent and temporary materials together with all other forces and effects which can operate on any part of structure during construction shall be taken into account. Allowances shall be made in the permanent design for "locked-in" stresses caused in any member during construction.

4.3.8 Shrinkage and Creep Provisions shall be made for the effects of shrinkage and creep within concrete structures.

This includes interface shear transfer mechanisms as a result of differential creep and residual shrinkage effects from staged casting of concrete elements. The shrinkage and creep strains shall be included in calculation of long term deflection of all structural elements in accordance with Annexure C of IS 456-2000 and the limits specified in clause 23.2 shall be applied.

The above ground structures shall be designed for shrinkage strain as below:

Shrinkage strain shall be evaluated as Cl. 6.2.4 of IS: 456 for plain and RCC structures and Cl. 6.2.4 of IS: 1343 for prestressed concrete structures.

Creep strain shall be evaluated as Cl. 6.2.5 of IS: 456 for plain and RCC structures and Cl. 6.2.5 of IS: 1343 for prestressed concrete structures.

xxiv. 4.3.9 Differential Settlement

Consideration of the forces resulting from differential settlement shall be made where the nature of the chosen foundation system and the ground conditions indicate that such a condition may arise but not more than:

- 10 mm Long Term Settlement
- 5 mm Short Term Settlement

xxv. Earth Pressure

Underground vertical elements that are in direct contact with the ground shall be designed as permanent retaining walls to resist the lateral earth pressure. The earth pressure coefficients shall be calculated based on geotechnical investigations.

xxvi. Surcharge

(a) Live Load: A vehicular live load surcharge of 24KPa (lateral & vertical) for on road stations shall be adopted for the design of all underground structures under live load category. Actual calculation shall be done for vertical live load surcharge on roof slab, in case of soil cover less than 1.5m. For heavy plants and equipment such as ancillary building, the actual loading shall be determined individually and considered in the design of station.

(b) Building Surcharge: For existing buildings and other existing structures occupying areas around the excavation, detailed assessments based on building and foundation type, and loading are to be carried out to determine the applied loads and other impacts of such building loads on the proposed structures, for future buildings or planned infrastructure around UG station, the appropriate authorities and Employers Representative shall be consulted for details. However, in general the minimum building load surcharge of 60 kN/m² shall be adopted. In case, the actual building load surcharge exceeds 60 kN/m² the actual value is to be considered.

xxvii. Groundwater

The effects of temporary drawdown, seepage and base heave effects shall be considered in design of the temporary works, and catered for in the permanent works if there is a 'locked-in' effect from carry-over forces. The extent of the temporary walls shall be sufficient to mitigate the effects of such loads during construction. The effects of flotation loads shall be allowed for in the design both in the temporary and permanent design stages.

Water levels to be considered in design for different stages have been mentioned further below in this report

Loads due to water pressure shall be calculated using a unit weight of 10 kN/m³. The Ground water table (Base value) shall be considered as maximum (in terms of RL) of Ground water table from

- (a) data published by Central Ground water board (CGWB) nearest bore holes,
- (b) Ground water table reported in Geotechnical report provided by NMRC in tender documents,
- (c) Ground water table reported in Geotechnical report provided by Design & Build contractor. The design Ground water table shall be taken as 2.0m higher than the Base value for evaluation of effects for design purposes during service stage. The level of water table for Construction stage analysis shall be adopted as Highest Record Level (HRL) at site.

Should liquefaction of soils be a potential risk then the design water table level for permanent structures shall include layers affected by liquefaction if this is above the design groundwater levels. The effects of temporary drawdown, seepage and base heave effects shall be considered in design of the temporary works and catered for in the permanent works if there is a "locked-in" effect from carry over forces. The extent of the temporary walls shall be sufficient to mitigate the effects of such loads during construction. The effects of flotation loads shall be allowed for in the design both in the temporary and permanent design stages. The proposed structures (primarily the stations) may act as obstructions to groundwater movement.

xxviii. Accidental

The design shall allow for a minimum impact loading of 50 kN acting at any position and at any direction on temporary works or on partially completed permanent works.

xxix. Air Pressure

From Trains entering and leaving stations

- 1.5 kPa at tunnel entrance and through platform
- 1.5 kPa in tunnel ventilation shafts and platforms
- 0.5 kPa elsewhere

xxx. Redundancy loads (missing in the report)

The temporary structure shall allow for the effects of a 'one –strut failure, condition.
A single strut failing at any position and at any stage shall be evaluated Ultimate Limit State (ULS) condition with a FOS of not less than 1.05

xxxi. Centrifugal Loads

Centrifugal forces shall be considered as per Cl 2.5.3 (b) of IRS Bridge Rules

$$C = WV^2 / 127R$$

Where W = Equivalent distributed live load in kN/m

V = Maximum speed in km/hr

R = Radius of curve in meter

C = Horizontal forces in kN/m

Since the stations are in straight alignment, centrifugal effects are not considered for the station design

xxxii. Differential Movement between In-Line Structures

Differential movement between adjacent in-line structures arising from static and/or dynamic loading shall be evaluated. Due allowance for such shall be incorporated into the size of the structures and detailing of joints to ensure that the total and differential movements, including distortion and relative rotation, between in-line structures shall not exceed the serviceability limits of the structures for the design life of the structures.

xxxiii. Early Age Thermal And Shrinkage Cracking

Suitable reinforcement shall be designed to prevent early age thermal and shrinkage cracking for walls and slab more than 250 mm thick and subjected to internal and external restraints during construction. The thermal and shrinkage strains due to early age temperature differences and shrinkage shall be accounted for in the design of reinforcement for cracking . It is preferred that smaller diameter bars in any direction are placed at closer intervals to prevent early age thermal and shrinkage cracks. Guidance can be sought from CIRIA C660 on Early Age Thermal Control of Concrete.

Highway loadings

- IRC class AA loading shall be considered for cut and cover structures like tunnels, ramp, station buildings etc. which are proposed under the roads as per Cl 1.5.3.17 ODS specification.
- As class AA loading has been removed from IRC 6 , RECOMMENDATIONS OF Cl. 204.3 of IRC 6 will be followed :
- For carriage way width up to 5.3m Class A loading, and for carriage way width between 5.3 to 9.6 m Class 70R(W) / Class A loading will be considered as per Cl. 204.3 of IRC:6, Whatever applicable.

xxxiv. Loading Combinations

Underground Structures

- Load combinations will be applied to underground permanent structures to check the structure in both the Ultimate and Serviceability Limit States.
- Ultimate Limit state Combinations

Table 14

Load Combination	Dead Load (DL)		Imposed Load (IL)		Ground and Water Loads		Wind Load 7 (WL)	Seismic Load 4 (EQ)
	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial		
1. DL + IL	1.5	-	1.5	-	1.5	-	-	-
2. DL + EQ	1.5	0.9	-	-	1.5	-	1.5	1.5
3. DL + IL + EQ	1.2	-	1.2	-	1.2	-	1.2	1.2
4. Construction	1.5	-	1.3	-	1.5	-	-	-
5. Collision/Accidental	1.5	1.0	1.5	-	1.5	1.0	-	-

Notes:

- 1 Load combination 4 will be used in checking temporary works proposals and checking the structure during temporary construction stages. The imposed load is the construction imposed load.
- 2 For checking structures at the Extreme water levels, the reduced partial factors of safety for water loads are to be 1.1.
- 3 Structural steel design load combinations and partial factors of safety for the design of structural steelwork are to be in accordance with IS 800 - Code of Practice for the Structural Use of Steel Work
- 4 Earthquake loads are reversible.
- 5 50% imposed load is to be used in line with the building mass calculated for seismic loads in load case 2 & 3.
- 6 Creep, shrinkage, temperature and differential settlement are not considered in combination with the lateral loads at ultimate limit state. Creep and shrinkage effects will usually be minor for building type structures, no specific calculation will be necessary for Ultimate limit state.
- 7 Wind load combinations are applicable for above-ground structures and shall be considered in addition to the other combinations.
- 8 Wind and earthquake load will not be considered to be acting simultaneously.
- 9 For those structural members which are load bearing during the construction stage and subsequently form part of the Permanent Works, the Serviceability Limit State(SLS) checks shall be carried out both for "Construction" and "Service/Operation" stages.

Service Limit state Combinations

Table 15

Load Combination	Dead Load	Imposed Load	Ground and Water Loads	Wind Load	Earthquake Load
1. DL + IL	1.0	1.0	1.0	-	-
2. DL + EQ	1.0	-	1.0	1.0	1.0
3. DL + IL + EQ	1.0	1.0	1.0	1.0	1.0

Other Concrete Works

For above ground structural works as well as for secondary concrete works within the underground box (such as platform, stairs etc.), combinations as given in IS: 456 shall be used.

Combinations used for ultimate limit state are:

- 1.5DL+1.5LL

- 1.5DL+1.5EQ (or WL)
- 0.9DL+1.5EQ (or WL)
- 1.2DL+1.2LL+1.2EQ (or WL)

For earthquake combinations, Live Load is to be halved.

Further where structural effects of temperature are significant, additional load combinations as per clause 35.4.1 of SP : 24-1983 shall be considered. These combinations for ultimate limit states are listed below:-

- 0.75 (1.4DL+1.4TL+1.7LL)
- 1.4DL+1.4TL

For serviceability limit states, the partial factors can be taken as unity while considering temperature effects.

If lateral loads due to earth pressure and hydrostatic pressure are also to be considered, load factor of 1.5 shall be used during service stage and 1.3 for construction stage.

Table 16

Load Case Detail	L/C No.	ULS STATIC									
		1001	1002	1003	1004	1005	1101	1102	1103	1104	1105
		Submerged Water @ GL					Saturated Soil				
		1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL	1.5DL +1.5IL
		(Max H - MAX V)	(Max H - MAX V)	(Max H - MIN V)	(MIN H - MAX V)	(MIN H - MAX V)	(Max H - MAX V)	(Max H - MAX V)	(Max H - MIN V)	(MIN H - MAX V)	(MIN H - MAX V)
Self Weight	1	1.5	1.5	1	1.5	1.5	1.5	1.5	1	1.5	1.5
SIDL	2	1.5	1.5	1	1.5	1.5	1.5	1.5	1	1.5	1.5
Soil Backfill	3	1.5	1.5	1	1.5	1.5	1.5	1.5	1	1.5	1.5
Live Load on concourse & platform	4	1.5	1.5	0	1.5	1.5	1.5	1.5	0	1.5	1.5
Train Live Load	5	1.5	0	0	1.5	0	1.5	0	0	1.5	0
Lateral Pressure Sub (WTat GL) K_0	6	1.5	1.5	1.5	0	0	0	0	0	0	0
Lateral Pressure Sub (WTat GL) K_a	7	0	0	0	1	1	0	0	0	0	0
Lateral Pressure Sat K_0	8	0	0	0	0	0	1.5	1.5	1.5	0	0
Lateral Pressure Sat K_a	9	0	0	0	0	0	0	0	0	1	1
Vertical Surcharge Load	10	1.5	1.5	0	1.5	1.5	1.5	1.5	0	1.5	1.5
Lateral Surcharge (Towards Right)	11	0	0	0	0	0	0	0	0	0	0
Lateral Surcharge (Towards Left)	12	0	0	0	0	0	0	0	0	0	0
Lateral Surcharge (Both sides)	13	1.5	1.5	1.5	0	0	1.5	1.5	1.5	0	0
Water Pressure on walls	14	1.5	1.5	1.5	1	1	0	0	0	0	0
Water Pressure uplift	15	1.5	1.5	1	1.5	1.5	0	0	0	0	0
Racking Force (Towards Right)	16	0	0	0	0	0	0	0	0	0	0
Racking Force (Towards Left)	17	0	0	0	0	0	0	0	0	0	0

Table 17

Load Case Detail	L/C No.	ULS SEISMIC (Racking)															
		4001	4002	4003	4004	4005	4006	4007	4008	4101	4102	4103	4104	4105	4106	4107	4108
		Submerged Water @ GL								Saturated Soil							
		1.5DL +1.5EL	1.5DL +1.5EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.5DL +1.5EL	1.5DL +1.5EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL	1.2DL+1.2IL +1.2EL
				(Max H - MAX V)	(Max H - MAX V)	(Max H - MIN V)	(Max H - MIN V)	(MIN H - MAX V)	(MIN H - MAX V)			(Max H - MAX V)	(Max H - MAX V)	(Max H - MIN V)	(Max H - MIN V)	(MIN H - MAX V)	(MIN H - MAX V)
Self Weight	1	1.5	1.5	1.2	1.2	1	1	1.2	1.2	1.5	1.5	1.2	1.2	1	1	1.2	1.2
SIDL	2	1.5	1.5	1.2	1.2	1	1	1.2	1.2	1.5	1.5	1.2	1.2	1	1	1.2	1.2
Soil Backfill	3	1.5	1.5	1.2	1.2	1	1	1.2	1.2	1.5	1.5	1.2	1.2	1	1	1.2	1.2
Live Load on concourse & platform	4	0	0	0.6	0.6	0	0	0.6	0.6	0	0	0.6	0.6	0	0	0.6	0.6
Train Live Load	5	0	0	1.2	1.2	0	0	1.2	1.2	0	0	1.2	1.2	0	0	1.2	1.2
Lateral Pressure Sub (WTat GL) K ₀	6	1.5	1.5	1.2	1.2	1.2	1.2	0	0	0	0	0	0	0	0	0	0
Lateral Pressure Sub (WTat GL) K _a	7	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Lateral Pressure Sat _K ₀	8	0	0	0	0	0	0	0	0	1.5	1.5	1.2	1.2	1.2	1.2	0	0
Lateral Pressure Sat _K _a	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Vertical Surcharge Load	10	1.5	1.5	1.2	1.2	0	0	1.2	1.2	0	0	1.2	1.2	0	0	1.2	1.2
Lateral Surcharge (Towards Right)	11	1.5	0	1.2	0	1.2	0	0	0	0	0	1.2	0	1.2	0	0	0
Lateral Surcharge (Towards Left)	12	0	1.5	0	1.2	0	1.2	0	0	0	0	0	1.2	0	1.2	0	0
Lateral Surcharge (Both sides)	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Pressure on walls	14	1.5	1.5	1.2	1.2	1.2	1.2	1	1	0	0	0	0	0	0	0	0
Water Pressure uplift	15	1.5	1.5	1.2	1.2	1	1	1.2	1.2	0	0	0	0	0	0	0	0
Racking Force (Towards Right)	16	1.5	0	1.2	0	1.2	0	1.2	0	1.5	0	1.2	0	1.2	0	1.2	0
Racking Force (Towards Left)	17	0	1.5	0	1.2	0	1.2	0	1.2	0	1.5	0	1.2	0	1.2	0	1.2

Table 18

Load Case Detail	L/C No.	SLS									
		3001	3002	3003	3004	3005	3101	3102	3103	3104	3105
		Submerged Water @ GL					Saturated Soil				
		1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL	1.0 DL + 1.0 IL
		(Max H - MAX V)	(Max H - MAX V)	(Max H - MIN V)	(MIN H - MAX V)	(MIN H - MAX V)	(Max H - MAX V)	(Max H - MAX V)	(Max H - MIN V)	(MIN H - MAX V)	(MIN H - MAX V)
Self Weight	1	1	1	1	1	1	1	1	1	1	1
SIDL	2	1	1	1	1	1	1	1	1	1	1
Soil Backfill	3	1	1	1	1	1	1	1	1	1	1
Live Load on concourse & platform	4	1	1	0	1	1	1	1	0	1	1
Train Live Load	5	1	0	0	1	0	1	0	0	1	0
Lateral Pressure Sub (WTat GL) K ₀	6	1	1	1	0	0	0	0	0	0	0
Lateral Pressure Sub (WTat GL) K _a	7	0	0	0	1	1	0	0	0	0	0
Lateral Pressure Sat _K ₀	8	0	0	0	0	0	1	1	1	0	0
Lateral Pressure Sat _K _a	9	0	0	0	0	0	0	0	0	1	1
Vertical Surcharge Load	10	1	1	0	1	1	1	1	0	1	1
Lateral Surcharge (Towards Right)	11	0	0	0	0	0	0	0	0	0	0
Lateral Surcharge (Towards Left)	12	0	0	0	0	0	0	0	0	0	0
Lateral Surcharge (Both sides)	13	1	1	1	0	0	1	1	1	0	0
Water Pressure on walls	14	1	1	1	1	1	0	0	0	0	0
Water Pressure uplift	15	1	1	1	1	1	0	0	0	0	0
Racking Force (Towards Right)	16	0	0	0	0	0	0	0	0	0	0
Racking Force (Towards Left)	17	0	0	0	0	0	0	0	0	0	0

Design Considerations – Excavation for Cut & Cover Structure

Following design consideration will be taken into account to check the stability of excavation.

Ultimate Limit State:

- Uplift for Blow-out failure
- Toe Stability

Serviceability Limit State:

- Wall deflection
- Ground settlement
- Effect on adjacent structures

Reinforcement Detailing Slabs & Walls

Minimum reinforcement shall be provided on each face in each direction and shall not be less than that required to limit cracking due to shrinkage and early-age thermal effects.

Recommendations given in Clause 3.9.4.19 of Part 1 of BS 8110 shall be followed with the modification that reinforcement on each face in each direction should be at least : -

For grades 415 and above: 0.125% of the concrete cross-sectional area.

For grade 250: 0.15% of the concrete cross sectional area.

For reinforcement layers nearest the concrete faces, the spacing of reinforcement bars shall not be greater than 200mm.

Columns / Piers :

Link spacing shall not be more than 300mm or 0.75 times the effective depth whichever is lesser.

Beams :

- The minimum tension reinforcement in beam is $0.85bd/f_y$, if the beam is designed as rectangular beam.
- Link spacing along the span shall not be more than 300mm or 0.75 times the effective depth whichever is lesser. The transverse reinforcement in beams shall be taken around the outer-most tension and compression bars.

Corner Details :

•For moments tending to “close” the corner, bend radii of main tension reinforcement shall be increased. Additional reinforcement shall be provided for crack control.

•For moments tending to “open” the corner, transverse ties shall be provided when tension reinforcement exceeds 1% in either of adjoining member.

Design Considerations:

- Maximum Redistribution of Moments is limited to : 30%
- Critical Section for Support Moment : At Face of Support
- For an effective haunch (with respect to the section capacity), on the compressive face, its slope shall be 1(perpendicular to the member axis): 3 (parallel to the member axis).
- Where load is applied to the bottom of a structural element (beam / slab), additional reinforcement shall be provided to carry the load to the far face, where steel plates or hooks shall positively anchor it.
- Torsional stiffness of the member may be ignored in analysis and torsion disregarded in the design for that member only when each of the following requirements are satisfied
- It can be demonstrated that the torsional strength of the member is not required to achieve equilibrium of the structure.
- It can be established through sound engineering judgement that the structural system is self-evidently not one in which significant torsional effects will tend to occur
- Links provided to resist shear are closed type complying with shape code 79 of BS 4466 or otherwise detailed so that they are fully developed around the circumference of the member
- The deflection limitations imposed in IS 456 and IS 800 shall be followed for the concrete and structural steel elements respectively

Analysis:

The structure shall be analysed for the loads and effects specified in this design manual to obtain the most severe combinations and envelopes of force resultants (moments, shear, axial force, deflection) on every component member. Irregular or analytically complex parts of structure which do not exhibit two-dimensional behaviour shall be analysed by grillage analysis, finite element plate analysis or similar. Other parts of structures with regular shapes (e.g. box), which are away from zones of three-dimensional effects, will be analysed as plane frames.

2.9.4 Computer Programmes

- STAAD Pro : 2D/3D general structural analysis program
- Roclab : RocLab is a software program for determining rock mass strength parameters, based on the generalized Hoek-Brown failure criterion
- WALLAP : Analysis program for analysing the stability of cantilevered and
 - propped retaining walls
- Oasys : Analysis program for analysing and design of reinforcement
 - concrete beam ,slab , column and piles .
- Excel Spreadsheet : In-house spread sheets to facilitate various design checks

Structural Scheme, Analysis, Design and Construction Methodology

General:

- Station structure and cut & cover tunnel shall be of reinforced concrete with no movement joints and shall be capable of withstanding aggressive soil and water conditions that may be present.
- The entrance subways shall be connected to the station box through a rigid joint.
- The structural design shall take differential settlement into account, where applicable.
- All train ways whether for mainline tracks, center sidings, test tracks or any other purpose, shall be separated from adjacent train ways or other operational area by continuous 4-hour fire separation reinforced concrete walls.

Structural Scheme and Construction Methodology:

- Proposed Structural Scheme and Construction Methodology for Stations:
- The cut & cover excavation shall be carried out using temporary earth retaining structures using majorly secant/contiguous bored pile/soldier piles wall upto the level of sound rock. From this level open excavation with temporary rock supports shall be made upto the bottom of the base slab. In case hard rock is not met upto final excavation level, temporary retaining structures will extend beyond final excavation level. Then Permanent structures are built as bottom up structure. Roof slab, Concourse slab shall be supported by outer walls and columns. Base slab will act as a raft foundation for transfer of loads from outer walls and columns.
- Proposed Structural Scheme and Construction Methodology for Station Entrance and Vent Shaft Structures:
- The structural scheme for underground station entrance and vent shaft structures will be a concrete rigid box using base slab, walls and roof elements resting on ground. It is proposed to construct station entrance and vent shaft structure using bottom up approach. It is proposed to use secant/contiguous bored pile wall upto level of sound rock and then from this level open excavation with temporary rock supports shall be made upto the bottom of base slab.

Standards & Codes of Practice:

The applicable codes are those issued by Bureau of Indian Standards (BIS), the British Standard Institute (BSI), Euro Codes, Indian Railway Standards (IRS), Indian Road Congress (IRC), the American Standards (ASTM, AASHTO).

Generally Indian codes and standard are to be preferred except in those instance where no comprehensive document exist. In such case equivalent international code and standard will be used.

The order preferences of codes will be as follows:

- i) BIS
- ii) BSI or EURO code
- iii) IRC
- iv) IRS
- v) AASTHO

As per the Outline Design Specifications, following codes / standards shall be followed. Any other relevant codes of practice shall be referenced where necessary

CIRIA Report C660	Early Age Thermal Crack Control in Concrete
Other Publications	
<ul style="list-style-type: none"> • RDSO Guidelines for Design & Construction of Tunnels • UIC/772-R The International Union of Railways Publication • UIC 774-3R • SS 460 48 66 1991 Swedish Standard Vibration and Shock Guidance Levels for Blast-Induced Vibrations • NS8141 1993 Vibration and Shock in Structures, Guidance Limits for Blasting –induced Vibrations • National Building Code (NBC) 2016 • British Tunnelling Society Specification for Tunnelling • Austrian Society for Rock Mechanics: Geotechnical Underground Structures Design • International Tunnel Association: Guidelines for the Design of Tunnels • ITA/AITES Accredited Material: Seismic Design and Analysis of Underground Structures • Muir Wood, A.M. (1975) The Circular Tunnel in Elastic Ground • D.J. Curtis et al (1976) Discussion Paper - Circular Tunnel in Elastic Ground • MORTH-specification • CPWD-specification • Model DBR for Underground Bored Tunnels for Metro Systems in India, approved by Ministry of Railways. 	

xxxv. Civil Design Works

Excavation Base Stability

The Contractor's design shall include adequate precautions against base heave, piping and failure of his excavations during construction. The stability of the excavation bases shall be checked in accordance with an acceptable method of analysis which shall allow for all reasonable loads within and outside of the excavation. The Contractor shall show in his calculations the contribution made to the base stability of the excavation by his proposed method of construction and shall state the factor(s) of safety used in the design. The factor(s) of safety shall relate to the method of construction and to the particular location of the Works and shall be subject to the notice of the Employer's Representative.

Excavation Toe Stability

Design checks shall be performed to ensure adequate toe stability of retaining structure during construction. The toe stability shall be checked in accordance with an acceptable method of analysis, which shall allow for all reasonable loads within and outside of the excavation.

The conventional approach based on active and passive pressures shall be preferred with a minimum factor of safety shall be 1.3 under SLS condition considering partial safety factor of 1.0 on soil parameters.

Waterproofing

For Water proofing, reference shall be made to Construction Specification, Civil Works.

xxxvi. Water Control in Excavations

1. During construction in water-bearing ground, seepage water shall be controlled by suitable means and the design shall provide for the same. The Contractor shall obtain the Employer's Representative's prior notice to the process he intends to adopt to control groundwater inflow, and the treatment and disposal of any groundwater collected.
2. Soldier pile/contiguous piles shall not be permitted in case design ground water table is higher than excavation level.
3. Retractable type or GFRP Rock anchor shall be used in case of anchor is used for temporary retaining system.
4. The piezometric pressure outside of the excavations shall at all times remain within the normal expected groundwater variation and permissible safe limits. The Contractor shall be responsible for all local authority approvals required for his groundwater control methods.
5. Ground water table outside of excavation shall not be lowered more than 2.0 m from existing GWL. Suitable water recharge shall be done to maintain the water table.

6. Notwithstanding the limits on groundwater leakage rates, the design shall aim to ensure that no loss of ground or groundwater occurs through any part of the structure.

xxxvii. Underpinning of Existing Building Structures (EBS)

1. Where the construction of box structures or other underground works necessitates the removal of existing support or foundations to existing buildings, structures, utilities, services, wells, pavements, road furniture and the like (collectively termed EBS) the Contractor shall carry out investigations on the extent of the existing works, their design and loading conditions.

2. The Contractor shall design and carry out such works as are necessary to maintain the integrity of the EBS at all times including its design life. No work shall commence prior to the notice of The Employer's Representative being given. Cost of design and provision of any support/strengthening of such structures will be deemed as included in the Contractor's Price.

xxxviii. Seepage Barriers

The Contractor shall provide seepage walls or barriers to all external underground walls that lie within public areas, staffrooms and plant-rooms, except for Pump, Environmental Control System and Ventilation rooms, shafts and plenums. In the public area, the seepage barrier may be provided by either a finished wall with air gap behind or by architectural finishes mounted on framing attached to the external wall. In non-public areas a block or brickwork wall shall be provided. In all cases the Contractor shall design the seepage gap with a seepage drainage channel such that discolouration or water damage to the seepage walls cannot occur. Access panels to inspect and maintain the drains shall be included. All such finishes, panels and fixings and the like shall be non-corrodible and comply with the Contract design life requirements. At platform level in the stations, the visual aspect of the platform walls must be aesthetically pleasing, and exposed diaphragm walls must be provided with a surface which will give a uniform finish without distinct changes in colour or alignment. All external trackside diaphragm walls must be either rendered or shotcrete or provided with another finish which has Notice of No Objection by the Engineer.

xxxix. Connection Details

Corners

Particular attention shall be paid to corner joints of large structural members. External wall/slab junctions shall be provided with crack control steel and transverse ties. Radius of bend of main tension bars shall be increased to cater for the high bearing stresses within the bend.

xl. Construction Joints

The design and detailing of construction joints shall be sufficient for the proposed works and the construction joints shall be minimised to reduce the risk of leakage.

xli. Slab to Wall Connections

For top-down construction in particular, attention shall be paid to the practicalities of the design and detailing of the slab to wall connections and the means by which the integrity of the construction joints at these connections will be assured. Suitable cover values for slabs shall be adopted, as defined earlier, to arrive at the centre line of top and bottom bars in various slabs for design purposes.

xlii. Connections between Cut-and-Cover Structures

The design of connection joint shall consider the possibility of differential movement during both construction and in-service. The differential movement between the cut-and cover structure shall be sufficiently small so as not to cause overstressing of this joint which shall be designed to permit an appropriate degree of movement in all directions. Particular attention shall be paid to the waterproofing detail, to ensure that the water-tightness of this joint is not inferior to the standard joint between precast segments.

xliii. Temporary Works
General Principles

In general, Temporary Works shall be designed in accordance with the same design standards/principles as the Permanent Works. However, Earthquake forces shall also be considered for Temporary structures design. Existing water table shall be used for temporary structure design. Soil properties shall be same as permanent works.

The design of Temporary Works shall take account of all the applied external forces and imposed structural deformations and, where applicable, the effects of removal of load from the ground.

xliv. Design of Temporary Excavation

Support Excavations for cut-and-cover structures in soft ground shall be supported by diaphragm walls, secant piles or similar which may be incorporated into the Permanent Works. Design of these elements shall include full step-by-step analyses of the progressive change in the loading and required temporary support conditions as the excavation proceeds and subsequently as these temporary elements are integrated into the Permanent Works.

Braced excavations shall be analysed by finite element or similar methods in which the changes in ground stresses are properly related to the deflections which occur in the structural elements, by the use of appropriate stiffness and other parameters. Relevant empirical evidence from similar excavations must be referred to in support of the conclusions of the analyses. Simplified analytical models and methods shall be employed to calibrate and support finite element analyses of the various permutations of structure geometry and loading.

Temporary works shall be designed as far as possible to be removed when no longer required and shall not be left in the ground. Temporary works which are viewed as being impossible to remove on completion of the Permanent Works shall be dismantled to a minimum depth of 2 metres below the finished ground surface and designed so that there will be no risk of ground settlement or other deleterious effects as a consequence of decay and/or collapse of these Temporary Works.

Ground Movements

The Temporary and Permanent Works designs shall limit ground movement and distortions around the site and to avoid damage to adjacent EBS.

The Contractor shall carry out a risk assessment for all EBS within the influence of the Works in accordance with the Contract. The analyses for the Temporary Works shall be properly related to the conclusions of this risk assessment.

Construction Dewatering

Temporary dewatering of construction excavations will be required to provide an undisturbed, stable and dry subgrade to permit construction and backfilling of the Permanent Works under dry conditions.

In general, the groundwater within the excavations shall be maintained at a level the permits achievement of the above and avoids heave, piping or base failure of the excavation.

Temporary dewatering methods and system operations, along with other required temporary works, shall not lower the groundwater outside the walls supporting the excavations, nor result in settlement, distortion or loss of ground at adjacent EBS.

The Contractor shall prepare and submit his design of his construction dewatering system to the Employer's Representative for his notice. The construction dewatering design shall include determination of subsurface conditions and geotechnical design parameters, analyses to establish feasible methods, and system definition in sufficient detail to demonstrate that the general objectives can be achieved without adverse effect on adjacent EBS. The selected system shall generally provide for continuous (24-hour-per-day) operation, adequate reserve equipment, and standby power.

Ground Improvement

Ground-improvement may be required along certain alignment segments of the BSRP Corridors to control ground and EBS movement and distortion that may be induced by excavation box locations.

The Contractor shall prepare and submit his designs and method statements supported by analysis for all ground improvement to the Employer's Representative for his notice. These designs shall define performance objectives for the ground improvement.

Instrumentation, monitoring and reporting details for verifying achievement of ground improvement performance objectives in accordance with this Contract shall be included in the ground improvement design submission.

The information and assumptions on which the ground improvement is based shall be shown on the design drawings.

Instrumentation

1. The Contractor shall instrument, monitor and report on ground and EBS movement and distortion, groundwater level, stress and displacement in the excavation and lateral support system, structural movement during construction to check his predictions.
2. Monitoring shall be carried out on a case-by-case day-to-day or more frequent basis depending upon the importance of the EBS and/or the risk of damage to that EBS. Special attention shall be paid to the historical buildings and wells located along the alignment.
3. Monitoring shall begin prior to commencement of the Works to enable instrument base-line values to be determined accurately and shall continue until all movements and distortions to the ground and EBS, and changes to the groundwater table that might be attributed to the Works, as shown by the monitoring, have effectively ceased for a period of three months.
4. The Contractor shall submit a complete comprehensive instrumentation, monitoring and reporting scheme with his Design and prior to any construction which is designed to achieve the following.
 - a) To establish typical background movement, distortion, groundwater fluctuation, and noise and vibration limits for the ground, groundwater and EBS prior to commencement of the Works.
 - b) Protection to all parties during and after the construction by providing early warning of any excessive and undue movement and distortion of the adjacent ground and EBS.
 - c) To provide movement and deformation information for design verification of the Temporary and Permanent Works.
 - d) To ensure that the maximum allowable tolerances associated with various structures/elements within the zone of influence of the Works are not exceeded.
 - e) To confirm that groundwater drawdown outside of the excavations does not exceed the expected fluctuation limits
5. Vibration recording devices shall be provided to monitor for vibrations which may cause damage to the proposed constructions and EBS. These devices shall be installed at intervals and locations to provide comprehensive coverage of the Works. Unless otherwise directed by the Fire/Life Safety Committee, these devices shall record ground accelerations generated by the Works to ensure that these accelerations do not exceed the values set by the relevant Authorities or those determined by the Contractor for the stability and safety of the Temporary and Permanent Works and adjacent EBS. Limiting Construction-Induced Vibrations at adjacent EBS

In the design, the effects of construction-related vibrations shall be considered. Unless otherwise accepted by the applicable government agencies and the Engineer
peak particle velocities at adjacent EBS shall not exceed the values in the Table below (as per AASHTO - 1990& DIN 4150 -3,1999):

Table 20

Peak Particle Velocities in mm/sec (Max. Allowable) at Adjacent EBS

Most structures in “good” condition	25
Most structures in “poor” condition	5
Most structures in “fair” condition	12
Water-supply structures	5
Heritage structures/bridge structures	5

Above limits are maximum permissible, however this may have to restricted further if required to avoid damage to the adjacent EBS or causing discomfort to the occupants. Along the proposed alignment, other limitations may be imposed at adjacent EBS, such as hospitals, school buildings, telephone-exchange structures, special water- supply structures and Heritage structures etc.. In addition working hours for such equipments causing vibrations may have to restricted, keeping the convenience and comfort of the occupants in mind.

Settlement and Building Protection

For settlement and Building Protection refer BSRP DBR.

List of Design Codes and Standards

A list of Codes and Standards is given for reference only.

(Note: the years of the codes mentioned below are notional, hence each time the designer shall adopt latest code with the latest correction slip)

6.1 Indian Railway Standards (IRS) Codes and Manuals

IRS	2008	Bridge Rules
IRS	1997	Concrete bridge Code (Reprint 2014)
IRS	1991	Bridge substructures and foundation code.
IRS	1997	Steel bridge Code

IRS	1998	Indian Railway Bridge Manual
IRS	1985	Manual on the Design and Construction of Well and Pile Foundations
IRS	2017	Earthquake resistant design of Railway Bridges

6.2 Indian Roads Congress Standards (IRC)

IRC 5:	2015	Standard Specifications and Code of Practice for Road Bridges. Section I – General Features of Design
IRC 6:	2017	Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses
IRC 11:	1962	Recommended Practice for the Design of Layout of Cycle Tracks
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
IRC 24:	2010	Standard Specifications and Code of Practice for Road Bridges, Section V – Steel Road Bridges
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 78:	2014	Standard Specifications and Code of Practice for Road Bridges, Section VII Parts 1 and 2, Foundations and Substructure
IRC 87:	1984	Guidelines for the Design and Erection of False Work for Road Bridges
IRC 89:	1997	Guidelines for Design and Construction of River Training and Control Works for Road Bridges
IRC:	SP 11	1988 Handbook of Quality Control for Construction of Roads and Runways

IRC:112 2011 Code of Practice for Concrete Road Bridges

6.3 Bureau of Indian Standards Codes

SP 7:	2005	National Building Code
IS 73:	1992	Paving Bitumen
IS 150:	1950	Ready mixed paint brushing, finishing stoving for enamel colour as required
IS 205:	1992	Non-ferrous metal Butt Hinges
IS 206:	1992	Tee and strap hinge
IS 207:	1964	Gate and shutter hooks and eyes
IS 208:	1987	Door handles
IS 210:	1993	Grey iron castings
IS 215:	1995	Road tar
IS 217:	1988	Cutback Bitumen
IS 269:	1989	33 grade Ordinary Portland Cement.
IS 278:	1978	Galvanised steel barbed wire for fencing
IS 280:	1978	Mild Steel wire for general engineering Purposes
IS 281:	1991	Mild Steel sliding door bolts for use with Padlocks
IS 362:	1991	Parliament hinges
IS 363:	1993	Hasps and staples
IS 383:	1970	Coarse and fine aggregates from natural Sources for concrete
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 453:	1993	Double-acting spring hinges

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 458:	1988	Precast concrete pipes (with and without reinforcement)
IS 459:	1992	Corrugated and semi-corrugated asbestos cement sheets
IS 460:	1985	Test sieves
IS 516:	1959	Method of test for strength of concrete
IS 650:	1991	Standard sand for testing cement
IS 733:	1983	Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes
IS 737:	1986	wrought aluminium and aluminium alloy sheet and strip for general engineering purposes
IS 771:	1979	Glazed fire-clay sanitary appliances Part 1 General requirements Part 2 Specific requirements of Kitchen and laboratory sinks Part 3/Sec. 1 Specific requirements of Urinals - Slab Urinals Part 3/Sec. 2 Specific requirements of Urinals - Stall Urinals
IS 774:	1984	Flushing cistern for water closets and urinals
IS 775:	1970	Cast iron brackets and supports for wash basins and sinks
IS 777:	1988	Glazed earthenware wall tiles
IS 778:	1984	Copper Alloy gate, globe and check valves for water works Purposes
IS 779:	1994	Water meters
IS 780:	1984	Sluice valves for water works purposes (50 to 300 mm size)

IS 781:	1984	Cast copper alloy screw down bib taps and stop valves for water service
IS 783:	1985	Code of practice for laying of concrete pipes
IS 800:	2007	Code of practice for general construction in steel
IS 814:	1991	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
IS 875:	1987	Code of practice for design loads (other than earthquake) for buildings and structures
IS 883:	1994	Code of practice for design of structural timber in building
IS 909:	1992	Under-ground fire hydrant, sluice valve type
IS 1003:		Timber panelled and glazed shutters
		Part 1 1991 Door shutters
		Part 2 1994 Window and ventilator shutters
IS 1030:	1989	Carbon steel castings for general engineering purposes
IS 1038:	1983	Steel doors, windows and ventilators
IS 1077:	1992	Common burnt, clay building bricks
IS 1080:	1986	Design and construction of shallow foundation in soil (other than raft ring and shell)
IS 1161:	1979	Steel tubes for structural purposes
IS 1195:	1978	Bitumen mastic for flooring
IS 1200	Part 1	Methodology of measurement of Building and Civil Engineering Works.
IS 1230:	1979	Cast iron rainwater pipes and fittings
IS 1237:	1980	Cement concrete flooring tiles
IS 1239:	1990	Mild steel tubes, tubular and other wrought steel fittings
		Part 1 Mild steel tubes

Part 2 Mild steel tubular and other wrought steel pipe fittings

IS 1322:	1993	Bitumen felts for water proofing and damp-proofing
IS 1341:	1992	Steel butt hinges
IS 1343:	1980	Code of practice for Pre-Stressed Concrete
IS 1346:	1991	Code of practice Waterproofing of roofs with bitumen felts
IS 1458:	1965	Railway bronze ingots and casting
IS 1489:	1991	Portland Pozzolana Cement
IS 1536:	1989	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS 1537:	1976	Vertically cast-iron pressure pipes for water, gas and sewage
IS 1538:	1993	Cast iron fittings for pressure pipes for water, gas and sewage
IS 1566:	1982	Hard-drawn steel wire fabric for concrete reinforcement IS
IS 1592:	1989	Asbestos cement pressure pipes
IS 1703:	1989	Copper alloy float valves (horizontal plunger type) for water supply fittings
IS 1726:	1991	Cast iron manhole covers and frames
IS 1729:	1979	Sand cast iron spigot and socket soil waste and ventilating pipes, fitting and accessories
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 prestressed concrete

Part 1 Cold-drawn stress – relieved wire

Part 2 As drawn wire

IS 1786:	1985	High strength deformed steel bars and wires for concrete reinforcement
IS 1791:	1985	Batch type concrete mixers

IS 1795:	1982	Specifications for pillar taps for water supply purposes
IS 1834:	1984	Hot applied sealing compounds 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 fibre
IS 1888:	1982	Method of load tests on soils
IS 1892:	1979	Code of practice for sub surface investigations for foundations
IS 1893	2016	Criteria for earthquake resistant design of structures,
		Part 1 General Provisions and Buildings
IS 1904	1986	Design and construction of foundations in soils General Requirements
IS 1948:	1961	Aluminium doors, windows and ventilators
IS 1949:	1961	Aluminium windows for industrial buildings
IS 1977:	1976	Low Tensile Structural steel
IS 2004:	1991	Carbon steel forgings for general engineering purposes
IS 2062:	2006	Steel for general structural purposes
IS 2074:	1992	Ready mixed paint, air-drying, red oxide-zinc chrome, Priming
IS 2090:	1983	High tensile steel bars used in prestressed concrete
IS 2114:	1984	Code of practice for laying in-situ terrazzo floor finish
IS 2116:	1980	Sand for masonry mortars
IS 2119:	1980	Code of practice for construction of brick-cum-concrete composite
IS 2202:	1991	Wooden flush door shutters
IS 2326:	1987	Automatic flushing cisterns for urinals
IS 2386:	1963	Methods of test for aggregates 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 making properties of fine aggregates

Part 7 Alkali – aggregate reactivity

Part 8 Petrographic examination

IS 2430:	1986	Methods of sampling of aggregate for concrete
IS 2548:	1996	Plastic seats and covers for water closets
IS 2681:	1993	Non-ferrous metal sliding door bolts (aldrops) for use with padlocks
IS 2690:	1993	Burnt - clay for flat terracing Tiles
IS 2692:	1989	Ferrules for water services
IS 2720	1972-2002	Methods of Tests for Soils (all Parts)
IS 2751:	1979	Recommended practice for welding of mild steel plain and deformed bars used for reinforced construction
IS 2906:	1984	Specification for sluice valves for water works purposes (350 to1200 mm size)
IS 2911:	2010	Code of practice for design and construction of pile foundations

Part 1 Concrete piles

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 Load test on piles

IS 2950:	1981	Code of practice for design and construction of raft foundations.
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IS 3067	1988:	Code of Practice for General Design Details and Preparatory Work for Damp-Proofing and Water-Proofing of Buildings
IS 3370:	2009	Code of practice for concrete structures for the storage of liquids
IS 3564:	1995	Hydraulically regulated door closers
IS 3812:	1981	Fly ash for use as pozzolan and admixture
IS 3847:	1992	Mortice night latches
IS 3955:	1967	Code of practice for design and construction of well foundations
IS 3989:	1984	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
IS 4082:	1996	Recommendations on stacking and storage of construction materials and components 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 coatings on mild steel tubes
IS 4826:	1979	Hot-dipped galvanised coatings on round steel wires
IS 4925:	1968	Concrete batching and mixing plant
IS 4926:	1976	Ready mixed concrete
IS 4968:	1976	Method for sub surface sounding for soils
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 prestressed concrete
IS 6006:	1983	Specification for uncoated stress relieved strands for prestressed concrete
IS 6051:	1970	Code for designation of aluminium and its alloys
IS 6248:	1979	Specification for metal rolling shutters and rolling grills
IS 6403:	1981	Code of practice for determination of bearing capacity of shallow foundations
IS 6603:	1972	Stainless steel bars and flats
IS 6760:	1972	Slotted countersunk head wood screws
IS 6911:	1992	Stainless steel plate, sheet and strip
IS 7181:	1986	Horizontally cast-iron double flanged pipes for water,gas and sewage
IS 7196:	1974	Hold fast
IS 7205:	1974	Safety code for erection of structural steel work
IS 7231:	1984	Specifications for plastic flushing cisterns for water closets and urinals
IS 7273:	1974	Method of testing fusion-welded joints in aluminium andaluminium alloys
IS 7293:	1974	Safety code for working with construction machinery
IS 7320:	1974	Concrete slump test apparatus
IS 7534:	1985	Sliding locking bolts for use with padlocks
IS 7861:	1975	Code of practice for extreme weather concreting
		Part 1 For Hot Weather concreting
		Part 2 For Cold Weather concreting
IS 7969:	1975	Safety code for handling and storage of building Materials

IS 8009	1976	Calculation of settlement of 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 for 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 9762:	1994	Polyethylene floats (spherical) for float valves
IS 10262:	2009	Recommended guidelines for concrete mix design
IS 10379:	1982	Code of practice for field control of moisture and compaction of soils for embankment and subgrade
IS 10500:	1991	Drinking water specification
IS 12269:	1987	53 grade ordinary Portland cement
IS 12894:	1990	Fly ash lime bricks
IS 13630:	1994	Ceramic tiles – methods of tests
IS 13920:	2016	Ductile detailing of reinforced concrete structures subjected to seismic forces
IS 15388:	2003	Specifications for Silica Fume
SP 36	(Part 1):	Compendium of Indian Standards on Soil Engineering

(Laboratory Testing)

SP 36	(Part 2):	Compendium of Indian Standards on Soil Engineering (Field Testing) Indian Standard Hand Book on Steel Sections Part-ICRRI and IOC, New Delhi Bituminous Road Construction Hand Book
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6.4 British Standards

BS 812		Testing Aggregates - Parts 117 to 119.
BS 1377		Methods of Test for Civil Engineering Purposes - Parts 1 thru 9.
BS 4395	Part 2	High strength friction grip bolts and associated nuts and washers for Structural Engineering Higher Grade
BS 4447		The performance of pre-stressing anchorages for post-tensioned construction
BS 4449		Specification for Carbon Steel Bars for the Reinforcement of Concrete
BS 4486		Hot rolled and hot rolled & processed high tensile alloy steel bars for pre-tensioning of concrete
BS 4550		Methods of testing cement
BS 4592		Industrial Type Metal Flooring, walkways and stair treads
BS 4604	Part 2	The use of high strength friction grip bolts in structural steel work. Higher grade (parallel shank)
BS 4870		Approval testing of welding procedures
BS 4871		Approval testing of welders working to approved welding Procedures
BS 4872		Approval testing of welders when welding procedure approval is not required
BS 5075		Concrete admixtures
BS 5135		Process of arc welding of carbon and carbon manganese Steels
BS 5212	Part 2	Cold poured joint sealants for concrete pavements

BS 5328		Methods for specifying concrete, including ready mixed Concrete
BS 5400		Steel, concrete and composite bridges
BS 5400	Part 4	Code of practice for design of concrete bridges
BS 5400	Part 6	Specification for materials and workmanship, steel
BS 5606		Accuracy in building
BS 5896		High tensile steel wire and stand for the pre-stressing of concrete.
BS 5930:		Code of Practice for Site Investigations.
BS 5950	Part 2	Specification for materials, fabrication and erection: hot rolled sections
BS 6031		Code of Practice for Earthworks.
BS 6105		Corrosion-resistant stainless-steel fasteners
BS 6164		Safety in tunnelling in the construction industry.
BS 6349		Code of Practice for Dredging and Land Reclamation.
BS 6443		Penetrant flaw detection
BS 6681		Specification for malleable cast iron
BS 7079		Preparation of Steel substrates before application of paints and related products
BS 7385	Part 2	Evaluation and measurement for Vibrations in Buildings – E to Damage levels from Ground-Borne Vibrations
BS 7542		method of test for curing compound for concrete
BS 8000	Part 4	Code of Practice for Waterproofing
BS 8000	Part 5	Code of Practice for Below Ground Drainage
BS 8002		Code of Practice for Earth Retaining Structures
BS 8004		Code of Practice for Foundations

BS 8007		Design of Concrete Structures for Retaining Aqueous Liquids
BS 8081		Code of Practice for Ground Anchorages
BS 8110		Structural use of concrete
BS 8301	Section 5	Code of practice for building drainage
BS 8550		Concrete – Specification of Materials
BS EN	1997	Eurocode 7: Geotechnical design
BS EN	1998	Eurocode 8: Design of structure for earthquake resistance
CIRIA	Report 44	Medical Code of Practice for working in compressed air
CIRIA	Report 80	A review of instruments for gas and dust monitoring Underground
CIRIA	Report 81	Tunnel water proofing
CIRIA	Report C515	Groundwater Control – Design and Practice
CIRIA	Report C580	Embedded Retaining Walls – Guidance for Economic Design
CIRIA	Report C660	Early Age Thermal Crack Control in Concrete

6.5 ASTM Standards

ASTM	C-1202	Test methods for Electrical indication of concrete's ability to resist chloride ion penetration.
ASTM	C-1240	Micro Silica/Silica fume in concrete
ASTM	D-297	Methods for Rubber Products-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 to metal
ASTM	D-573	Accelerated aging 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-1075	Effect of water on cohesion of compacted bituminous mixtures
ASTM	D-1143	Test method for piles under static axial comp. test
ASTM	D-1149	Accelerated ozone cracking of vulcanized rubber
ASTM	D-1556	In-situ density by sand replacement
ASTM	D-1559	Test for resistance to plastic flow of bituminous mixtures using Marshall apparatus
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-3689	Testing method of testing individual piles under static axial tensile load
ASTM	D-4945	Test method for high strain dynamic testing of piles
ASTM	E-11	Specification for wire cloth sieve for testing purpose
ASTM:	Section 4:	Construction, Vol. 04.08: Soil and Rock I, and Volume 04.09: Soil and Rock II,

6.6 AASHTO Standards

AASHTO	M6-81	Fine aggregate for Portland cement concrete
AASHTO	M31-82	Deformed and plain billet-steel bars for concrete reinforcement
AASHTO	M42-81	Rail-steel deformed and plain bars for concrete reinforcement
AASHTO	M54-81	Fabricated steel bar or rod mats for concrete reinforcement
AASHTO	M 81-75	Cut-back asphalt (rapid-curing type)
AASHTO	M 82-75	Cut-back asphalt (medium-curing type)

AASHTO	M85-80	Portland cement
AASHTO	M 140-80	Emulsified asphalt
AASHTO	M 147-67	Materials for aggregate and soil–aggregate sub-base, base and surface courses
AASHTO	M148-82	Liquid membrane-forming compounds for curing concrete
AASHTO	M154-79	Air-Entraining admixtures for concrete
AASHTO	M173-60	Concrete joint-sealer, hot-poured elastic type
AASHTO	M194-82	Chemical admixtures for concrete
AASHTO	M213-81	Preformed expansion joint fillers for concrete paving and structural construction
AASHTO	M 282-80	Joints sealants, hot poured, elastomeric-type, for port-land cement concrete pavements
AASHTO	M 294-70	Fine aggregate for bituminous paving mixtures
AASHTO	T22-82	Compressive strength of cylindrical concrete specimens
AASHTO	T23-80	Making and curing concrete compressive and flexural strength test specimens in the field
AASHTO	T26-79	Quality of water to be used in concrete
AASHTO	T96-77	Resistance to abrasion of small size coarse aggregate by use of the Los Angeles machine
AASHTO	T99-81	The moisture-density relations of soils using a 5.5-lb(2.5kg) rammer and a 12-in (305mm) Drop
ASHTO	104-77	Soundness of aggregate by use of sodium sulphate or magnesium sulphate
AASHTO	T176-73	Plastic fines in graded aggregates and soil by use of the sand equivalent test
AASHTO	T180-74	The moisture density relations of soils using a 10-lb (4.54kg) rammer and an 18-in (457mm) Drop

C. Road Works and other allied works.

- i. 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.
- ii. Construction of embankment for road work with approved materials gravel / Moorum 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 / moorum, watering charges & compaction by vibratory roller to 95% of modified proctors density. MORTH Specification No.305.
- iii. Construction of sub grade and earthen shoulder with approved material Gravel / Moorum 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.
- iv. 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.
- v. 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.
- vi. Providing and applying tack coat using hot straight run bitumen of grade VG - 10, including heating the bitumen, spraying the bitumen with mechanically operated spray unit fitted on bitumen boiler, cleaning and preparing the existing road surface as per specifications.
- vii. 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.
- viii. Providing and laying bitumen mastic wearing course (as per specifications) with industrial bitumen of grade 85/25 conforming to IS : 702, prepared by using mastic cooker and laid to required level and slope, including providing antiskid surface with bitumen precoated fine grained hard stone chipping of approved size at the rate of 0.005 cum per 10 sqm and at approximate spacing of 10 cm center to center in both directions, pressed into surface protruding 1 mm to 4 mm over mastic surface, including cleaning the surface, removal of debris etc. all complete. (Considering bitumen using 10.2% as per MORTH specification).
- ix. 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.
- x. 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 5.5% VG-30 Bitumen and lime filler @ 3% (percentage by weight of Aggregate).
- xi. Design and Construction of Junction arrangements with cross roads as per the site condition.
- xii. 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.
- xiii. 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.
- xiv. 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.

- xv. 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.
- xvi. 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 80mm thick blocks of M35 grade for medium traffic.
- xvii. Supplying and fixing precast RCC gratings including cost of all materials, transportation, labour etc. complete (60x40 cm) with all lead and lifts.
- xviii. Providing and fixing railing used in rows for footpath or anti-crash barrier railing.
- xix. Providing & laying non pressure RCC pipe as per the requirement
- xx. Temporary road diversion works are in the scope of Alignment contract, however if need arises, the contractor under this contract will be required to construct alternate road for diversion of current traffic passing the LC. Maintenance of the alternate road will be in the scope of the contractor until opening of ROB or handing over of road to the concerned authority for public use. The payment for this work will be made under relevant Schedule based on latest KPWD SOR.
- xxi. 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 approved by Engineer.
- xxii. 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.
- xxiii. 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.
- xxiv. Road works and allied works to be carried out in co-ordination with BBMP/Zilla Panchayath/PWD etc as per MORTH, NH specification or applicable specifications. Contractor may also take up development or extension of culverts or construction of new culverts along the alternate road, if necessary, as directed by Engineer.
- xxv. 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.
- xxvi. 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.
- xxvii. 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 aluminum 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.
- xxviii. 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.

- xxix. Filling pot holes and patch repairs with bituminous concrete.
- xxx. 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.
- xxxi. Day to day cleaning of worksite throughout the execution period.
- xxxii. Clearing of site and handing over of all the Works, as specified or as directed.
- xxxiii. 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.

D. Initial site Preparatory works

- i. Before carrying out the work at site, necessary permissions from local agencies / authorities / road authorities / railway authorities such as BBMP, Zilla Panchayat, PWD, BWSSB, BESCOM, GAIL, KPTCL, traffic police etc., shall be required to be obtained by the contractor. Employer will assist only by the way of issue of necessary letters.
- ii. Any work affected by the construction must be temporarily supported by the contractor. The work of temporarily supporting the utilities and services during the execution of works shall be deemed to be part of the contract.
- iii. The contractor shall take all precautions for safe guarding the environment during the course of construction 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 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 error or omission in the levels or strata turning out different during execution from what is shown in the drawings.
- v. The contractor shall at all time carryout the work on highway/road/service road/railways tracks in a manner creating least interference to the flow of traffic or train operations. The contractor shall take prior approval of Engineer, traffic police, BBMP/ZP/PWD, Railways, traffic police etc., for approval of traffic diversion plan during construction works.
- vi. Site to be cleared of any obstruction along the ROB/RUB works.
- vii. Tree cutting, preservation and disposal (or) translocation along the alignment for cutting / disposal / Translocation / afforestation in lieu of cutting / Translocation.
- viii. 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.
- ix. Conducting survey and fixing bench marks and alignment markers.
- x. Necessary permanent / temporary diversion of Utilities.
- xi. Temporary barricading wherever required.
- xii. Deployment of adequate manpower (Traffic marshals and watchmen) for management of traffic at intersection, junctions, traffic diversions etc.
- xiii. Demolition / dismantling of road, footpath, kerb stone, central verge, boundary wall, etc.
- xiv. Surveying by establishing DGPS control points and TBMs, True and proper setting out and layout of the works 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 shall be fixed using DGPS double frequency and the accuracy of 1 in 50,000 or better shall be assured.

- xv. Providing temporary barricade as per the approved drawing, painting (including primer of approved quality) with synthetic enamel paint of approved colour, quality and brand, painting letters and logo of K-RIDE, including maintenance of the same duly cleaning the same on fortnightly basis and immediately repainting whenever 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. It shall be maintained in position till completion of all works at the relevant location. Nothing extra will be paid for dismantling and re-erecting the barricades at a different location. The barricades shall be relocated as the work progresses and as directed by the Engineer.

- xvi. Supply of caution watchmen 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. for continuous vigil and to exhibit necessary signals to the trains for their safe passage over the caution spot as directed by the Engineer in charge.
- xvii. Felling of trees of girth as directed (measured at a height of 1m above ground level) with lead and stacking of material including preservation.
- xviii. Tree cutting, preservation and disposal (or) Translocation along the alignment for cutting/disposal/translocation/afforestation (as per the norms of Forest Department) in lieu of cutting/translocation

The applicable permits/ permissions for felling of tress / Translocation shall be arranged by Employer. The tree cutting and disposal is included in the scope of work. Payment for cutting/translocation will be made under relevant BOQ item. The cut trees will be the property of the contractor. However, the contractor shall deposit an amount not less than Reserve Price of the trees (as fixed by Forest Department/ BBMP) plus FDT (Forest Development Tax) to KRIDE for onward transmission to Railways/BBMP/Forest Department, as the case may be.

- xix. Transportation for disposal of tree trunks, branches, roots, complete including loading and unloading as per BBMP / Forest and local authority guidelines.
- xx. Preparation of earth ball of tree roots of desired depth & diameters including necessary soil tests
- xxi. Dislodging, lifting, transportation and translocation tree from original place to the new place including all arrangements, labour etc. for successfully completing the work.
- xxii. 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.
- xxiii. Diagonal Cross trenching works for identifying underground Utility at every Pier location, 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 scope also 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.

- xxiv. Dismantling of existing structures after ensuring necessary approval form the competent authority of the concerned department. The 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 slab / 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.
- xxv. The scrap materials will be the property of the contractor except the materials of local authorities (BBMP, BWSSB, BESCOM, BSNL) and Railways.
- xxvi. Any other item of work as may be required to be carried out for completing the construction of ROB/RUB structures 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.

- xxvii. Casting Yard: The land for setting up one 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 as per the requirement and shall be decided by the KRIDE after recommendation by Engineer. No land for casting yard or offices/laboratories etc., will be provided by the employer.
- xxviii. 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
- xxix. 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.
- xxx. The Contractor shall provide the Key Personnel as per Appendix-IV.
- xxxi. The Contractor shall provide the Key Plant and Equipment's as per Appendix-V.
- xxxii. 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.
- xxxiii. 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.
- xxxiv. The contractor shall take suitable and sufficient measures as per SHE manual for working at height.

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 as part of Contract
- d) Indian and International Standards referenced therein.
- e) 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 along Corridor-4 of Suburban Rail Project between Heelalige and Benniganahalli.

The scope of work includes construction of closed RCC Box in Cut Cover method along Corridor-4 of Suburban Rail Project between Heelalige and Benniganahalli.

Availability of Land:

The required land for the execution of works is available along the alignment. 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. Project site is located along the existing BBMP/ZP/PWD roads. The contractor shall conduct 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 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 Employer to carry out some specific works in order to strengthen/repair the road, Employer shall get such works executed through the existing contractor.

Bidders should find out the capacity of the quarries and accordingly plan procurement of course/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. 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 deemed to be included as part of the Contract and it shall be paid as per the corresponding items rate available in the SoR of KPWD/ USSOR/BESCOM/BWSSB/KPTCL. 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 RCC cast in situ Box and it's allied works.
 - b. Utilities pertaining to Existing IR track, BBMP, BWSSB, GAIL, BESCOM 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.
- x. 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.
- xi. 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.
- xii. 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.
- xiii. Road widening works wherever required. 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.
- xiv. Restoration of Road and allied works immediately after completion of work up to road level or as per instructions of Engineer.
- xv. 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.
- xvi. 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.
- xvii. 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.
- xviii. 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.
- xix. 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.
- xx. Design 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.
- xxi. Maintaining and keeping the Existing Railway banks, structures and adjacent roads clean in the area of work and where construction machineries ply.
- xxii. Measures to minimize water, air and noise pollution;
- xxiii. All aspects of quality assurance, including testing of materials and other components of the work, as specified and as directed;
- xxiv. Clearing of site and handing over of all the Works, as specified or as directed
- xxv. Maintenance of the completed Work during the maintenance period as directed;
- xxvi. Submission of completion (i.e., 'As-Built') drawings and other related documents as specified; and
- xxvii. The contractor shall not display any name-board for the works without the written permission of the engineer.
- xxviii. 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.
- b) There are some one-way roads where traffic can't move in both directions.
- c) Generally, at least two lanes of traffic in both directions have to be kept while the works are on, including foundation works.
- d) 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.
- e) 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. 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.

9.1 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.

9.2 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.

9.3 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.

9.4 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.

9.5 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.

9.6 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.

9.7 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

E. Design.

- a. A Designer or Designers shall be employed by the Contractor. The Designer(s) shall have relevant experience as defined in Qualification of Tenderer of Section-2 for designing of Viaduct/Underpass/ROB/RUB. The Contractor shall provide full details of the Designer(s) past experience and details of the proposed design discipline leads for the Engineer's approval.

The Contractor may propose to carry out the design work in-house if they have a design office with an experienced design team capable of carrying out the design work for this Contract. The in-house design team should have the relevant experience as prescribed above for the Designer. The Contractor shall provide full details of his design teams past experience and details of the proposed design discipline leads which he intends to deploy for the Engineer's approval.

To ensure progressive design assurance is achieved the Designer(s) discipline leads (including Key Personnel) shall be available at all times for design meetings and workshops with the Engineer and shall be located in Bengaluru.

- b. The Permanent Works shall be designed and constructed in such a way that, when maintained in accordance with the Contractor's Operations and Maintenance manuals, the structures will remain serviceable for a minimum 100-year design life.
- c. The Contractor shall develop their design and construction methodology to suit the areas provided for the Works including but not limited to the special design wherever needed on the stations, ramps and other locations.
- d. The Works shall be designed to the Employer's requirements and all relevant current codes, specifications and drawings including Design basis report of KRIDE or as otherwise directed by the Engineer.
- e. The design shall be fully coordinated for all disciplines including systems installations. The Contractor shall design all disciplines in a fully coordinated BIM 3D model to minimise clashes, which shall be shared with other Project Partner Contractors and Stakeholders, and this shall be carried out on a common digital platform to which the Engineer and other Project Partner Contractors will be provided access.
- f. The Contractor shall appoint a proof check consulting agency (the "Proof Consultant") for proof checking of all permanent and temporary structures after proposing to the Engineer / Employer a panel of 3 (three) names of qualified and experienced firms and Engineer / Employer will select 1 Proof Consultant from panel. The Parties agree that no firm or person having any conflict of interest shall be engaged hereunder.
- g. The Contractor shall appoint a safety consultant and 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.

F. DRAWINGS:

GFC DRAWINGS:

Errors, Omissions and Discrepancies in Specifications and Drawings:

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. 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.

Only stated dimensions are to be taken and not those obtained from scaling drawings.

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.

As between the written description or written dimensions on the drawing and the corresponding one in the specifications, the former shall apply.

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**.

The drawings on a **large scale** shall take precedence over those on a smaller scale; and

Drawings approved as construction drawings from time to time shall supersede corresponding drawings previously approved.

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.

Responsibility For Specifications, Design and Drawings

a. Specifications

One copy of technical specifications shall be supplied to the Contractor.

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.

b. Drawings for Permanent Works:

- i. GAD showing general dimensions & details elaborating the scope of work (not based on detailed design) are supplied along with the tender 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 Engineer, to incorporate additional details as per design, and as described in the Specifications. Construction drawings shall be supplied progressively depending on the progress of work by the contractor during execution of work well in time for each activity. The contractor cannot claim as a matter of right that all GFCD (Good For Construction drawings) shall be given soon after award of contract. GFCD/Advance copies required for the next three months work shall ordinarily be given by the Employer for his planning, procuring etc. The GFCD will be released as and when it is required without any delay to the successful Tenderer after the issue of Letter of Acceptance.

No claim whatsoever shall be admissible on account of any changes that may be introduced by the Engineer

- ii. The "Good for Construction" drawings which shall be issued to the Contractor by the Engineer after the award of work shall delineate the extent of work to be done by the Contractor
- iii. No deviation shall be made from these drawings without a written authorization from the Engineer.
- iv. Contractor shall co-ordinate with Division and SWR/HQ for getting approvals of necessary GAD, Detailed design and drawings as and when required. Contractor will be complete responsible for obtaining approval of Design and drawing from IR/SWR.

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 tender and / or as approved by Engineer.
- ii. The contractor would design all the Ancillary and Temporary works including launching girder / truss, temporary supports, false work, formwork, staging scheme etc. and will submit the same and related working drawings to the Engineer for approval. After check by an independent third-party designer. Bar Cutting and bending schedule for the reinforcement, shop drawings for fabrication work, detailed drawings for anchorage and temporary supports for prestressing cables etc. shall also be prepared by the Contractor and submitted for Engineer's approval

iii. Shop drawings

Based on "Good for Construction" drawings issued by the Engineer 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.

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 equipment and materials, clearances and spaces required between various portions and any other information specifically called for

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

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

- iv. Approval of Engineer of any such proposal / drawings shall not relieve the contractor of his responsibility of sufficiency of such works
- v. Drawing Management

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.

The drawings submitted for approval shall be in any one of the standard sizes - AO, AI, A2, A3 or A4, in accordance with Indian standards

All drawings shall show the following particulars in the lower right hand corner in addition to the Contractor's name

Project Title
 Name of the Employer
 Name of Consultant
 Contract No.
 Title of Drawing.
 Scale
 Date of Drawing.
 Contractor's Drawing Number.
 Space for the Engineer's drawing number.
 Name of the Engineer.
 Name of Review Consultant.
 This drawing is based on Drawing No. (s).
 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. The clouding shall be done on the backside of the tracing by pencil. All dimensions on drawings shall be metric units, unless otherwise specified. However, all levels shall be in meters.

All shop drawings shall be prepared on CAD using AUTO-CAD Version 2008 or higher.

Shop drawings shall be prepared for the following works:

Reinforcing bar bending schedules

Working drawings for placing of reinforcement

All form works, Shuttering and Scaffoldings

Shop drawings for structural steel

Shop drawings for launching Girder / Truss including support arrangement

Metal work (ferrous and non-ferrous) for, rolling shutters, railings, balustrades, grilles gratings, screens, inserts, structural work in built up sections etc.

Seismic joints

Expansion joints
Construction joints
Waterproofing
All MEP services
Any proprietary system

e. Drawing Management at Site

The Contractor shall ensure that all drawings 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.

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.

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

v. 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.

v. 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 in size as required by Engineer. Copies required in excess of these shall 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:

Three sets of "As Built Drawings" in the standard sizes 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.

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.

Four sets of catalogues of all manufactured materials with the name and addresses of the manufacturers for all equipments provided by him.

The Contractor shall also submit one 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:

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".

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

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 Bill of Quantities and nothing extra shall be paid for on this account.

Appendix – I - Programme Requirements

1.1 General

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 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) 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 Conditions of Contract and Particular of conditions of contract will be applicable in cases of delays due to Contractor.

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.

1.3 Methodology

- a) The computerized 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.
- b) Unless otherwise agreed by the Engineer, all programs submitted by the Contractor shall be produced using computerized Primavera Networks developed implementing the Precedence Diagramming Method (PDM) with Resource Loaded Charts and Tables.
- c) 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 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.
- d) Program management software
Primavera programming software used shall be Primavera 6.0 v 21.12 programming software shall be used.

1.4 Submissions

- 1.4.1 The Contractor shall develop bid 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:
- Program: Baseline Primavera Network
 - Program: Baseline Milestone based Cost Activity Schedule
 - Baseline Schedule Report
 - Narrative
 - Baseline Physical Progress 'S' curve
 - Baseline Resource Charts (with Resource levelling)
 - 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 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:
- Key Dates, and Works Area Hand-over Dates and Interface dates.
 - All physical work to be undertaken in the performance of the Contract obligations, including Temporary Works,
 - The requested date for issue of any drawings or information by the Engineer,
 - Procurement of major materials and the delivery and/or partial delivery date on-Site of principal items of Contractor's Equipment,
 - 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 Primavera Network Logic Diagram, expressed in percentage terms. This 'S' curve shall be generated from the computerized Primavera Network Logic Diagram.
- 1.5.12 Baseline Resource Charts
- The Contractor shall also submit a Resource Charts, generated from the Contractor's Primavera Network Diagram, showing the anticipated manpower and main Construction Equipment usage during the execution of the Project. The Resources shall be properly levelled 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 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 ₹. 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:
 - a) 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.
 - b) Identify by activity number and description, activities in progress and activities scheduled to be completed.
 - c) 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

- 2.12.1 A review of all environmental issues during past month shall include all monitoring reports, mitigation measures undertaken, and activities to control environmental impacts.
- 2.12.2 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.

Appendix – II - 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.

Appendix III - Quality Manual

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1 Purpose

This document titled 'Construction Quality Guideline' sets the minimum Quality Standards that are to be adopted and implemented across all the projects of the BSRP project Programs. This document only provides an outline and overview of the obligations, the detailed and specific quality requirements are described in Indian Legislation.

2 Scope

- This procedure applies to Bangalore Suburban Rail Projects and sub projects at BSRP, project information / records created regardless of format, which includes information generated by the General Consultant, D&B Contractor(s) and 3rd Parties.
- KRIDE contracts complete packages. These packages consist in detail engineering, construction / production, quality planning, assurance and control and at last quality verification.
- KRIDE requires the fulfilment of the KRIDE CMS Quality Policy, the quality objectives and the project quality plan(s) throughout the lifecycle of the contracted work

3 Definitions

Table 1: Definitions

Term	Definition
KRIDE	The Employer and Client
General Consultant	Bangalore Suburban Rail Projects' General Consultant (Egis, AECOM & WSP JV).
The Engineer	General Consultant
Initiator / Originator	The person who starts the process.
Participant	The person who is or may be involved in the implementation of the procedure.
D&B Contractor	The organization contracted by the Employer to carry out the Project D&B works.
3 rd Parties	3 rd party Project stakeholders.
Project Partners	The term 'Project Partners' used throughout this document includes the Client, General Consultant, other Consultants, Contractors, Subcontractor's, Suppliers and anyone else who undertake works on the Bangalore Suburban Rail projects.

4 Responsibilities

4.1 Project Directors

- Provide positive leadership on quality issues.
- Promote an enthusiastic quality culture that delivers positive commitment to and engages all employees in continuous improvement in quality performance.
- Keep abreast of developments of Indian quality legislation and industry standards.
- Ensure that a quality management system is implemented within their sphere of responsibility and monitor and review its effectiveness and take necessary improvement action.

- e. Monitor that personnel under their control comply with their individual responsibilities in quality matters.
- f. Ensure that the disciplinary process to address breaches of the quality policy or management system is applied where necessary.

4.2 Senior Managers

- a. Senior Managers are people in the organisation at any level above senior supervisor and below director.
- b. Provide positive leadership on quality issues within their area of operation.
- c. Promote an enthusiastic quality culture that delivers positive commitment to and engages all employees in continuous improvement in quality performance.
- d. Implement the business unit quality management system. In particular:
 - i. Identify quality training needs and have the necessary training arranged and when arranged, release those who require training.
 - ii. Make arrangements for quality induction training for all new starters at the workplace under their control.
 - iii. Implement operating procedures, for the planning and control of activities associated with identified risks.
 - iv. Ensure that written method statements, risk assessments and/or quality rules are brought to the attention of management.
 - v. Appoint appropriate personnel to undertake quality duties.
 - vi. Ensure that suitable arrangements are in place for the effective control of changes to planned methods of work.
 - vii. Keep abreast of developments in Indian quality legislation and industry standards.
 - viii. Monitor and review the effectiveness of the quality management system and report deficiencies.
 - ix. Monitor that personnel under their control comply with their individual responsibilities in quality matters.
 - x. Give personnel under their control, including contractors, clear instructions as to their responsibilities to ensure correct working methods.

4.3 Designers

- a. Ensure staff, are competent and adequately resourced to address the quality issues likely to be involved in the design.
- b. Consider quality when designing structures, equipment systems, temporary works.
- c. When carrying out the design, provide adequate information about any quality risks associated with the design.
- d. Coordinate activities with that of others to improve the way in which quality is managed and controlled.

4.4 Quality Managers and Officers

- a. Provide positive leadership within their area of operation and promote the adoption of best practice.
- b. Promote an enthusiastic quality culture that delivers positive commitment to and engages all employees in continuous improvement quality performance.
- c. Keep abreast of developments in quality legislation and industry standards.
- d. Monitor and report on the effectiveness of the quality management system and progress against the quality performance standards and make recommendations for improvement as appropriate.
- e. Monitor and report on operational quality performance and make recommendations for improvement and monitor to ensure that effective action is taken.
- f. Lead and provide functional management for any quality personnel under their control.
- g. Assist with the identification of quality training needs, and monitor delivery and recording.
- h. Monitor and report on the implementation of the approved quality objectives.

- i. Produce quality performance reports as required.
- j. Promptly alert line and functional management to significant quality issues and where appropriate be involved in the investigation and ensure that the findings are reported.
- k. Review quality reports, identify any trends and ensure that there is an appropriate response to prevent future recurrence.

4.5 Section, Site, Discipline Engineers and Foremen

- a. Appreciate the responsibility allocated to individuals within the operative and management structure.
- b. Set a good example and leadership on the site.
- c. Ensure that only trained and authorised workers use plant and equipment and that persons undergoing training do not operate plant and equipment unless closely supervised by a competent person.
- d. Ensure that employees under their control attend quality induction training before working on the site and that they are correctly supervised at all times
- e. Ensure that materials, plant and equipment under their control or brought to site by the subcontractor has any necessary certificates of test, inspection and examination and is safe to use
- f. Ensure that clear instruction and information is given to persons under their control.
- g. Carry out recorded quality inspections of site conditions.
- h. Attend any meeting on quality issues as required and as applicable, co-operate with all personnel on matters of quality.

4.6 Supervisors

- a. Supervisors are people at the first level in the organisation that have responsibilities over the work of others.
- b. Provide positive leadership on quality issues for the members of the work team for which they are responsible.
- c. Promote a positive attitude in the workforce and encourage behaviours that protect both people and the environment.
- d. Monitor that personnel under their control comply with their individual responsibilities in quality matters.
- e. Give personnel under their control, including contractors, clear instructions about the required methods of work.
- f. Identify any quality training requirements of personnel under their control and advise appropriate management accordingly.
- g. See that all quality issues are reported immediately to the relevant manager.

4.7 All Employees

Set a good personal example on quality issues within your area of operation.

5. Legal and Other Requirements

- a. All work is to be undertaken in compliance with the requirements of Indian Law. If no local standard exists or the applicable standard is not specified, the appropriate and compatible internationally recognised standard or code of practice shall be adopted.
- b. The hierarchy of standards is as follows:
 - i. Indian Standards (IN),
 - ii. Euro Norm (EN),
 - iii. British Standards (BS),
 - iv. International Standards and Codes of Practice
 - v. Alternative standards may be proposed if they can satisfactorily be demonstrated that they are

equivalent, in all respects, to the defined standards. Where there is a discrepancy or a conflict, the higher or stricter standards shall take precedence. Project Partners are to ensure that all prescribed registers, certificates and records are maintained and available for inspection at the relevant work locations by any authorised person.

6. Quality Objectives

- a. Quality objectives must be defined and made available for all internal and external stakeholders. The completion of the quality objectives must be checked on a regular basis and the measures must be adopted accordingly in line with the KRIDE's Quality Strategy and to achieve Right the First Time.
- b. These quality relevant objectives (KPI) will be defined by the KRIDE's Executive Management and Program Team as appropriate.
- c. Quality goals which are applicable to each program and/or project contract and particular type of work will be defined by the Project Partner with agreement of the Engineer.

7. Quality Standards, Codes and Specifications

- a. Quality standards, codes and specifications must be defined during design and engineering by the engineering disciplines (infrastructure and civil works, system/MEP, rolling stock, operation and maintenance) for the different packages.
- b. The program will comply with all pre-defined international codes and standards which satisfies the requirements of ISO 9001:2015 and deliver a state-of-the-art BSRP.

8. Tender and Procurement

- a. Quality during tendering and procurement will be ensured by the following measures:
 - i. All tendering documents must fulfil the requirements of ISO 9001:2015.
 - ii. All program partners must be certified according to ISO 9001:2015. The certification must include the scope of services being provided to KRIDE and include the specific project location.
 - iii. Basic quality requirements for all tendered parts must be defined (during design and construction) with documentation by engineering discipline (e.g. infrastructure and civil works, system/MEP, rolling stock, operation and maintenance).
 - iv. Define selection criteria based on selected capabilities and experiences.
 - v. Define pre-qualification in line with KRIDE processes and procedures.
 - vi. Detailed quality requirements must be defined by program partners according to the complexity of their scope of supply (to be defined during procurement Process).
 - vii. Potential program partners must provide a provisional quality plan according to the complexity of their scope of supply (to be defined during procurement). This provisional quality plan must be submitted together with the bidding documents.
 - viii. Ongoing improvements of quality requirements (e.g. change of standards) by the KRIDE program and potential program partners must be incorporated throughout the project lifecycle.
 - ix. Tendering documents must be approved by engineering discipline, where applicable (e.g. infrastructure and civil works, system/MEP, rolling stock, operation and maintenance).

9. Design and Engineering

- a. The contractor must define:
 - i. Design and engineering stages.
 - ii. Review, verification and validation appropriate to each design and engineering stage.
 - iii. Responsibilities and authorities for design and engineering.
 - iv. Inputs, related to the contract requirements, must be defined as there are:

- v. Functional and performance requirements:
 - Applicable statutory and regulatory requirements.
 - When applicable, information derived from previous similar designs.
 - Other requirements essential for design and engineering.
- b. Design and engineering outputs must:
 - i. Define relevant standards, codes and specifications.
 - ii. Meet the project requirements.
 - iii. Define testing/inspection procedures as appropriate.
 - iv. Provide appropriate information and documentation (e.g. for purchasing,
 - v. Construction/production, testing, training, operation, maintenance etc.).
 - vi. Be reviewed at suitable stages by an independent Design Verification Engineer (DVE) in order to:
 - Evaluate the ability of the results or design and engineering to meet requirements.
 - Identify any problems and propose necessary actions.
- c. Design and engineering changes must be identified and records maintained
- d. Design and engineering changes must be reviewed, verified and validated as appropriate, and approved by DVE before implementation.
- e. Changes must be explicitly mentioned in order to highlight that the initial requirements have been altered.
- f. During testing phase special attention should be paid to changes (of scope or quality requirements) to the project.
- g. All defined quality relevant measures must be integrated in the contractor's Quality Management Plan (QMP).
- h. Design and engineering results must be checked, evaluated and validated by DVE before construction/production begins. These checks, evaluations and approvals must be documented and reported (communicated). The quality of the design work must be validated by the DVE at the end of the contract.

10. Construction

- a. To ensure adequate quality planning during the construction phase the following measures are foreseen:
 - i. Program Partners must have a validated QMP
 - ii. Copy of the contractor's current QMP
 - iii. Schedule showing all foreseen tests/inspections
 - iv. Schedule to perform audits in the contracted work
 - v. Procedure describing the handling of corrective action
 - vi. Procedure describing non-conforming items
 - vii. Process for continuous improvement.
- b. Program Partners must accomplish their work according to their validated QMP and have to:
 - i. Fulfil quality requirements.
 - ii. Accomplish the work according to the relevant standards, codes and specifications.
 - iii. Document and report the accomplished work.
 - iv. Train their personnel and assess their competencies.
 - v. Fulfil the requirements related to the contracted work.
 - vi. Perform and document planned tests/inspections.
 - vii. Deliver as-built-drawings to KRIDE.
 - viii. Demonstrate the traceability of all quality relevant issues.
 - ix. Preserve products.
 - x. Control the monitoring and measuring equipment, including documentation.
 - xi. Perform and document internal audits.
 - xii. Handle non-conformities according to the related procedure. Nonconformities must be demonstrated to KRIDE propositions/solutions resulting from nonconformities

- xiii. Carry out a continuous improvement (corrective and preventive action) with documentation. Solutions resulting from the continuous improvement process must be analysed
- c. The Engineer will, as regularly as deemed appropriate, monitor work samples with a frequency to ensure quality:
 - i. By inspecting the contractor's work on site.
 - ii. Verify the contractor's work according to the QMP.
 - iii. Perform and document planned tests/inspections.
 - iv. Verify the as-built-drawings of the contractor.
 - v. Analyse and approve changes within the contract.
 - vi. Pay special attention to project changes (scope or requirements) during test phase.
 - vii. Perform internal audits for each applicable contract.
 - viii. Analyse non-conformities with the contractor and approve solutions.
 - ix. Analyse solutions resulting from the continuous improvement process of the contractor within the contract and approve them.
 - x. Testing
- d. To ensure adequate quality planning during the test phase the following measures are foreseen:
 - i. Involving of end-user
 - ii. Organisation of test performance
 - iii. Definition of test results
 - iv. Test scheduling
 - v. Definition of any quality procedures during test performance
 - vi. Training of personnel, as required
 - vii. Test documentation.
- e. Performing quality assurance during the testing phase will be guaranteed by the following measures:
 - i. Definition of functions
 - ii. Observance and fitting of new designed functions with documentation
 - iii. Observance and fitting of functions which caused problems during design and
 - iv. Engineering or construction phase with documentation
 - v. Observance and fitting of functions which have been changed or optimised during design and engineering or construction phase with documentation
 - vi. Testing documentation in general.
- f. KRIDE contracts complete packages. These packages consist in detail engineering, construction / production, quality planning, assurance and control and at last quality verification.
- g. KRIDE requires the fulfilment of the KRIDE Quality Policy, the quality objectives and the project quality plan(s) throughout the lifecycle of the contracted work.

11. Commissioning and Handover

- a. To ensure adequate quality planning during the commissioning and handover phase the following measures are foreseen:
 - i. Involving of end-user
 - ii. Organisation of commissioning procedures
 - iii. Definition of commissioning results
 - iv. Commissioning scheduling
 - v. Definition of specific quality procedures for commissioning process
 - vi. Training of personnel
 - vii. Commissioning documentation
 - viii. As-built-drawings must be prepared and supplied upon completion.
- b. To ensure adequate quality assurance during the commissioning and handover process a number of measures have to be foreseen. These measures include, but are not limited to a general check of project, project packages and interfaces, including check of:

- i. Documentation
- ii. Materials
- iii. Buildings and installations
- iv. Electrical equipment
- v. HVAC equipment (all building services)
- vi. Earthworks
- vii. Concrete works
- viii. Structural works
- ix. Waterproofing
- x. Painting and coating
- xi. Operation processes and procedures
- xii. Training processes
- xiii. Regular testing and inspection processes and equipment
- xiv. Emergency and escape procedures and equipment.

12. Operations and Maintenance

- a. Quality planning during operation and maintenance will be guaranteed by adopting the following measures:
 - i. Operation ability must be demonstrated and documented.
 - ii. Operating rules must be defined.
 - iii. Roles and responsibilities must be defined.
 - iv. Operation personnel must be trained, including the certification of the trainees.
 - v. New personnel must be trained according to the job-requirements before starting. Fulfilling of the job-requirements must be demonstrated and documented.
 - vi. All training measures must be planned.
 - vii. Required, adequate documentation (operation and maintenance manual) must be available.
 - viii. Inspections must be planned.
 - ix. Precautionary maintenance must be planned.
 - x. Inspection and maintenance personnel must be trained.
 - xi. Inspection and maintenance tools must be available.
 - xii. Spare parts must be available.
 - xiii. Inspection and maintenance documentation must be available.
 - xiv. Operation and maintenance procedures must be defined.
- b. To ensure adequate quality assurance during operation and maintenance the following measures are foreseen:
 - i. Operational ability procedure
 - ii. Personnel training documentation and planning procedure
 - iii. Inspection planning and documentation procedure
 - iv. Maintenance planning and documentation procedure.

13. Training

- a. To ensure adequate quality planning for the training the following measures are foreseen:
 - i. Operation personnel must be trained according to a pre-defined training schedule with demonstration of the fulfilling (e.g. examination, depending on the job description) of the requirements.
 - ii. Inspection and maintenance personnel must be trained according to a pre-defined training schedule with demonstration of the fulfilling (e.g. examination, depending on the job description) of the requirements.
 - iii. New personnel must be trained according to the job requirements before starting. Fulfilling of the job requirements (e.g. examination, depending on the job description) must be demonstrated and

documented.

- b. To ensure adequate quality assurance for the training the following measures are foreseen:
 - i. Personnel ability procedure
 - ii. Personnel training documentation and planning procedure.

14. Closing

- a. To ensure adequate quality planning for the closing process of the contract the following measures are foreseen:
 - i. Operation ability must be demonstrated over a pre-defined period
 - ii. Tests and inspections must be finished and documented
 - iii. Personnel must be trained.
- b. To ensure adequate quality assurance for the closing of the project all previous quality planning, assurance and control measures must be closed. Therefore, all project elements must be checked to ensure the required documentation is available and handed over to KRIDE. For example:
 - i. Tendering and Procurement
 - ii. Contracting
 - iii. Design and Engineering
 - iv. Construction
 - v. Testing
 - vi. Commissioning and Handover
 - vii. Operation and Maintenance
 - viii. Training.
- c. A completion list will be implemented and all missing documentation must be compiled within an adequate timeframe. The contract will be closed when KRIDE gives a written confirmation of the final acceptance of all deliverables before handover to the operator.

15. Quality Surveillance, Non-Conformities and Improvement

- a. The Quality Manager (QM) must conduct internal audits at planned intervals to determine whether the QMP:
 - i. Conforms to the planned arrangements and to the requirements of KRIDE
 - ii. Is effectively implemented and maintained.
- b. An audit program must be planned, taking into consideration the status and importance of the processes and areas to be audited, as well as the results of previous audits. The audit criteria, scope, frequency and methods must be defined. An audit schedule must be prepared.
- c. If non-conforming project execution is detected the following measures are required:
 - i. Take action to eliminate the detected non-conformity
 - ii. Authorise its use, release or acceptance under concession by a relevant authority
 - iii. and, where applicable, by KRIDE
 - iv. Take action to preclude its original use or application
 - v. Take action appropriate to the effects or potential effects of the non-conformity, if the non-conforming project execution is detected after beginning of operation.
- d. When non-conforming project execution is corrected it must be subject to re-verification to demonstrate conformity to the requirements.
- e. Records on the nature of non-conformities and any subsequent actions taken, including concessions obtained must be maintained.
- f. The QM must continually improve the effectiveness of the QMS through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and project quality reviews.
- g. The QM must take action to eliminate the causes of non-conformities in order to prevent recurrence.

Corrective actions must be appropriate to the effects of the nonconformities encountered and include, but are not limited to:

- i. Reviewing non-conformities
 - ii. Establish the causes of non-conformities
 - iii. Evaluating the need for action to ensure that non-conformities do not recur
 - iv. Assessing and implementing corrective action
 - v. Recording the results of action taken
 - vi. Reviewing the effectiveness of the corrective action taken.
- h. The QM must determine action to eliminate the causes of potential nonconformities in order to prevent their occurrence. Preventive actions must be appropriate to the effects of the potential problems, at least:
- i. State potential non-conformities and their causes
 - ii. Evaluating the need for action to prevent occurrence of non-conformities
 - iii. Set and implement the needed action
 - iv. Records of results of action taken
 - v. Reviewing the effectiveness of preventive action taken.

16. Quality Monitoring and Reporting

- a. To ensure the effectiveness of the quality monitoring and reporting KRIDE will implement a quality committee who will meet regularly. This quality committee will analyse and report to the management team of the KRIDE program the following matters at least (not limited to the list below):
- i. Minutes of the previous meeting/review of pending actions and decisions
 - ii. Quality key issues
 - iii. Project status
 - iv. Project documentation and reporting
 - v. Inspection and testing
 - vi. Surveillance
 - vii. Non-conformities and improvement
 - viii. Audits
 - ix. Next meeting

Appendix-IV - Organisation Chart and Key Positions

The Contractor shall provide the following organization chart for the Works as follows:

1) 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.

2) 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.

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	Design manager	Post Graduate Degree/ Bachelor's Degree in Structural Engineer	Minimum 10 years total experience and 5-year experience in the role of Design Manager in the execution of similar type of work	1
3	QA & QC Manager.	Bachelor's Degree in Civil Engineer	Minimum 10 years total experience and 8-year experience in execution of similar type of work.	1
4	Safety Manager	Bachelor's Degree in Civil Engineer & Diploma in Safety Course.	Minimum 8 years total experience and 3-year experience in the role of Chief Safety and Health Manager in the execution of similar type of work.	1
5	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.	1
6	Senior Civil Engineer	Bachelor's Degree in Civil Engineer	Total minimum 7 Years for graduate & 10 years for Diploma in relevant field.	2

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 and 2 as per approved man power 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 and 2.
8. All Key Personnel must be permanently stationed at Bangalore till the completion of the work.
9. The penalties imposed are non-refundable.

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Appendix-V - Plant and Equipment

The Tenderer or JV as a whole must deploy the minimum required Contractor's Equipment for the Works as given below.

S. No.	Type of equipment required for the work.	Minimum No. of Units of equipment required for the work	Remarks
1	Piling Equipment Rotary Rig/Hydraulic Rig for soil boring and rock boring including diamond bits for rock boring.	---	
2	Piling rig (Tripod) with conventional winch	---	
3	Fully Automatic and Computerized Batching Plant -1 Nos. (1 of 30 Cum/h) minimum or equivalent capacity in different configuration at casting yard with a RO of suitable capacity for proper quality of water.	1nos	
4	Concrete boom placers	1nos	
5	Concrete pumps with sufficient pipes	2nos	
6	Transit Mixtures	5nos	
7	RCC BOX Shutters including Staggering and Supporting arrangements.	Min 60 meters	
8	250 MT or more capacity suitable cranes for erections and lifting	1nos	
10	Trailers of Suitable capacity as per site requirement	1nos	
11	Man-lift for adequate height	1no	
12	Crash Barriers & Friction slab Shutters	2sets	
	Road work, Embankment and cutting works.		
13	Hydraulic excavator (1 cum bucket)	2nos	
14	Tippers/trucks (10 cum capacity)	3nos	
15	Crane 35 MT capacity	1no	
16	Generators 125 KVA	1nos	
17	Vibratory roller 8-ton capacity	1nos	
18	Smooth wheeled roller 8-ton capacity	1nos	
19	Pneumatic road roller	1nos	
20	Tandem road roller	1nos	
21	Water tanker of 6000 lit capacity	1nos	
22	Grader	1nos	
23	Plate Vibratory Roller	as required	
24	Slope Compactor Roller	as required	
25	Survey equipment's: Total stations and auto level	2set	

Notes:

- The Tenderer shall undertake to deploy sufficient resources to carry out the Works. These resources are for peak period of each activity and shall be mobilised by the Contractor to suit his works programme.
- If the Contractor opts for short line method for casting, the number of pre-cast bed shall be increased accordingly.
- The Contractor's Equipment shall not be more than five years old reckoned from the date of original manufacture.
- Hiring of Cranes shall be as per approved vendors for supply of cranes. The contractors are free to propose and utilize plant and machinery after getting approval from the Engineer. Third party certification of cranes, competency certification of the operators etc. would be required before grant of approval.
- Deleted
- The proposed Contractor's Equipment shall not in any event be construed as a submission of final requirement for the Works.
- 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 within the stipulated completion period the Tenderer shall deploy additional machinery as circumstances warrant at no extra cost. Plant and machinery above shall not be older than 5years. In case of failure of any plant and machinery deployed at site the same shall be repaired/replaced within 7days from the time of failure.
- Tenderer shall submit the copies of ownership of the equipment, In case of hire / purchase, Copies of MOU with the supplier/ owner of the equipment.
- *Contractor shall be penalized as deemed fit.



- x. 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.
- xi. Deleted.
- xii. Deleted.

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Appendix – VI – Office Accommodation, Equipment and Personnel

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Appendix VII - Document Submission and Response Procedure

1 Project Management Information System (PMIS)

The Contractor shall utilize 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. Make or standard of PMIS shall be as directed by Employer.

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-filename.

2. Records And Reports

a) 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.

b) 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.

c) 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.

d) 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.

3. 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 all 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 with Comments has been received for the previous stage of the same Works or any sub-system, part or section thereof.

5. Responed Procedure

5.1 Responed 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 Re-Submit within 15 calendar days of receipt of "Notice of Rejection" from the Engineer addressing the Engineer's comments. Subsequently the Engineer shall respond within 15 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 Objection" with Comments, (NOWC) 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 NOWC 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 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 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/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 Walk through
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.

Appendix VIII - Drawing List

Deleted

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Appendix-IX - 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 available adjacent to railway track for contractor's temporary construction use / enabling works yard, the necessary land rent / lease charges shall be levied as advised by Railway concerned / Govt. authority norms / K-RIDE norms and the same will deducted from IPC 's of the Contractor.

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Appendix-X - Works Areas & Temporary Power Supply

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 Works 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 water course shall be used without consent of the Engineer.
 - (c) Damages or obstructions caused to any water course, 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 all the 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) Regulations 1990.

5. **Electrical General**

Temporary electrical Site installation 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**

- (4) The site mains voltage shall be as per the electricity authority, 415V/3 phase 4 wire system.
 - ii. Single phase voltage shall be as per the electricity authority, 230V supply.
 - iii. Reduced voltages shall conform to BS7375.
2. Types of Distribution Supply

The following voltages shall be adhered to for typical applications throughout the distribution systems:

 - iv. fixed plant-415V/3phase;
 - v. movable plant fed by trailing cable-415V/3 phase;
 - vi. installations in Site buildings- 230V/1phase;
 - vii. Fixed flood lighting-230V/1phase;
 - viii. Portable and hand held tools-115V/1phase;
 - ix. Site lighting (other than flood lighting)-115V/1phase; and
 - x. 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) BSEN 60898; and
 - (iii) BS 7375;
 - (iv) Any other appropriate Indian Standards.
9. **Earthing**
 - (1) Earthing and bonding shall be provided for all electrical installation sand 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 Outlet Sand Couplers**

Low voltage plugs, sockets and couplers shall be colors coded in accordance with BS 7375, and constructed to confirm BSEN 63809 high voltage coupler sand 'T' connections shall be in accordance with BS3905.
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:
 - c) BS6708 flexible cables for use at mines and quarries;
 - d) BS6007 rubber insulated cables for electric power and lighting; and
 - e) BS6500 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) BS6346 for armored PVC insulated cables; and
 - b) BS6708 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 in accordance with BS 7375 and BS4363.
- (2) Voltage shall not exceed 55V 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 IP54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP65 shall be employed.
- (4) The Contractor shall upgrade the lighting level to a minimum of 200 lux by localized 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 BS4999: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 IEE 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 works record.
- (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 separately metered and invoiced supply or supplies of electricity for: -

- (a) Site fabrication facilities;
- (b) Site work shops and work yards; and
- (c) Site offices and stores.

Appendix - XI – Utilities

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DEFINITIONS

1. Utilities:

Utilities are defined as public utilities above or below ground and include all live water mains, sewer mains, water wells, power cables, streetlights, transformers, pillar boxes, telephone posts, telecommunication cables, gravity sewers, storm water drains, gas lines which are either shown on the Employer's Drawings (charted) or identified on site by the Contractor (uncharted).

1.1 Charted Utilities:

Charted Utilities are the utilities (as defined above) which are shown on the Employer's Drawings.

1.2 Uncharted Utilities:

Uncharted Utilities are the utilities (as defined above) which are not shown on the Employer's Drawings.

1.3 Responsibility of the Contractor.

- 1.3.1 The Contractor shall make his own enquiries and investigations, including excavating trial holes/pits, to ascertain the existence, nature, location, and size of utilities. A schedule of utility diversions and utilities to remain but to be supported / protected (the utility diversion plan) shall be prepared by the Contractor and submitted.

The schedule will list out utilities that:

- will be diverted by the Contractor during the course of the Works, and
- will remain in place and require the use of specific construction protection methods to complete the underground structures around and below the utilities including support of the utilities during construction by the Contractor.

- 1.3.2 The Contractor shall take into consideration the time required for utility diversions into the overall Works Programme for the Contract. However, efforts shall be made to avoid diverting/disturbance of any utility and continue the Works by supporting the same but the required services being provided by these utilities shall be maintained at all the times by the Contractor. Any delay to construction works due to delay in Utility diversion work will be responsibility of contractor, no claims shall be entertained in this regard.

- 1.3.3 The diversion work shall be undertaken by the Contractor as per the approval of the Utility owning Agencies and a notice from the Engineer. Temporary supports and protection by methods proposed by the Contractor and agreed by the Utility Agency shall be provided to the utilities. Permanent supports and protection shall be provided wherever required for the safety and security of the utility service.

- 1.3.4 The Contractor shall immediately inform the Engineer and the Utility Agencies of any
- (a) damage to utilities.
 - (b) leakage of utilities.
 - (c) discovery of utilities not previously identified.

- 1.3.5 When diverting and/or protecting sewerage and storm water lines the Contractor shall ensure that drainage to the site and adjacent areas is maintained at all times and that at no times flooding/overflow or other nuisance occurs.

- 1.3.6 The Contractor shall inform the Employer/Engineer of the programme of all works of utility diversion/ protection works and shall take all steps to enable the utility diversions to proceed in accordance with the programme. The Contractor shall maintain close liaison with the Utility Agencies. The Contractor shall set up and manage a Utility Liaison Group of experienced personnel for the duration of the Contract.

- 1.3.7 Records of the existing utilities encountered shall be kept by the Contractor on the Site and a copy provided for the Employer/Engineer. The records shall contain the following details:

- (d) location of utility.
- (e) date on which the utilities were encountered.
- (f) nature and sizes of the utilities.

- (g) condition of utility.
 - (h) temporary or permanent supports provided, and
 - (i) Diversions made –Temporary or permanent
- 1.3.8 The Contractor shall include the details (plan, location, ownership, size, and material) of all such utilities on the As Built Drawings.
- 1.3.9 The diversion/protection of utilities (Charted/Uncharted) shall be covered under the provisional sum given in the Pricing Summary. The Contractor shall be paid as per the current Schedule of Rates of the respective departments (KPWD, IR-USSOR, BWSSB, BESCOM, BSNL, or any other Govt agency etc.) plus 10% for overhead and profit. The priority of reference for deriving rate shall be in the same order as stated above. Until such time as such rate(s) are agreed or fixed, the Engineer, after consultation with the Employer, shall determine the provisional rate(s) to enable IPC to be issued by the Engineer.
- 1.3.10 Temporary diversion of each utility is allowed for one time. If the utility is to be restored, permanent restoration shall be considered in addition to the temporary diversion.
- 1.3.11 NOC & Approval of schemes for Diversion of Utilities from the concerned regulatory /statutory/Local Authority is the responsibility of the Contractor in coordination with Employer, Employer will only assist in getting permission and nothing extra is payable on this account. Similarly, necessary precautions which are specified from time to time by the utility owning agencies shall be followed. Contractor should make his own survey for identification of underground/above ground utilities.
- 2. Diversion and Protection of Underground/Overhead Utility Lines**
- 2.1 The work comprises of replacement, relocation, diversion and protection of existing subsurface, surface and overhead public utilities viz. sewer mains, water lines, water wells, storm water drains, gully pits including connection pipes, house drains, gas pipe lines, electric and telephone cables, optical fibre cables including their appurtenance structure, O.H. electrical transmission line, electric poles, traffic signals, etc. which will be disturbed due to construction of the stations, where applicable.
- 2.2 The Contractor shall effectively protect all public utilities falling within the stations, station entry & exit locations and their immediate adjoining areas or which are likely to be exposed, disturbed or damaged during the execution of the work or in consequence thereof, in such a manner and using such materials as required or specified by the concerned public Utility Agencies and as per instruction of the Engineer, and hold them in proper position without any damage being caused to them during execution of work. Where adequate spaces are not available adjacent and outside the stations, the utilities may have to be hanged within the station-box itself to facilitate the construction work.
- 2.3 The contractor shall provide and lay pipes, water wells, gas mains/gully pit connections/house drains and other electric, telephones, copper telecom cable, optical fibre cables and other cables or any other underground structures or services falling within the station and their immediate adjoining areas which may be found to have been disturbed or damaged due to the Contractor's fault and/or defective and careless workmanship. The decision of the Engineer in this respect shall be binding and final and all costs of rebuilding or repairing of such damaged services or structures as foresaid shall be deducted from the Contractor, if the same is not taken care of within a reasonable time frame, mutually agreed between the Engineer and the Contractor. The claim or penalty imposed by the concerned utility department for the damage of utilities done by the contractor shall be recovered from the Contractor.
- 2.4 The Contractor shall enquire of and collect information from all concerned public Utility agencies, owners, Government Departments and local bodies in connection with the sewer lines, water mains, water wells, cables, wires and any other obstruction either overhead or on ground or underground which may be encountered in the course of execution of the work and which are likely to affect the progress of the work, at

his own cost and risk. No idle labour charge will be admissible on account of delay in collecting the above-mentioned information.

- 2.5 The Contractor shall have to excavate trial trenches of suitable sizes for satisfactorily exploring all the underground utilities as required and as instructed by the Engineer before commencement of any permanent work below ground level. All works related to utility identification and preparation of drawings obtaining stake holders approval shall be included in the Contractors quoted price. The time of completion for the project is inclusive of diverting and/or protection (temporary as well permanent) of utilities.

3. Additional Conditions for Diversion/Protection of BWSSB Utilities

- 3.1 It is the responsibility of the Contractor to get the approval of the proposed water/sewer/storm water/ pipeline etc., diversion/shifting from the concerned Agency/Authority. However, Engineer / Employer may facilitate the co-ordination work with concerned agency for getting the necessary approval.
- 3.2 In case the concerned utility agency/authority maintains a list of registered/approved contractors for undertaking such works and desires such shifting/diversion of pipeline/utility etc. work to be undertaken by such registered/approved contractors, then such shifting/diversion of pipeline/utility etc., shall have to be carried out by engaging the registered/approved contractors.
- 3.3 In case the Engineers of concerned utility agency intend to supervise the work, the Contractor (or sub-contractors engaged by the Contractor) have to carry out the work as per the instruction of the utility agency during diversion work by the Contractor.
- 3.4 In case of permanent diversion of water/sewer/storm water/pipelines etc., it is the responsibility of the Contractor to carry out such work without affecting water supply/without affecting sewage disposal etc. If required alternative temporary arrangement shall have to be made by the Contractor without any additional cost.
- 3.5 In case of temporary water pipe/sewer pumping mains (without manholes) diversion (which means divert the pipeline temporary away from station box and brought back to the original position after completion of station work), it is the responsibility of the Contractor either to use the retrieved diverted pipes or new pipes to restore back the original place without affecting the water supply/utility service.
- 3.6 In case of temporary diversion of gravity sewer pipelines with manholes are required, the Contractor, initially before taking up the station work has to ensure that the flow is diverted by laying sewer pipeline and constructing manholes away from the station box and then only divert the flow. After completion of station work, the Contractor shall have to lay again another sewer pipelines and again construct new manholes for restoring back to the original place.
- 3.7 In case of temporary supporting of water/sewer pipelines, if any damages occur during construction period it is the responsibility of the Contractor to rectify the damages to the satisfaction of concerned agency. The cost of the rectification works shall have to be borne by the Contractor.
- 3.8 It is the responsibility of the Contractor to obtain completion certificate from concerned utility agency for each diversion work. The payment for such diversion work will be made to the Contractor after obtaining completion certificate from concerned utility agency.
- 3.9 The Contractor shall handover all the retrieved material to the stores of the concerned utility agency/concerned department at the Contractor's cost and submit the proof of handing over.

4. Electrical Utilities (BESCOM/KPTCL)

- 4.1 The Contractor shall submit the utility diversion programme to Engineer / Employer with diversion justification based on trial pit information.
- 4.2 The Contractor shall submit the diversion plan to Engineer at least 60 (sixty) days in advance of work commencing to obtain approval from Electrical utility agencies. For utility diversion proposals of BESCOM /

- KPTCL, the Contractor shall submit diversion justification with trail pit information and drawing(s) with the proposed diversion route(s).
- 4.3 The Contractor would submit application of diversion works to electrical utility agencies with diversion plans. The Contractor shall render necessary assistance.
 - 4.4 The Contractor shall coordinate with the local officials to assess quantities and specifications of materials required for diversion works. Necessary assistance would be provided by the Employer and the Engineer.
 - 4.5 The Contractor shall obtain necessary permission from the concerned departments/agencies to carry out the diversion/shifting works and get necessary permission from Traffic Police Department.
 - 4.6 Wherever possible, horizontal directional drilling method shall be adopted at location where utility diversion works crosses roadways and require lane closures for excavation to avoid inconvenience to the traffic.
 - 4.7 The electrical utilities diversion/ shifting should be carried out by the Contractors/agencies registered with the electrical utility agencies / KPWD and have the required grade license from the Chief Electrical Inspector to Government. The Contractor should be well acquainted with electrical works so as to maintain the standard. The Contractor shall inform the same to Employer/Engineer for getting consent from the concerned electrical utility agency.
 - 4.8 The Contractor shall identify the quantity of materials required for the contract such that the material can be procured by the Contractor in bulk and in advance to the implementation of the utility diversion works. The quality of materials to be procured shall be approved by the concerned utility agency. Materials used for diversion/ shifting shall be of quality conforming to the applicable standard of the electrical utility agency and as per relevant BIS.
 - 4.9 The source of materials and the guarantee for the materials to be used shall be submitted to Engineer for obtaining approval from the concerned utility agency. Any failure of the material within the guarantee period shall be replaced and installed free of cost by the Contractor.
 - 4.10 Contractor shall inform the local officers/officials of the concerned utility agency about the diversion works at least 15 (fifteen) days before the execution of diversion.
 - 4.11 The diversion / shifting utility work shall be carried out under the direct supervision of officials and the utility agency decision shall be final in this regard. The Contractor shall provide free access to officers/ officials / workman for the purpose of inspection/supervision.
 - 4.12 After restoration of regular service completion certificate shall have to be obtained from the concerned departments/agencies. The regulations for working with utility agencies shall be as follows.
 - a. The diversion/shifting utility work should be carried out without causing any inconvenience to the operation and maintenance of Sub-Station and other departmental works of the concerned utility agency.
 - b. The Contractor shall execute and complete the work strictly in adherence to the time schedule and to the satisfaction of the engineers and adhere strictly the direction of the utility agency in any matter.
 - c. The Contractor shall be responsible to protect the public and the employees of the utility agency against any accident that may arise during the execution of diversion/shifting utility works. The Contractor shall indemnify the Employer for any claims for damages/injuries to the person/property resulting from any such accident. The Contractor shall Compensation Act by the way of obtaining an accident risk type insurance to meet all purpose of relief, failing which or otherwise the Contractor shall be solely responsible for meeting the compensation awarded under the said Act.
 - d. The Contractor shall undertake to ensure free flow of traffic during execution of the diversion / shifting works and shall be responsible for any accident/loss of lives/property. Damage to the other existing utilities during diversion shall have to be rectified by the Contractor at his own cost.
 - e. The Contractor shall employ qualified technical personnel to carry out the diversion/shifting of utility works.

- f. The Contractor shall apply well in advance for Line Clearance (LC) for carrying out the joint works/shifting works. Employer would authorise the Contractor to take LC from the concerned utility agency. If needed, Employer would provide assistance to the Contractor to get the LC. LC will be given by the concerned utility agency depending upon exigencies, which have to be strictly adhered to.
- g. The Contractor shall handover all the retrieved / unused material to the stores of the concerned utility agency /concerned department at the Contractor's cost.
- h. Contractor to pay the penalty/charges imposed by the utility agency for damage to the utilities on their own.
- i. The Contractor shall undertake not to revoke the above conditions until the completion of diversion/shifting works.

5. **BBMP Utilities diversion**

- 5.1 Diversion of Storm water drain shall be carried out as per the design, standard and general specifications of BBMP /PWD/concerned Highways Department.
- 5.2 The diversion route for storm water drain shall be approved by BBMP /concerned PWD/ Highways Department.
- 5.3 The invert level of diverting drain shall be maintained on par with upstream/downstream of connecting drains.
- 5.4 The Contractor shall make alternate arrangements to divert and ensure smooth flow of water from upstream side during construction.
- 5.5 The Contractor shall provide the adequate sizes of drain or follow the existing sizes as agreed by the concerned agency.
- 5.6 Diversion of storm water drain shall be carried out through the registered Contractors of BBMP/PWD/Highways Department (if such a list of approved/registered contractors is maintained by the utility agency).
- 5.7 Streetlights shifting shall be carried out as per the specification of BBMP.

6. **BSNL Utilities diversion**

BSNL utilities such as copper cable and OFC cables which are likely to be affected to be identified based on trial pit information. Contractor to prepare the diversion plan in coordination with the BSNL utilities agencies and get approval for the diversion plan. Employer/Engineer may provide assistance in this regard. Contractor to assess the required quantities based on the diversion plan. Cables procured to be Quality control checked by the concern wing of BSNL. Contractor to coordinate and arrange for the Quality control check by BSNL. Diversion of BSNL utilities to be done by the BSNL approved subcontractors and the completion certificate to be obtained from BSNL for the utility's diversion done. Private Telecom/OFC cable Contractor to manage the existing private telecom and OFC cables.

7. **GAIL Utilities diversion**

GAIL utilities such as gas pipelines which are likely to be affected to be identified based on trail pit information. Contractor to prepare the diversion plan in coordination with the GAIL authorities / agencies and get approval for the diversion plan. Employer/Engineer may provide assistance in this regard. Contractor to assess the required quantities based on the diversion plan. Contractor to coordinate and arrange for the Quality control check by GAIL Authority. Diversion of GAIL utilities to be done by the GAIL approved subcontractors and the completion certificate to be obtained from GAIL for the utility's diversion done.

8. **Indian Railway (IR) Utilities diversion**

IR utilities which are likely to be affected to be identified based on trail pit information. Contractor to prepare the diversion plan in coordination with the Railway authorities / agencies and get approval for the diversion plan. Employer/Engineer may provide assistance in this regard. Contractor to assess the required quantities based on the diversion plan. Contractor to coordinate and arrange for the Quality control check by Railway Authority. Diversion of Railway utilities to be done by the Railway approved subcontractors and the completion certificate to be obtained from Railway for the utility's diversion done.

9.

General

The Contractor shall provide 6 months rolling programme every 3 month.

K-RIDE

Appendix-XII - 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
Soil laboratory	30 Sqm floor area
2 Office each	15 Sqm floor area
1 store room	10 Sqm floor area
1 kitchen	10 Sqm floor area
Male/Female 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, weather proof 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 watert ank with minimum capacity of 2000 liters shall be installed. Constant water pressure of 15Kpa 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 maybe 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:

- (4) 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 3 rd party test at approved or reputed NABL accrdited laboratory at the discretion of engineer.
- (5) Employer / Engineer in charge may recommend any test pertain to work or material to any laboratory of repote if they are accredited for the relevant work to a standard acceptable to the Engineer. The cost of such tests shall be borne by contractor.

Determining Liquid Limit (1 complete set)

Liquid limit device (Casagrande type)	1set
Grooving tools	1No
Evaporating dish	1No
Spatula 100mm blade	1No
Laboratory balance, capacity 500gm, (Sensitivity 0.01gms.)	1No
Wash bottle, capacity 500ml.	1No
Moisture cans capacity 50ml.	24No

Determining Plastic Limit (1 complete set)

Evaporating dish	1No
Spatula 100mm blade	1No
Glass plate 250mm x 250mm x 12mm	2No
Moisture cans capacity 50 ml	12 No
Stainless steel rods, 3mm dia.	2No

Determining Moisture Content (1 complete set)

Micro Oven, capacity 35 liters, control temperature upto	200°C
1 No weighing machine, capacity 200gm., sensitivity 0.01gm.	1No
Lab. Tongs	1No
Moisture cans 75ml. with lid	36No

Compaction Characteristics (1 complete set)

Standard compaction mould 100mm dia.	1No
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Modified compaction mould 150 mm dia.	1N
Standard compaction Rammer,2.5kg.	1No
Modified compaction Rammer,4.5kg.	1No
Straight edge 300mm long	1No
Sample ejector for 100mm and 150mm	1No
Mould Sample tray 60x60x8cm	3No
Wash bottle, 500ml.	2No
Moisture cans 250ml	24No

Density of soil in-place by sand replacement method (2 complete set)

Sand density cone apparatus 150ml	2No
Plate, 300mm X 300mm	2No
Chisel 25mm X 150mm	2No
Hammer	2No
One gallon's field cans	24No
Sampling spoons	2No
Soft hair brush	2No
Moisture cans 250ml	48No

Sieve Analysis

Sieve shaker (portable)	1 unit Coarse sieves in sizes from
100mm to 10mm	(1 set Fine sieves #4, #8, #16,
#30, #40, #50, #100, #200 each)	

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 1 set

Suitable water container 1 No.

Unit wt.of aggregate

Balance, 100Kg cap. With 10gm precision	1No
Tamping rod 16mm dia X 600mm long	1No
Measuring containers (3,10,15, 30 ltrs)	1each

Flakiness & Elongation

Flakiness gauge, Elongation Index	1set
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Soundness Test

Sodium Sulphate	25Kg
Soaking Tank	1nos
Balance, Cap. 3Kg, sensitivity 0.1gm	1set
Sieves: coarse, Fine	1set

Concrete

Bickets for concrete sampling	12Nos
Slump Cone	12Nos
Tamping rod	12No
Base plate	12No
Mixing pan for concrete	2No
Scoop for general purpose	2No
Concrete thermometer	2 No
Concrete cylinder mould 150mm*300mm; 100mm*300mm	10each
Concrete cube mould,100mm cube &150 mm cube	10each
Adjustable spanners for Dismantling cube moulds	6No.
Capping set	2No

Capping compound

Concrete curing tank with capacity for 270 cubes, temperature controlled, with circulation system drain and lockable cover	5No.
Schmidt test hammer	1No.

Compression testing machine (simple hand operated)	1 No.
Mould oil Temperature chart recorder	1No.

Miscellaneous

Vernier callipers to measure up to 200 mm, with elongated jaws	5 Nos
Steel rule, 300mm long graduated	2Nos
Rubber gloves	10Pair
Cotton working gloves	20Pair
First aid kit	1set
Wire brush	6Nos
Steel tape, 3m, 5m, 30m	3each
Ball peen hammer, 1kg	2Nos
Paint scraper. Approx. 100mm wide	8Nos
Float, steel Approx. 280 x 120mm	8Nos
Sack barrow	1No
Shovel: Square Mouthed	2Nos
Round Mouthed	2Nos
24-wheel trolley, heavy duty, approx. 0.7m X 1.0m long Pneumatic tyred type	1no
Wheelbarrow, rubber tyred	
Comprehensive tool kit	1no
Claw hammer, multi-grips, spanners (adjustable)	1No
Type NR Schmidt Hammer and tester with recording device	1No
Testing Anvil for Schmidt Hammer test (SHT)	1No.
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	1No.
Permeability Testing Machine.	

**APPENDIX-XIII
PROJECT INTERFACE MATRIX**

DELETED

K-RIDE

APPENDIX XIV
IGBC NORMS

Deleted

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APPENDIX XV

KEY DATES

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:

Key Dates No.	Description of stage	Period (Days)	Liquidity Damages for non-achieving the key dates
KD 1	Approval of Detailed design consultant and Proof consultant.	D+30	0.001% of total contract price per day of delay for the key date
KD 2	Engineer's approval of CV and mobilization of all key personnel.	D+30	0.001% of total contract price per day of delay for the key date
KD 3	Submission and Engineer's approval of Contractor's Design, Quality, Health & Safety and Environment policies and manuals	D+30	0.001% of total contract price per day of delay for the key date
KD 4	Submission of Detailed design parameters, Design Basis Report, and list of GFCs	D+45	0.001% of total contract price per day of delay for the key date
KD 5	Submission and Engineers approval of contractors detailed works program	D+45	0.001% of total contract price per day of delay for the key date
KD 6	Approval of Detailed design and drawings Complete	D + 90	0.001% of total contract price per day of delay for the key date
KD 7	Completion of Casting of Foundations/ bottom slab.	D* + 150	0.001% of total contract price per day of delay for the key date
KD 8	Completion of works up to Side wall casting including all associated works	D* + 280	0.001% of total contract price per day of delay for the key date
KD 9	Completion of casting of Top Slab	D* + 340	0.001% of total contract price per day of delay for the key date
KD 10	Completion of all works and handing over with all respect	D*+ 365	0.036% of total contract price per day of delay for the key date

Note: 1. D is the date of issue of LOA.
2. D* is the Commencement date

Annexure – I: Right of Access to the Site

Time for access to, and possession of the Site

The Right of access for the land for the permanent works shall be handed over Progressively from the date of agreement.

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 indicate the, extra railway land or Govt land or private land beyond what is shown in the tentative tender drawing with the view to achieve best fit alignment for improved operational efficiency. On review by Engineer and Employer, the Contractor will be advised with the approved Horizontal/Vertical alignment for permanent works. For additional land if needed by the Contractor beyond the right of way the same shall be arranged by the contractor at his own cost.

In case any operation connected with traffic necessitates diversion, obstruction or closure of any road, railway or any other right of way, the proposal is to be developed by the contractor for review for the approval of the Engineer/Employer and the consents and approval of the concerned authorities shall be obtained well in advance by the Contractor.

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.

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.

Annexure – II:

-Deleted-

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Annexure – III : Tree Cutting and Forest Clearances–in Process

The permission for obtaining tree cutting / translocation is in progress with BBMP and Forest Department. The tree numeration list and joint inspection with Forest officers / BBMP / TEC is in progress.

Tree cutting, preservation and disposal (or) Translocation along the alignment for cutting / disposal / translocation / afforestation (as per the norms of Forest Department) in lieu of cutting / translocation to be arranged by Contractor at her / his own cost. The applicable permits / permissions for felling of trees / Translocation shall be arranged by Employer. The tree cutting and disposal is included in the scope of work. The cut trees will be the property of the contractor. However, the contractor shall deposit an amount not less than Reserve Price of the trees (as fixed by Forest Department / BBMP) plus FDT (Forest Development Tax) to KRIDE for onward transmission to Railways / BBMP / Forest Department, as the case may be.

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Annexure – IV :

- Deleted -

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Annexure – V : Applicable Permits

i. **Applicable Permits**

- 1.0 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.

K-RIDE

Annexure – VI : 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 Item rate (BOQ) 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 – VII : Completion Certificate

- ii. 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 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.
- iii. 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.....
- i. The test on completion of civil works shall also include the integrated testing. 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..
- ii. The completion certificate is as per railway standard format. Please refer Cl.30.6 at page 161, para 12 and para 2 . The format can be altered as per the contract conditions. The tender conditions prevails.

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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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. Design basis report of KRIDE.
3. Legend:

ASCE	American Society of Civil Engineer
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 Engineer, 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:CBC;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 in 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	Ready Mix Concrete
IS 4926:2003	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-Chatelier 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	Bearings
IRC:83Part-II	Standard specifications and code of practice for road bridges Elastomeric Bearings
IRC:83 Part-III	Standard specifications and code of practice for road bridges Pot Bearings
	Standard specifications and code of practice Spherical Bearings for road bridges
T	UPVC Pipe for Drainage
IS 4985	Unplasticized PVC Pipes for portable water supplies
U	PILING
IS :2911 PART-I	Bored Cast in-situ Concrete Piles
IRC:78	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 A

**EARTHWORK : ACCORDING TO SPECIFICATION
NO.RDSO/2020/GE: IRS-0004 (SEPT 2020)**

COMPREHENSIVE GUIDELINES AND SPECIFICATIONS FOR RAILWAY FORMATION

EARTHWORK: According to Specification No .RDSO/2020/GE: IRS-0004 (Sept 2020)

K-RIDE

SECTION – 02 B

**SPECIFICATION FOR SUPPLY, FABRICATION,
ERECTION & LAUNCHING OF STEEL GIRDERS FOR
RAILWAY AND ROAD OVER BRIDGES**

SECTION – S.02 B SPECIFICATIONS

ADDITIONAL SPECIAL CONDITION & SPECIFICATION FOR SUPPLY, FABRICATION, ERECTION & LAUNCHING OF STEEL GIRDERS FOR RAILWAY AND ROAD OVER BRIDGES.

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.

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) with latest correction slips and Standard Specifications.
- 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.
- iv) IRS Steel Bridge Code
- v) IRS Fabrication Code (B1)
- vi) IRS Welded Bridge Code
- vii) IRS Indian Railway Bridge Manual

1.3. **The scope of work shall include:**

- a. Supply, Fabrication, assembling and Erection of 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 B1 - 2001.

2.4 Tolerance in Fabrication

Fabrication tolerance for girders shall be as stipulated in Appendix II of IRS-B1-2001.

Permissible deviation for driven rivets shall be as stipulated in Appendix IV of IRS-B1-2001.

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.B1-2001 issued by RDSO, Reprint -2008 (Upto date)and BS-110 – **March 2016.**
- (ii) IRS : Bridge Rules (2008)/Latest
- (iii) IRS : Welded Bridge Code (1989)/Latest with latest correction slips
- (iv) IRS : Steel Bridge Code (2003)/Latest with latest correction slips

- (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.
- (viii) Indian Railways Schedule of Dimensions.
- (ix) IRS Bridge Substructures & Foundation Code
- (x) IRS Fabrication Code (B1)
- (xi) IRS Indian Railway Bridge Manual

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)
- (xiv) IS : 269 Specs for Ordinary and Low Head Portland cement
- (xv) IS : 278 Specs for Galvanized Steel Barbed Wire for Fencing
- (xvi) IS : 383 Specs for coarse and fine aggregates from natural sources for concrete
- (xvii) IS : 432 Specs for Mild steel and medium tensile steel bars (Part 1)
- (xviii) IS : 455 Specs for Portland Slag Cement
- (xix) IS : 456 Plain and reinforced concrete - code of practice
- (xx) IS : 458 Specs for Precast Concrete Pipes (With & Without Reinforcement)
- (xxi) IS : 460 Specs for Test Sieves
- (xxii) IS : 650 Cement Testing Standard Specification for Standard Sand
- (xxiii) IS : 783 Code of Practice for Laying of Concrete Pipes
- (xxiv) IS : 800 Code of practice for General Construction Steel
- (xxv) IS : 814 Specs for Covered Electrode for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel
- (xxvi) IS : 815 Classification Coding of Covered Electrodes for Metal Arc Welding of Steel Structures
- (xxvii) IS : 823 Code of Practice for Manual Arc Welding of Mild Steel
- (xxviii) IS : 875 Code of Practice for Design Loads Part 1, 2 3, 4& 5 (Other than Earthquake)
- (xxix) IS : 1077 Specs for Common Burnt Clay Building Bricks
- (xxx) IS : 1080 Design and construction of shallow foundations in soils (other than raft ring and shell)
- (xxxi) IS : 1161 Specs for Steel Tubes for Structural Purposes
- (xxxii) IS : 1200 (all parts) Method for Measurement of Building and Civil Engineering Works
- (xxxiii) IS : 1343 Code of practice for Pre-stressed concrete-based essentially on CP-110

- (xxxiv) IS : 1364 Hexagon Head Bolts, Screws & nuts of product grades A & B Part 1 (part 1 Hexagon, Head Bolts (size range M 16 to M64)
- (xxxv) IS : 1489 Specification for Portland pozzolana cement (Fly ash based)
- (xxxvi) IS : 1785 Specs for Plain Hard Drawn Steel Wire for Prestressed Concrete
- (xxxvii) IS : 1786 High strength deformed steel bars and wires for concrete reinforcement
- (xxxviii) IS : 1893 Criteria for Earthquake Resistant Design of structures
- (xxxix) IS : 1791 General Requirement for Batch Type Concrete Mixes
- (xl) IS : 1834 Specs for Hot Applied Sealing Compounds for Joints in Concrete
- (xli) IS : 1838 Specs for Preformed fillers for Expansion Joints in Pavements & Structures
- (xlii) IS : 1888 Methods of Load Test on Soils
- (xliii) IS : 1892 Code of Practice for Subsurface Investigation for Foundations
- (xliv) IS : 1904 Design and construction of foundations in soils general requirements
- (xlv) IS : 1905 Code of practice for structural use of unreinforced masonry.
- (xlv) IS : 2062 Specifications for weldable Structural steel
- (xlvii) IS : 2430 Methods of Sampling of Aggregates for Concrete
- (xlviii) IS : 2502 Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- (xlix) IS : 2720 (All parts) Methods of Test for Soils
- (l) IS : 2751 Code of Practice for Welding of Mild Steel Plain & Deformed Bars for RCC
- (li) IS : 2911 (All parts) Code of practice for Design and construction of Pile foundation
- (lii) IS : 2950 Design and construction of raft foundations
- (liii) IS : 2386 (All parts) Methods of Test for Aggregates for Concrete
- (liv) IS : 3812 Specs for Pulverized Fuel Ash
- (lv) IS : 3935 Code of Practice for Composite Construction
- (lvi) IS : 4000 High Strength Bolts in Steel Structures
- (lvii) IS : 4082 Recommendation on Stacking & Storage of Construction Materials and Components at Site
- (lviii) IS : 4138 Safety Code for Working in Compressed Air
- (lix) IS : 4326 Code of practice for Earthquake resistant design and construction of Buildings
- (lx) IS : 4656 Specs for Form Vibrators for Concrete
- (lxi) IS : 4736 Specs for Hot-Dip Zinc Coatings on Mild Steel Tubes
- (lxii) IS : 4826 Specs for Hot Dip Galvanized Coatings on Round Steel wires
- (lxiii) IS : 4923 Hollow steel sections for structural use -specification
- (lxiv) IS : 4925 Specs for Concrete Batching and Mixing Plant
- (lxv) IS : 4926 Code of Practice of Ready Mix Concrete
- (lxvi) IS : 5525 Recommendation for Detailing of Reinforcement in Reinforced Concrete Works
- (lxvii) IS : 5816 Splitting Tensile Strength of Concrete - Method of Test
- (lxviii) IS : 5889 Specs for Vibratory Plate Compactor
- (lix) IS : 5892 Specs for Concrete Transit Mixers
- (lxx) IS : 6006 Specs for Uncoated Stress Relieved Strands for PSC
- (lxxi) IS : 6403 Code of Practice for Determination of Bearing Capacity of Shallow Foundation
- (lxxii) IS : 7205 Safety Code for Erection of Structural Steel Work
- (lxxiii) IS : 7293 Safety Code for Working with Construction Machinery
- (lxxiv) IS : 7320 Specs for Concrete Slump Test Apparatus
- (lxxv) IS : 7861 (All parts) Code of Practice for Extreme Weather Concreting
- (lxxvi) IS : 7969 Safety Code for Handling & Storage of Building Materials

- (lxxvii) IS : 8009 Calculation of settlements of shallow foundations
- (lxxviii) IS : 8041 Specs for Rapid Hardening Portland Cement
- (lxxix) IS : 8112 Specifications for 43 grade ordinary Portland cement
- (lxxx) IS : 8142 Method of Test for Determining Settling Time of Concrete by Penetration Resistance
- (lxxxi) IS : 8500 Specs for Structural Steel - Microalloyed
- (lxxxii) IS : 9013 Method of Making, Curing and Determining Compressive Strength of Accelerated Cured Concrete Test Specifications
- (lxxxiii) IS : 9103 Specifications of Concrete admixtures
- (lxxxiv) IS : 9417 Recommendation Welding Cold Worked Bars for Reinforced Concrete Construction
- (lxxxv) IS : 9595 Recommendation for Welding of Carbon and Carbon Manganese Steels
- (lxxxvi) IS : 10262 Guidelines of Concrete Mix Proportioning
- (lxxxvii) IS : 10379 Code of Practice for Field Control of Moisture and Compression of Soils of Embankment and Sub-grade
- (lxxxviii) IS : 11384 Code of practice for Composite Construction in Structural Steel and Concrete
- (lxxxix) IS : 12070 Code of practice for Design and construction of shallow foundation on Rocks
- (xc) IS : 12269 Specification for 53 grade ordinary Portland cement
- (xci) IS : 13920 Ductile detailing of reinforced concrete structures subjected to seismic forces code of practice
- (xcii) IS : 14268 Uncoated Stress Relieved Low relaxation Seven-ply Strands for Prestressed concrete
- (xciii) IS : 14593 Design and Construction of Bored Cast-in-Situ Piles Founded on Rocks
- (xciv) IS : SP: 36 (All parts) Compendium of Indian Standards on Soil Engineering

3.3. INDIAN ROAD CONGRESS SPECIFICATION (ROBS) (With Latest Versions and All Amendments Up To Base Date)

- (i) IRC: 6 (loading & forces)
- (ii) IRC: 22 (Composite construction)
- (iii) IRC: 24 (Steel Road bridges)
- (xcv) IRC: 5 Standard Specifications and Code of Practice for Road Bridges, Section-I – General Features of Design.
- (xcvi) IRC: 36 - Recommendations for Construction of Earth Embankments & Sub-grade for Road Works.
- (xcvii) IRC: 37 - Tentative Guidelines for the Design of Flexible Pavements.
- (xcviii) IRC:54 - Lateral and Vertical Clearances at Underpasses for Vehicular Traffic.
- (xcix) IRC: 75 - Guidelines for the Design of High Embankments.
- (c) IRC: 78 - Standard Specifications and Code of Practice for Road Bridges, Section VII- Foundations and Substructures (Revised Edition).
- (ci) IRC:83 (Part I) - Standard Specifications and Code of Practice for Road Bridges, Section IX – Bearings, Part I: Rocker and Roller Bearings.
- (cii) IRC:83 (Part II) - Standard Specifications and Code of Practice for Road Bridges, Section IX – Bearings, Part II: Elastomeric Bearings.
- (ciii) IRC:83 (Part III) - Standard Specifications and Code of Practice for Road Bridges, Section IX – Bearings, Part III: POT, POT-CUM-PTFE, PIN and Metallic Guide Bearings.
- (civ) IRC:83(Part IV) - Standard Specifications and Code of Practice for Road Bridges, Section IX – Bearings (Spherical and Cylindrical).

- (cv) IRC: 87 - Guidelines for Formwork, Falsework & Temporary Structures for Road Bridges.
- (cvi) IRC:112 - Code of Practice for Concrete Road Bridges.
- (cvii) IRC:SP:35 - Guidelines for Inspection and Maintenance of Bridges.
- (cviii) IRC:SP:37 - Guidelines for the Evaluation of Load Carrying Capacity of Bridges.
- (cix) IRC:SP:64 - Guidelines for the Analysis and Design of Cast-in-Place Voided Slab Superstructure.
- (cx) IRC:SP:65 - Guidelines for Design and Construction of Segmental Bridges.
- (cxi) IRC:SP:66 - Guidelines for Design of Continuous Bridges.
- (cxii) IRC:SP:67 - Guidelines for Use External and Un-bonded Pre-stressing Tendons in Bridge Structures.
- (cxiii) IRC:SP:69 - Guidelines and Specifications for Expansion Joints.
- (cxiv) IRC:SP:71 - Guidelines for Design & Construction of Precast Pre-tensioned Girders for Bridges.
- (cxv) IRC:SP:102 - Guidelines for Design & Construction for Reinforced Soil Wall.
- (cxvi) IRC:SP:114 - Guidelines for Seismic Design of Road Bridges.
- (cxvii) MORT&H Specification-(Fifth Revision):2013 Specification for Road and Bridge Works.

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 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

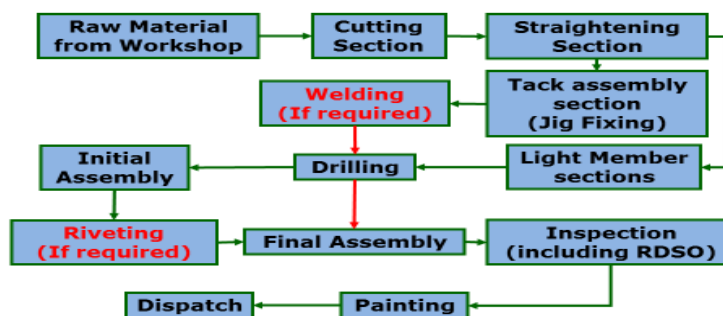
• WORKSHOP MAINLY CONSISTS OF—

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 on 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 B1-2001. 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 of 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 a 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 B1-2001 (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 B1-2001.

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 bed made only after approval of 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 ensured 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 haven 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.

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 measure 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 B1-2001. 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 / Berger 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 out 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 contractors consultant and final approval by the Engineer.
- The joints at the end of each top & bottom chord shall be drifted, bolted and preferably stitch riveted to their Geometrical outline.
 - 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.
 - The bottom chord members shall then be placed on the camber jacks, carefully leveled and checked for straightness and the joints completed by riveting.
 - 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-B1-2001 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/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/ RDSO / Third party engaged by Railway for inspection.
	(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)	
	(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 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:

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.

- (i) 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.
- (ii) 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.
- (iii) 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 Shcedule, 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:

Land required by the contractor for contractors office at sites, field work shop, stores, assembly, erection yard 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 B1-2001 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 Engineer/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 Engineer/Employer 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:

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.

- (i) 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/GC 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 standard.

SECTION – 02 C

CONDITIONS & SPECIFICATION FOR BOX PUSHING TECHNIQUE

SECTION- S.02 C

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 Engineer and Employer.

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 Engineer. 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, progressive payments can be made for the length of the box cast which will be payable as per the following formula:

Payment due :{ (length of the box cast) }
 { (Total length of box for jacking/pushing) x 30% of the
 { } contract
 value for
 box pushing
 item

- (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.

SECTION – 02 D

SPECIFICATION FOR CONSTRUCTION OF RUB UNDERPASS BY CUT AND COVER METHOD

SECTION- S.02 D**SPECIAL CONDITIONS & SPECIFICATION FOR CONSTRUCTION OF RUB UNDERPASS BY CUT AND COVER****METHOD**

1. The work of RUB underpass is to be carried out by precast segmental boxes of specified size and length at proposed site. The works of casting and curing of precast segmental boxes to be carried out before operation of traffic block for insertion by cut and cover method.
2. The work is to be executed by Cut & cover method within a prescribed block period as decided by the KRIDE/Railway authorities, Contractor has to arrange following equipment's for cut and cover method.
 - a. Road crane with 300 T capacity or more and one stand by crane of 300T or more capacity
 - b. Excavator: Two nos. EX-350 capacity or more and one standby Excavator of EX-350 or equivalent capacity and out of two one should have rock braking arrangement.
 - c. One no of Hydra of minimum 14 T capacity
 - d. 6 Nos of dumpers of min 6 cum capacity
 - e. Levelling equipment's
 - f. Wire ropes/slides and U clips for each RCC box segment
 - g. Jack hammer along with compressors to handle rocky strata/boulder etc.
 - h. Other machineries and equipment's and tools and plants as per site requirements as decided by Engineer-in-charge.
3. The tenders/Contractors are advised to visit the Limited Height Subway site of work and ascertain for himself/themselves all the aspects of site conditions viz. accessibility availability of approach road, nature of soil, availability of materials, extent of lead and lift involved in the work, availability of skill and unskilled labour etc. that may be encountered in the course of execution of work. As the nature of work warrants high level of dimensional precision, accuracy along with good quality control, tenders should make it a point to understand the work carefully and thoroughly before quoting the rates.
4. Before execution of work necessary survey should be carried out at the site of work with Railway's representative with all latest survey instruments for detailed planning at site
5. The work shall be carried out as per approved drawings issued by Railway and KRIDE.
6. Procurement of all necessary plants, equipments, pumps etc. should be done by the contractor at his own cost and no extra payment will be made on that account.
7. Construction of precast RCC box, wing walls at approaches of wing/return wall etc to be done as per approved General arrangement drawing. Levelling of the ground, preparation of casting bed to be done by the contractor at his own cost.
8. Transverse trenches are to be made to identify electrical/S&T cable. Contractor should not damage any cable during making trenches. Contractor will be responsible for damaging the structures and the cost of such damages thereof will be recovered from the bills. The nature of damage and cost thereof to be recovered will be at the discretion of Engineer/Employer. Removal of existing underground cables as well as overhead obstructions like OHE in the Railway area near the site of work which are likely obstruct the work will be executed by the Employer.
9. The contractor will transport his machines, tools and plants, labour to the site by his own means. Employer will not provide any new service roads for movement of contractor's vehicles. However existing service road can be used by the contractor free of charge. At other places contractor will have to make his own arrangements for movement of his vehicle. The Railway however reserves the right to make use of the facilities maintained by the contractor as and when required without any payment to the contractor.

10. Horizontal boring should be done at the bottom of excavation level to ascertain presence of any rocky strata and suitable steps should be taken for excavation of the rocky strata.
11. The design mix of cement concrete should be got done by the contractor at his own as per direction of the Engineer before execution of work.
12. Entire method for design mix concrete shall be approved by Engineer and step will have to be followed strictly. All necessary arrangements and test for concrete mix design have to be done by contractor at his own cost. No extra payment will be made on this account.
13. For assuring the quality of concrete works, the contractor(s) shall the cube test report at his own cost as approved by Engineer as per the specified frequency.
14. All the materials used during the execution should confirm to Railway's specification, decision of Engineer will be final in this regard.
15. All mass cement concrete and reinforced cement concrete shall confirm to relevant IS code of practice & IRS concrete Bridge code and shall be machine mixed and mechanically vibrated.
16. The precast boxes and slabs shall be casted at the specified locations near each LC as directed by the Engineer, so that these units can be transported and handled easily with crane for erection. The bottom surface of the slab and boxes shall be even and smooth and there should not be any unwanted projections on the surface since any uneven surface will create problem during erection and the faces of the box units will not be matched, proper platform for casting of the boxes. Any box unit which has uneven surfaces or projection on the surfaces will be rejected and no payment will be made for such work. The cost of dismantling of these boxes shall be borne by the contractor
17. Based on the weight of precast RCC box and wing walls, cranes of adequate, capacity (as mentioned at SI.No.2 (a),(b) & (c)) are to be arranged by the contractor to lift and place in the correct position as per GAD. One working crane and one as standby crane are to be provided by the contractor under single track, for construction below more than one track in single block more than two such cranes should be provided as decided by Engineer. No extra payment will be made for waiting charges or for keeping the standby crane. If necessary, contractor has to complete the work during night hours also.
18. Following pre block works should be done before taking traffic and power block for launching of precast RCC boxes
 - a. The RCC box segment as per approved drawing should be casted and curing should be done
 - b. All RCC surfaces coming in contact with soil should be painted with bitumen or coal tar of approved quality @ 1.464 kg/Sqm.
 - c. Reference lines are to be marked on the track for correct alignment. and levels are to be fixed by Dumpy level with reference to Rail level or OHE structure etc
 - d. Existing LWR to be cut and fish plate is to be provided in consultation with SSE/P.Way at site and suitable speed restriction will be imposed by railway.
 - e. Execution of the earth cutting from edge of shoulder ballast should be done at 1:1 slope or flatter depending upon the type of formation soil as per site condition at both the ends of proposed sites in case of any failure the slope should be protected by suitable means such as keeping sand bags, bullock piling/Rail piling etc. Tarpaulin of suitable size should be kept at site to protect the cut surfaces from rain during pre block/block period.
 - f. Sufficient numbers of sand bags should be kept on both sides of proposed work for protection of formation.
 - g. Required quantity of boulders should be stacked near site to be used at back of RCC box segments.

- h. Required quantity of back fill material should be kept ready near work site to be used as back fill material.
 - i. Required quantity of track ballast should be collected near work site to be used on track.
 - j. G.I sheet of 0.8mm thickness or more should be made available for putting over joints of box segments.
 - k. Required numbers of skilled/semi-skilled staff for execution and launching of boxes should be available.
 - l. Required numbers of P.Way staffs should be available for associated P.Way works.
 - m. Arrangement of sufficient number of safety helmets and other necessary equipment for the works.
 - n. Placement of pre cast RCC box segments near location for smooth crane working.
 - o. Testing working of each machinery and equipment at site.
19. In double/multiple line sections, suitable speed restriction should be imposed on adjacent lines also. If the distance between the two lines is inadequate, use of relieving girder on adjacent lines should be done as per approved GAD.
20. Launching/laying of precast RCC boxes will be done in traffic and power block which will involve following activities
- a. Slewing/lowering of OHE in case of Electrified section by concerned Dept.
 - b. De linking the track assembly including sleepers by road crane and placing it at suitable location as directed Engineer
 - c. Removal of ballast up to formation level and excavation of formation by excavator. Excavation of earth should be done with side slope of 1H : 3V or even flatter to avoid slippage of earth depending upon nature of formation earth. GI/Nylon wire mesh or equivalent should be fixed with adequate nos of nails on side slope of excavated earth to prevent slope failure of cut face.
 - d. Preparation of bed below base slab should be as per actual site condition in order to achieve adequate bearing capacity required to withstand the foundation pressure given in related drawing. A minimum sand layer of 200mm thick to be spread below the RCC slab.
 - e. Base slab should be laid in proper position. After placing all the slabs, level should be checked and holding hooks of the base slab should be cut and epoxy painted before placing RCC box segments.
 - f. RCC box lifting and placement of each box with road crane gently to the line, level and alignment. Alignment rods of 32mm dia are to be inserted already placed units. When the next box segment is placed these rods are guided into that. It helps proper alignment of box segments. RCC box segment should be placed on the base slab in such a manner that the joints of the box are staggered and do not fall on the slab joints.
 - g. Holding hooks of the RCC box segments will be cut and epoxy paint should be applied. GI sheets of suitable thickness of 0.8mm or more should be used at top and both sides of RCC box segments so that proper sealing of joints can be done as anti leakage measure afterwards.
 - h. After placing RCC boxes at proper place, sand bags will be placed at the ends of the gap between RCC box segment and formation. Behind RCC boxes, boulder filling and back fill materials shall be provided. The boulder filling shall consist of well hand packed boulders and cobbles to thickness not less than 600mm with smaller size towards the back. Behind the boulder filling, back fill materials consisting of granular materials of GW, GP, SW groups as per IS: 1498-1970 shall be provided.

- i. After completing back fill material up to formation level, ballast is spread over it and track is placed on the ballast with the help of road crane as directed by Engineer-in-charge. The track is linked and packing is done to achieve proper gauge, cross level and alignment. After that fitness of track to be certified by Railway.
 - j. Slewing back of OHE at proper location and alignment and cancellation of power block by concerned dept in case of electrified section.
 - k. Train should be allowed as per temporary signaling and speed restriction diagram mentioned in the approved drawing.
21. Temporary arrangement required, if any to prevent/arrest collapse of side walls/bank to be carried out as per site requirement as decided by Engineer.
 22. Removal/disposal of earth excavated to be done by contractor as per the instructions of Engineer.
 23. The speed restriction board and other indication board for protection of site as required for safety of track would be arranged by the Railways. Work will be under taken only in presence of SSE/P/Way and SSE/JE/Works. All the temporary work such as sheet piling, G.I/Nylon wire mesh etc. as required in view of safety of track during the execution of work will be done by the contractor as directed by the Engineer-in-charge or his representative at site.
 24. The contractor shall keep his look out man for warning the workmen of the arrival of train etc. to ensure safety of the workmen and equipment.
 25. After initial settlement of box segments, gap between box segments are to be sealed by pressure grouting with cement/epoxy mortar to make the joints leak proof. Details of such arrangements at joints shall be submitted by the contractor and shall be got approved by the Engineer-in-charge.
 26. After completion of Limited Height subway including wing/return wall and other allied works, speed restriction should be relaxed to normal sectional speed as per provision of IRPWM.
 27. The contractor shall have to make his own arrangement at his own cost for movement of his vehicle, machinery like cranes, poclain/Hitachi/JCB etc.
 28. The contractor will be responsible for maintenance of assets for 06 (Six) months after completion of the work. Security deposit will be released only after maintaining period after completion of the work.

Technical specification for construction of RUB UNDERPASS by Cut and Cover method

1. Depending on the site conditions a general arrangement drawing (GAD) should be prepared for each site by Railway and specific activities to be undertaken before, during and after traffic block should be worked out and detailed in the GAD.
2. M-35 Grade concrete shall be used for the precast RCC box segments
3. Base slab units of M25 grade concrete.
4. Grade of concrete for wearing coat shall be of M25.
5. Grade of wing wall and return wall shall be M25.
6. Minimum grade of cement shall be 43 grade ordinary Portland cement confirming to IS: 8112 or equivalent.
7. HSD/TMT bars conforming to IS:1786-2008 shall be used as reinforcement.
8. Lapping of bars should be minimized and staggered wherever necessary. Minimum length of lap shall be as given in IRS concrete bridge code for TOR steel.
9. Clear cover of reinforcing bars should be 50mm.
10. All RCC surface coming in contact with soil should be painted with bitumen or coaltar of approved quality @ 1.464 Kg per S.Mtr.
11. Back fill material should be as per clause 7.5 of IRS Bridge substructure and foundation code.

12. Tolerance shall be followed as per IRS concrete bridge code.
13. Bed slope shall be adjusted as per condition by competent authority. It should be kept minimum 1 in 100.
14. Weep hole shall be of 75/100 dia PVC/AC pipes staggered @ 1000C/c in both wing wall /return wall and earth retainer of box.
15. Excavation of earth should be done up to required level after levelling of surface, 200mm thick layer of sand to be provided and compacted.
16. Base slabs should be laid in proper position. After placing all the slabs level should be checked and holding hooks of the base slabs should be cut before placing RCC box segments.
17. 17.RCC box segments should be placed on the base slab in such a manner so that joints of the box are staggered and do not fall on the slab joints.
18. 18.Construction of wing wall, return walls, ballast retainer, laying of road work and wearing course etc. should be done.
19. 19.After allowing initial settlement of box the gaps between the box joints are to be sealed by pressure grouting with cement/epoxy mortar.
20. Suitably designed drainage arrangement should be provided.
21. Suitable road signals and height gauges should be provided on road approaches on both sides at prescribed distance.

K-RIDE

SECTION- 03

STRUCTURAL CONCRETE

SECTION- S.03

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.

3.0 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 accoding to IS:456 confirming 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:-

$$\% \text{ equivalent Na}_2\text{O} = \% \text{ acid soluble Na}_2\text{O} + 0.658 \times (\% \text{ acid soluble K}_2\text{O})$$

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 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
	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		
	Pier and pier		RCC	0.45	340	OPC 53 grade	Permitted to use

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
	cap		M50			conforming to IS 12269	micro silica/ silica fumes or Flyash as per IS 456 over and above minimum cement content as per mix design requirement.
	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
	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 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/ underground structures	IS 456	RCC M35	0.45	340		
	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

- For RCC members including piles - 0.40
- 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 CRRI 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 10°C 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 21°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 an 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: 1367 part 1 to 16, 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 of 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.

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:
- Steel plates not less than 4mm thick of specified sizes stiffened with a suitable structural framework and fabricated true to plane
 - Timber planks of 20mm actual thickness and of specified surface finish, width and reasonable length,
 - 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 within 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 / vacume 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 K 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	$2 \epsilon_y$	$0.5 f_y$	4cycles
3	$5 \epsilon_y$	$0.5 f_y$	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 locking 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.

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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.

Sl. 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

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 typing 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. |
| 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, Dwydag, 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 Dynamics |
| 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.

K-RIDE

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 2.mm 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 Pre-tensioning

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 piping, 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.

K-RIDE

SECTION-7

STRUCTURAL STEELWORKS

SECTION- S.07

7. (A) STRUCTURAL STEEL WORKS

7.1 STRUCTURAL STEELWORK SPECIFICATIONS- GENERAL

(Station Roof and Viaduct/ROB 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. iReaming 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 811for 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 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
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 specified 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 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 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.

6 (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
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

Part

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	

	<p>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</p> <p>The primer shall be applied by Conventional/Airless Spray only at site</p>	
2 nd coat(Finish Paint)	<p>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</p> <p>DFT-75 microns</p> <p>The paint shall be applied by Conventional/Airless Spray only at site.</p>	

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 there 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

3.	Control of welded joint quality	Control of assembly accuracy and technological welding process	Checking of assembly quality & centering of welded members Checking of welding equipment conditions. Checking correctness of welding procedure. Visual examination of welds
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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 Engineer.

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 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.

K-RIDE

SECTION-08

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 1.0 meter 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 exiting 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 / ROB location 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.
- Description of soil conditions, ground water table, actual boring and installation records, concrete cube test results.
 - Method of load application
 - Load settlement readings during loading and unloading
 - Time load-settlement curve
 - 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	Desired Results
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	applied	
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 –

Sl.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 contrscuted 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 permant 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.

SECTION-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 Engineer.

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 $F_y > 1050 \text{ MPa}$

- Tensile stress $F_u > 1200 \text{ MPa}$
- Elongation at breaking $> 10\%$
- Resilience at $20^\circ\text{C} > 50 \text{ Joules}$:

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
- 4 million 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 1500mm².

(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 1600mm² per meter length of the joint and the center to center spacing shall not exceed 250mm. The ultimate resistance of anchorage 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)

- The strip seal joint system and all its component parts including anchorages shall be supplied by the manufacturer /system supplier.
- 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.
- 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
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 (24 h/50 pphm/25 deg C/20 per cent elongation)	-20 per cent
Swelling behaviour in Oil (168h/25 deg. C) ASTM Oil No. 1	No cracks
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 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 pounded 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 may be 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 100 micron.

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
Density	41.7 – 51.3 kg/cum
(ii) Compression set on 25mm	50% compression samples (ASTM D 3575) for 22 hours at 23° C, 2 hour recovery; 13% set.
(iii) Working temperature	-70 to +70°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%

(I)

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 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% confirming 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) Shelf 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, Lintace, 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 jointly shall be tooled slightly concave after the sealant is installed. The tolled 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 whist 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 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 cable 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 max 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 confirming 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 $\geq 1.50 \text{ W/m}^2\text{K}$ 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 epoxybonding 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.

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PRECAST U-GIRDER AND RELATED ITEMS

SECTION- S.10 - DELETED

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SECTION-11

ADDITIONAL SPECIFICATIONS FOR PRECAST SEGMENTAL CONSTRUCTION

SECTION- S.11 - DELETED

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SECTION-12

STEEL BRIDGE GIRDER ERECTION

SECTION- S.12

12. STEEL BRIDGE GIRDER ERECTION

(Fabrication and erection as per RDSO guidelines)

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 alternatives 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 Pricees 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 form 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 to 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 Bergerthane or approved equivalent applied by spray or brush in approved colour.	NA
Finish Coat	Acrylic polyurethane finish aliphatic isocyanate cured DFT-30 µm shall be Bergerthane 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 smoothening 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) Contractor 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.

K-RIDE

SECTION-13

ROADWORK

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 Bitumen aggregate mixtures	AASHTO T-182	Minimum retained 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 weigh 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/ Fine aggregate/ Mineral Filler - as percentage by weight of total aggregate including Mineral Filler

- III. A single definite percentage passing each sieve for the mixed aggregate (Vide Table 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 from 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

14.1 Scope of works

- 1.1 The scope covers the Design and Construction of Reinforced Soil Walls for approach roads (earth fill) leading to the open spans of bridges, and Road Over-Bridges crossing Railway tracks using Reinforced Soil Technology confirming to section 3100 of "Specifications for road and bridge works - 5th revision, 2013, "published by Ministry of Road Transport and Highways, under heading Reinforced Soil (hereinafter referred as 'Specifications of MORT&H') and Special Publication No. IRC-SP-102-2014 "Guidelines for Design and Construction of Reinforced soil Walls" (hereinafter referred as IRC-102-2014).
- 1.2 The specification provides project requirements as well as construction guidance to both the contractor and inspection personnel which includes the following, but is not limited to:
 - i. Design methods and construction of reinforced soil wall
 - ii. Materials and properties proposed for reinforcement as well as the soil.
 - iii. Types of reinforcements, fills, and facings.
 - iv. Supply and erection of reinforcing elements
 - v. Supply & placement of fascia elements (Pre- Cast Reinforced Concrete Panels/ or Pre-Cast Concrete Modular Blocks as prescribed)
 - vi. Supply of all associated components
 - vii. Testing of all materials associated with construction.
 - viii. Complete supervision including earthwork and pavement works for effectiveness of Reinforced Soil Technology.
- 1.3 The design shall cater for all the loads of Road traffic, including loading from pavement, seismic activity and other various components like adequate foundation, PCC leveling pad, facing elements, drainage subsystem, friction slab crash barrier, toe protection etc.
- 1.4 The design of reinforced soil retaining wall shall be based on the actual site conditions and bidders are requested to visit the project site and carry out necessary Geotechnical investigation and submit a realistic design, after the award of work.
- 1.5 The contractor shall need to assess and substantiate the design for adequacy of safe bearing capacity of soil under the location of the wall before execution of the work and cater for necessary foundation treatment, if required, to ensure safe founding besides ensuring stability against slip circle failure. In case the reinforced soil structure needs strengthening/improvement of existing ground, detailed proposals shall be incorporated in the design. Annexure-A1 of IRC: SP: 102-2014 gives a summary of ground improvement measures commonly used.
- 1.6 The Contractor shall submit the design calculations and design drawings (prepared by the Consultant) for review and approval by Railway prior to beginning construction.

14.2 Technology of the reinforced soil structure:

- 2.1 The contractors/agencies and officials associated with RE Wall work should have thorough understanding of 'specifications of MORT&H' and IRC: SP: 102-2014 to understand various aspects requiring close attention for ensuring quality of the work.
- 2.2 The contractor shall provide performance bond in conformance with contract requirements valid for at least 10 years for items pertaining to RE wall.
- 2.3 All the materials shall be supplied by a single entity, to ensure a single source of responsibility, with demonstrated experience in projects of similar nature.

- 2.4 Construction Requirements: Detailed instructions with regard to installation of Reinforced Soil products, testing standards, field inspections and frequencies are outlined with illustrations in 'specifications of MORT&H' under section 3100 and IRC: SP: 102-2014. However, the following constitutes a supplementary and easy guidance to field staff in execution of work.
- 2.5 Field representatives of GC/KRIDE and Contractor should very carefully read the specification requirements for the specific type of system to be constructed, with special attention given to material requirements, construction procedures, soil compaction procedures, alignment tolerances, and acceptance/ rejection criteria.
- 2.6 Special attention should be given to the construction sequence, corrosion protection systems for metallic reinforcement, special placement requirements to reduce construction damage for polymeric reinforcement, soil compaction restrictions, and details for drainage requirements and utility construction.
- 2.6.1 The facing Element should be tough and robust and shall be one as illustrated in Figures 3A, 3B, 3C, 4A and 4B of IRC-SP-102-2014.
- 2.6.2 Maximum height of approach RS walls of any type of facing shall be restricted to 8 m to 8.50m above ground level and 10m above levelling pad.
- 2.6.3 Most reinforced fill systems will use a variety of panel types on the same project to accommodate geometric and design requirements (geometric shape, size, finish, connection points). The facing element types must be checked to make sure that they are installed exactly as shown on the plans. They also need to be inspected for damage (bent connectors, damaged panels/blocks etc.) and imperfect molding, honey-combing, severe cracking, chipping, or spalling, color of finish variation on the front face, out-of-tolerance dimensions, misalignment of connections etc. In case of any damaged components observed, the same shall be reported to the Engineer-in-Charge.
- 2.6.4 Reinforcing Elements - Reinforcing materials Steel (bars, strips, plate, mesh etc.) and Polymeric elements like strips, grids, rods, mesh etc. and Geosynthetic materials should arrive at the project site securely bundled or packaged to avoid damage. They come in a variety of material types, configurations, and sizes (gauge, length, product styles). The contractor and inspecting personnel should verify that the material is properly identified and check the specified designation. Material verification is especially important for geotextiles and geogrids where many product styles look similar but have different properties. For strip reinforcements, the length and thickness should be checked. Geogrids or geotextile samples should be sent to the laboratory or engineer for verification testing. Protective coatings, i.e. galvanization or epoxy should be verified by certification or agency conducted tests and be checked for defects.
- 2.6.5 Tensile strength of polymeric reinforcement materials should be evaluated by conducting a wide width tensile test (ISO 10319 or ASTM D 6637) or EN 10223-3 for (woven steel wire mesh). All tests related to reinforcements should be performed in an independent accredited laboratory which is accredited by a competent authority.
- 2.6.6 The construction of a multilayered soil reinforcement system of RS wall, is carried out in the following steps:
- 2.6.6.1 Preparation of subgrade, which involves removal of unsuitable materials from the area to be occupied by the retaining structure. All organic matter, vegetation, slide debris and other unstable materials should be stripped off and the subgrade compacted, if required.
- 2.6.6.2 Foundation for placement of a levelling pad/strip footing minimum 350 mm wide and 150 mm thick in M15 grade plain concrete for erection of facing elements. (Section 3106.1 of 'specifications of MORT&H')

- 2.6.6.3 If Pre-cast concrete panels are used, erection of the first row of facing panels on the prepared leveling pad: The first row facing panels may full or half height panels, depending upon the type of facing utilized. The first tier of panels must be shored up to maintain stability and alignment.
- 2.6.6.4 Construction should always begin adjacent to any existing structure and proceed toward the open end of the wall. The panels should be set directly on the concrete leveling pad. Horizontal joint material or wooden shims should not be permitted between the first course of panels and the leveling pad. Temporary wood wedges may be used between the first course of panels and the leveling pad to set panel batter, but they must be removed during subsequent construction.
- 2.6.6.5 For segmental panel walls, panel spacing bars, which set the horizontal spacing between panels, should be used so that subsequent panel rows will fit correctly.
- 2.6.6.6 The first row of panels must be continuously braced until several layers of reinforcements and backfills have been placed. Adjacent panels should be clamped together to prevent individual panel displacement.
- 2.6.6.7 After setting and battering the first row of panels, horizontal alignment should be visually checked with survey instruments or with a string line.
- 2.6.6.8 When using full height panels, initial bracing alignment and clamping are even more critical because small misalignments cannot be easily corrected as construction continues.
- 2.6.6.9 The required thickness of drainage material 600mm shall be placed at back facing panel. The drainage material shall be compacted with vibratory plate compactor and within the block cavities. No heavy compaction equipment shall be allowed to operate within 1.50m of the back of the face panel.
- 2.6.6.10 Back fill require high quality for durability, good drainage, constructability, and good soil reinforcement interaction which can be obtained from well graded, granular materials as RS wall systems depend on friction between the reinforcing elements and the soil. In such cases, a material with high friction characteristics is specified and required. (Section 3104 of specifications of MORT&H). Where galvanized steel reinforcement is used, the fill material shall be free draining granular material and shall meet requirements as per Table 3100.1 of specifications of MORT&H'. Where Geosynthetic reinforcements manufactured from polyester yarn are used, the PH value of the fill material shall be between 3 and 9 and for reinforcing elements manufactured from PVA, PP and HDPE, the PH value shall be greater than 3. (Section 3104.1.1 and 3104.1.2 specifications of MORT&H)
- 2.6.6.11 Placement of backfill on the subgrade behind the drainage zone to the level of the first layer of reinforcement and its compaction: The fill should be compacted to the specified density as per 'specifications of MORT&H' (section 3106.5) and IRC: SP: 102-2014.
- 2.6.6.12 Placement of the first reinforcing elements on the back fill: (Section 3106.2 specifications of MORT&H). The connection between the fascia panels and the reinforcing element shall be using either nut or bolt, HDPE inserts with bodkin joints, hollow embedded devices, polymeric/steel strips/rods/pipes, fibre glass dowels or any other materials shown in the drawings. The connection between the panel and the reinforcement shall provide 100% of the long term design strength of the reinforcing element in continuity. (Section 3105.3 specifications of MORT&H).
- 2.6.6.13 Placement of the backfill over the reinforcing elements to the level of the next reinforcement layer and compaction of the backfill: The steps are repeated for each successive layer.
- 2.6.6.14 At no stage of construction, the compaction or any other equipment shall be allowed to operate directly on the reinforcement.
- 2.6.6.15 To provide a coherent reinforced soil mass, the vertical spacing of primary reinforcement shall not exceed 800 mm in all types of reinforcements. The spacing of the nearest reinforcing element shall be

such that maximum height of facing above uppermost reinforcement layer and below the lower most reinforcement layer does not exceed 400mm.

- 2.6.6.16 The correct placement of the first row or two of panels is very important which is placed on the leveling pad and braced.
- 2.6.6.17 The panels need to be on the proper alignment, grade and be level. The correct spacing is also very important. Without the correct spacing, panel corners will crack and spall with settlement. Hence, spacers (bearing pads) must be used.
- 2.6.6.18 The panels shall be placed vertically with the aid of a compatible light crane. For erection, panels are handled by means of lifting devices set into the upper edge of the panels.
- 2.6.6.19 Panels shall be placed in successive horizontal lifts in the sequence shown on the drawings as back fill placement proceeds. As fill materials is placed behind a panel, the panels shall be maintained in vertical position by means of temporary wooden wedges placed in the joint at the junction of the two adjacent top rows of panels during construction.
- 2.6.6.20 Wooden wedges made from hard wood (such as oak, maple or ash) are also used to help hold the vertical alignment of the panels. The contractor should not keep more than three levels of the wooden wedges in the wall. If more than three levels of wedges are used, they may become bound in the wall making them very difficult to remove and can cause the panel to spall.
- 2.6.6.21 As construction proceeds and the panels above the wedged panel is completely erected and backfilled and as soon as a fourth row is erected, the lowest row of wedges can be removed and so on.
- 2.6.6.22 Corner panels shall be used at all corners. If corner panels are not indicated in the shop drawings, the Contractor shall contact the Wall Design Engineer immediately.
- 2.6.6.23 Precast facing panels are purposely set at a slight backward batter (toward the reinforced fill) in order to assure correct final vertical alignment after backfill placement. Minor outward movement of the facing elements from wall fill placement and compaction cannot be avoided and is expected as the interaction between the reinforcement and reinforced backfill occurs. Most systems which have segmental precast panels also have some form of construction alignment dowels which aid in proper erection.
- 2.6.7 If Dry Cast Modular Block Wall (MBW) units or Precast Concrete Blocks or Segmental Blocks are used, the following shall be ensured:
 - 2.6.7.1 These blocks are dry cast and shall be manufactured from fully automatic block making machines. The minimum grade of concrete shall be M35 for all kinds of blocks. In case of hollow blocks, the hollow area shall not exceed 40% of the cross sectional area of the block. The outer side of the block shall have minimum thickness of 100 mm. (Section 3105.1.2 of Specifications of MORT&H-2013)
 - 2.6.7.2 These are relatively small, squat concrete units that have been specifically designed
 - 2.6.7.3 and manufactured for retaining wall applications. The weight of these units commonly ranges from 15 to 50 kg, with units of 35 to 50 kg routinely used for highway projects. Unit heights typically range from 100 to 300 mm for the various manufacturers, with 200 mm typical. Exposed face length usually varies from 200 to 450 mm. Nominal front to back width (dimension perpendicular to the wall face) of units typically ranges between 200 and 600 mm. Units may be manufactured solid or with cores. Full height cores are filled with aggregate during erection. Units are normally dry-stacked (i.e. without mortar or bearing pads) and in a running bond configuration. Vertically adjacent units may be connected with shear pins, lips, or keys. Several example MBW units are illustrated in Figure 4A of IRC: SP: 102-2014.
 - 2.6.7.4 This is a typical rock wood type block and this block it has a length of 400 millimeters and the height is 200 millimeters and this depth is 250 millimeters and this particular block is made of M35 grade

concrete by cold pressing process, we just simply take the mould and then prepare the concrete as per the as per the mix design and then just simply pour it and then press it to form this block.

- 2.6.7.5 For construction with MBW units, full sized blocks are used throughout with no shoring. The erection of facing panel or blocks and placement of the soil backfills should proceed simultaneously.
- 2.6.7.6 The entire construction is started by levelling the ground and preparing the base.
- 2.6.7.7 The facing blocks are assembled and just simply placed on the prepared leveling pad along the row and along the height without use of any cement motor.
- 2.6.7.8 Erection of the first row of facing blocks on the prepared leveling pad.
- 2.6.7.9 The required thickness of drainage material 600mm shall be placed at back facing block and in the hollows of facing block.
- 2.6.7.10 Placement of backfill on the subgrade behind the drainage zone to the level of the first layer of reinforcement and its compaction.
- 2.6.7.11 Placement of the first reinforcing elements on the back fill.
- 2.6.7.12 Placement of the backfill over the reinforcing elements to the level of the next reinforcement layer and compaction of the backfill: The steps are repeated for each successive layer.
- 2.6.7.13 Not more than one intervening block shall be left without having primary reinforcement.
- 2.6.7.14 The maximum height of facing left unreinforced (a) above the uppermost reinforcing layer and (b) below the lowest reinforcing layer, shall not exceed the width of the block (measured from the front face to the back face of the block).
- 2.6.7.15 The reinforcement is held by friction between the facia block and reinforcement as well as block to block friction. Block to Reinforcement friction/connection strength tests for reinforcement shall be as per ASTM D 6638 "Standard Method of Test for Determining Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units" and shall satisfy the requirement of the Long Term Design Strength of the primary reinforcement.
- 2.6.7.16 Shear key: Basically the shear key sits in the opening between this two adjacent blocks, so that there is some shear interlocking and the construction each of this, the upper blocks they will have an offset of about 10 millimeters from the blocks below so that there is a natural batter that is given.
- 2.6.7.17 Care should be taken to ensure that reinforcement (geogrids) is slightly away from the external junction of outside face of facia block. This will ensure that the geogrids does not protrude out of the wall and prevented from UV ray exposure.
- 2.6.7.18 Placing of the blocks is very simple, we just simply bring them and manually place them at the site after spreading the reinforcement layer.
- 2.6.7.19 Bearing pads are not routinely used with MBW units.
- 2.6.7.20 A zone of aggregate fill, usually 600mm wide, is used behind the MBW units.
- 2.6.8 It must be verified that the batter of the RE wall and the overall RE wall batter be measured often and at regular intervals. This is important because the vertical alignment of the panels /blocks being installed may be affected by the compaction of the soil behind the panels/blocks being installed. The Railway personnel should measure the overall batter regularly.
- 2.6.9 Construction of traffic barriers and copings: This final construction sequence is undertaken after the final panels have been placed, and the wall fill has been completed to its final grade.
- 2.6.10 The system suppliers generally provide some degree of technical assistance for construction and correction of construction problems. Most suppliers will also provide an individual on site to advise the contractor as to correct construction procedures, though these technical advisors will not generally be on site full time. However, they should be on site roughly two or three days initially and periodically thereafter, depending on the contractors' previous experience with the system.

- 2.6.11 The technical representative of the RE Wall designer shall be present periodically on site during the casting and erection phases to ensure that the quality of the works performed by the Contractor is in accordance to the specifications. All expenses relative to his presence on site shall be borne by the Contractor.
- 2.6.12 The method statement for construction of panels and blocks shall be approved by the Engineer-in-Charge and shall have quality assurance plan and tolerance as outlined in section 3106.6 of specifications of MORT&H-2013.
- 2.6.13 **HANDLING, STORAGE AND TRANSPORTING**
All elements shall be handled, stored and transported in such manner as to eliminate the danger of chipping, cracks, fracture and excessive bending stresses. Elements in storage shall be supported on firm blocking located adjacent to the tie strips to avoid bending. Panels/ blocks should be stored flat. This is done for a couple of reasons; (i) it protects the connections from being bent and damaging the galvanization. (ii) They should be stored out of the mud to avoid staining the panel face.
- 2.6.14 Engineer must verify that all components (panels, reinforcement) are handled, stored and shipped in a manner that prevents, chipping, cracks, fractures, excessive bending stresses. The Department has the right to reject panels with damaged connectors. If bent tabs are seen it should be brought to the notice of Engineer-in – Charge, immediately. Also, the Railway personnel should point out to the Contractor when the storage of panels is not being done properly.
- 2.6.15 Reinforcement storage: Like the panels/blocks, the reinforcement should be stored on flat ground and carefully handled to prevent damage. Damage may include bending of the reinforcement and damaging the galvanization. The soil reinforcement, i.e., metallic and polymeric reinforcements should not be bent, torn, galvanization chipped off or otherwise damaged. The polymer reinforcement should not be torn, cut, left in the sun or otherwise damaged. The inspecting personnel should check the reinforcement for the required length, size and supplier's product designation for compliance with design drawings and shop drawings and proper placement of soil reinforcement. No equipment should be allowed to run directly on the reinforcement. Typically, the reinforcement is placed perpendicular to the wall face. Any slack in the reinforcement should be removed.
- 2.6.16 Facing Joint Materials - Bearing pads, joint filler ((EPDM) and joint cover (geotextile) should be properly packaged to minimize damage in unloading and handling. For example, polymer filler material and geotextiles must be protected from sunlight during storage.

Other technical guidelines and highlights of specifications:

- 2.6.17 The maximum height of the RE wall shall be restricted to 8m to 8.5m above ground level and 10m above leveling pad.
- 2.6.18 The design of the RE wall shall have to be carried out duly taking ϕ value as 30o and 'C' value as 0 (zero).
- 2.6.19 Before taking up the design, the geo technical investigation and back fill test shall be conducted and reports should be made available to Design Agencies of RE wall. These tests have to be conducted in any NABL Accredited Laboratories duly witnesses by contractor's agents and departmental supervisor.
- 2.6.20 In case of weak founding soil suitable ground improvement measures have to be designed and adopted before taking up the RE embankment.
- 2.6.21 Cruci form or T shaped RE panel shall be used to have staggered arrangement of joints and to avoid continuous vertical/horizontal joints.
- 2.6.22 Thickness of the RE panel shall be of 180mm. (Minimum)
- 2.6.23 The width of RE panel shall be less than 2.0m and height shall be less than 1.60m.

- 2.6.24 Preferably the erection of RE panel shall be started from the abutment.
- 2.6.25 The galvanized steel strips shall be tested for its tensile strength, yield strength, galvanization and elongations through NABL Accredited Laboratories as per Quality Assurance Plan (QAP) approved by Railway.
- 2.6.26 The Quality Assurance Program for procurement of materials, testing of materials and casting of RE panels, erection of RE panels and all other connected processes shall be submitted along with the Design so as to verify the entire process in total. It applies for selected back fill materials also.
- 2.6.27 The connectors such as bolts and nuts shall be tested for its shear strength, tensile strength, and galvanization through NABL Accredited Laboratories.
- 2.6.28 All horizontal joints between panels shall be provided with a minimum of two bearing pads of 20 mm thickness. The EPDM (Ethylene Propylene Diene Monomer) bearing pads shall confirm to durometer hardness of 70 IRDH (International Rubber Degree of Hardness).
- 2.6.29 The Quality Assurance Program for procurement of materials, testing of materials and casting of RE panels, erection of RE panels and all other connected processes shall be ensured.
- 2.6.30 The quality of backfill material and other various parts of RE wall shall be personally checked at the level of JAG officer frequently.
- 2.6.31 At the face of RE wall, 600 mm thick filter media conforming to MORT&H specifications shall be provided.
- 2.6.32 Materials can be selected randomly by the Railway and give it to third party lab.
- 2.6.33 Resting of RCC panels on pile cap should be avoided at cross wall or abutment face wall or closing wall. (The load on pile cap will be reduced but a portion of approach slab will not rest on fill soil.) This needs to be looked into during design of abutments by structural designers.
- 2.6.34 Design submitted by Consultant shall be proof checked by IIT/IISC before submitting to KRIDE for approval.
- 2.6.35 The density of the soil shall be minimum of 20 KN/m³.
- 2.6.36 Only galvanized ribbed steel strips should be used for reinforcement of Soil and the fill material shall be free draining granular meeting the requirement as per the specifications of MORT&H (3104.1).

14.3 ACCEPTABILITY

Acceptability of the precast elements shall be determined on the basis of compression tests, as per specifications of MORT&H and visual inspection.

14.4 REJECTION

Elements shall be subject to rejection in case of failure to meet any of the requirements specified above. In addition, defects, which indicate imperfect moulding, or defects indicating honeycombed or open textured concrete, shall be sufficient cause for rejection.

ANNEXURE -8B – 1
APPROVED VENDORS LIST



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1. APPROVED MANUFACTURERS /SUPPLIERS FOR CIVIL WORKS

All materials and products shall conform to the relevant standards/specifications of IS code, BS Code etc. and shall be of approved make and design. A list of manufacturers / vendors is given herein below for guidance. The approval of a manufacturer/vendor shall be given only after review of the sample / specimen by the Client. The complete system and installation shall also be in conformity with the – **“Applicable Codes, Standards and Publications”**.

List of approved makes for products and materials is given below. The Employer reserves the right to adhere any of the vendor against each of the item.

No.	Details of Materials/Products	Manufacturer's Name
1.	Epoxy / Polyester resin For fixing anchor fasteners in soffits	<ul style="list-style-type: none"> • Fosroc Chemicals • STP MBT • Apple chemie • BASF • Sika • Hilti
2.	Fire rated Sealant	<ul style="list-style-type: none"> • Dow Corning's "Firestop Sealant 700: by Universal Silicones Lubricants Pvt Ltd. • GE Silicone's Pensil 300 Fire stop Sealant" • Hilti
3.	Ply wood	<ul style="list-style-type: none"> • Uniply • Europly • Archidply • Century ply • Hunsurply • Corbett • Duroply (Green marked, BWR Grade) of Sarda Plywood Industries Ltd., • Green Plywood Kitply
4.	Block board	<ul style="list-style-type: none"> • Uniply • Euro Board • Greenply blockboard • Century board • Archid blockboard • Duroboard of Sarada Plywood • Bhutan Board
5.	Veneers	<ul style="list-style-type: none"> • Greenply • Euro make • Jackson • Timex • Legend • Sarda Plywood Industries Ltd.

No.	Details of Materials/Products	Manufacturer's Name
6.	Burl Veneer	<ul style="list-style-type: none"> • Greenply • Euro make • Jackson • Venture Enterprise • Kitply Industries Ltd.
7.	Adhesive	<ul style="list-style-type: none"> • "Pidilite • Araldite • Jivanjor • Apple chemie • SUPREME BITUCHEM INDIA PVT. LTD. • Fairmate
	Cement based Adhesive	<ul style="list-style-type: none"> • Ultratech • APPLE CHEMIE INDIA PVT. LTD • MYK Laticrete • BASF • FOSROC • Fairmate
8.	Flush Doors	<ul style="list-style-type: none"> • Kuty, • Karnataka State forest department, • Greenply, Decorative Duroply (Green marked), • Kitply
9.	Plastic Laminates	<ul style="list-style-type: none"> • Formica • Greenlam • Vir • Sundeck • Neoluxe • Bakelite Hylam • Century • Marino
10.	Aluminium Sections	<ul style="list-style-type: none"> • Indian Aluminium Co. • Hindustan Aluminium • Jindal, • Boruka • Hindalco
11.	Aluminium Composite Panel	<ul style="list-style-type: none"> • Flexibond • Alucobond • AluKbond • Eurobond • AlucoPanel • Alstrong Enterprises India Pvt Ltd. • Alutech Industries. • Eurobond Industries Pvt Ltd. • City Bond • Hunter Douglas • Durobuild.
12.	Float Glass/Toughened Glass Insulating Glass	<ul style="list-style-type: none"> • Float Glass India Ltd • Modiguard

No.	Details of Materials/Products	Manufacturer's Name
		<ul style="list-style-type: none"> • Saint Gobain • Belgium glass Ltd
13.	Bevelled and Embossed Glass/Mirrors	<ul style="list-style-type: none"> • Gujarat Guardian Ltd. • Modi • Saint Gobain
14.	Powder Coatings	<ul style="list-style-type: none"> • Berger • Nerocoat • Jenson & Nicholson
15.	Asphalt Emulsion	<ul style="list-style-type: none"> • Karnak Chemical Corporation • STP
16.	Tile Joint Filler	<ul style="list-style-type: none"> • Bal Adhesives & Grouts • Roff construction Chemicals Pvt Ltd. • GE Bayer Silicon • MC-Bauchemie (IndiaPvt Ltd) • Apple Chemie • BASF • Fosroc • Pidilite
17.	PVC Tile Spacers	<ul style="list-style-type: none"> • Kajaria Ceramics Limited • Arpitha Exports
18.	Heavy Duty Chequered Tiles	<ul style="list-style-type: none"> • NITCO • Modern Tiles • Johnson • Kajaria
19.	Ceramic Tiles	<ul style="list-style-type: none"> • Kajaria • Bell • Spartek • Goldcoin • Johnson • Somany • RAK Ceramics • Murudeshwar Ceramics • Asian Granito India Limited. • NITCO
20.	Vitrified Tiles	<ul style="list-style-type: none"> • "Naveen Diamontile" of Murudeshwar Ceramics Ltd. • "Granamite" of Restile Ceramics Limited • "Marbo Granit" of Bell Granito Ceramica Ltd • Johnson Tiles • Somany Tiles • Asian Granito India Limited. • RAK Ceramics • Bell • Kajaria

No.	Details of Materials/Products	Manufacturer's Name
21.	Marble blended Vinyl Tiles/Sheet	<ul style="list-style-type: none"> • Armstrong of Inarco Ltd • Terkett Floorings • Krishna Vinyl
22.	Glass Mosaic Tiles	<ul style="list-style-type: none"> • Mridul Enterprises • Italia • Palladio
23.	Marble Mosaic Tiles	<ul style="list-style-type: none"> • Nitco • Basant Tiles
24.	Aluminum Linear Ceiling	<ul style="list-style-type: none"> • Luxalan • Interarch • J C Industries • Hunter Douglas • Fundermax • Armstrong
25.	Steel Panel Ceilings	<ul style="list-style-type: none"> • Interarch • Armstrong • Metckaft
26.	Resin Bonded Glass Wool	<ul style="list-style-type: none"> • Rockloyd • Kingsway • LLYOD Insulations (INDIA) Ltd.
27.	MS Tubes	<ul style="list-style-type: none"> • Tata • Lloyd Metal & Engineering Co. • NSL Limited • Jindal • SAIL • ESSAR • JSW • Jindal Steel & Power Ltd. • Apollo • Surya
28.	Modified Bituminous	<ul style="list-style-type: none"> • "Multiplas Standard" of Integrated • Waterproofing Membrane Limited • "SUPER THERMOLAY"/"POLYFLEX" • of STP Limited . • "LOTUS-3" of the Structural Waterproofing Co. Limited • "HEAVY DUTY POLYPLY" of Ana • Roofings Private Ltd • Apple chemie • Shell • Hincola
29	Polysulphide Sealants	<ul style="list-style-type: none"> • Pidilite Industries Ltd. • STP • Fosroc • Choksey • Apple chemie • Fair Mate Chemical Pvt Ltd.

No.	Details of Materials/Products	Manufacturer's Name
		<ul style="list-style-type: none"> • Hindcon Chemicals Limited • APPLE CHEMIE INDIA PVT. LTD • BASF
30.	Silicone Sealants	<ul style="list-style-type: none"> • G.E. Bayer Silicone • Dow Corning • Waclear • APPLE CHEMIE INDIA PVT. LTD
31.	Sealant Joints	<ul style="list-style-type: none"> • Watson Bowman Acme Corporation • "Silpray" of G.E. Bayer Silicare
32.	Paints	<ul style="list-style-type: none"> • Berger • Jonson & Nicholson • Asian Paints • Dulux • Nerolac •
33.	Emulsion Paint	<ul style="list-style-type: none"> • Dulux Velvet • Luxol Silk • Jonson & Nicholson • Asian Paints • Dulux • Kansai Nerolac Paints Ltd.
34.	Acrylic Emulsion paint	<ul style="list-style-type: none"> • Berger • Asian Paints • Dulux • Kansai Nerolac Paints Ltd
35.	Synthetic Enamel	<ul style="list-style-type: none"> • Berger • Jonson & Nicholson • Asian Paints • Dulux • Kansai Nerolac Paints Ltd.
36.	Cement Based Primer	<ul style="list-style-type: none"> • Berger • Asian Paints • Kansai Nerolac Paints Ltd. • Dulux.
37.	IPN	<ul style="list-style-type: none"> • Berger • Kansai Nerolac Paints Ltd. • Krishna Conchem Products Pvt Ltd.
38.	Epoxy Paint	<ul style="list-style-type: none"> • Berger • Asian Paints • Kansai Nerolac Paints Ltd

No.	Details of Materials/Products	Manufacturer's Name
		<ul style="list-style-type: none"> • Choksey Chemicals Pvt Ltd. • Apple chemie • BASF
39.	Texture Paints	<ul style="list-style-type: none"> • Spectrum • Unitile • Surfa • Birla
40.	Wall Putty	<ul style="list-style-type: none"> • Birlawhite • Berger • JK
41	Epoxy Putty	<ul style="list-style-type: none"> • Berger • Asian Paints • Kansai Nerolac Paints Ltd
42	Polyurethane Paint	<ul style="list-style-type: none"> • MRF • Berger • Kansai Nerolac Paints Ltd.
43	Wax Polish	<ul style="list-style-type: none"> • Reckitt & Colman • Asian • Berger
44.	Melamine	<ul style="list-style-type: none"> • ICI Delux Timberstone Melamine Coating • Asian / • Berger
45.	Membrane Water Proofing	<ul style="list-style-type: none"> • TREMCO • Bitumat • Apple Chemie • BASF • Pidilite • SUPREME • Tikidan
	Cement based water proofing	<ul style="list-style-type: none"> • Ultratech • Supreme • Silka • Weber • Pidilite • Perma
46.	Cement Bonded Particle Board	<ul style="list-style-type: none"> • Bison Panel Board • Everest Industries
47.	Stainless Steel Railings	<ul style="list-style-type: none"> • Salem Steel • GM 2 metal works • Entarchcon Infratech Pvt. Ltd. • Renuka Equipments Pvt Ltd
48.	Raised (Access) Floor / Cavity floor	<ul style="list-style-type: none"> • Hewetson • United Insulation • Proactive Systems • Universal Infrastructure Systems

No.	Details of Materials/Products	Manufacturer's Name
49.	Fire Check Doors	<ul style="list-style-type: none"> • Shakthi Hormann Pvt.Ltd. • Signum
50.	Pressed Steel Door Frames	<ul style="list-style-type: none"> • Deccan Structural Systems Pvt. Ltd, • Agew • San-Harvic • Signum
51.	Ceramic Claustra	<ul style="list-style-type: none"> • Scindia Potteris
52.	Interlocking Paving Tiles	<ul style="list-style-type: none"> • Pavestone Marketing Pvt Ltd • Nitco Marble & Granite Pvt. Ltd • NITCO
53.	Ashford Formula	<ul style="list-style-type: none"> • JB Associates
54.	Eleganstone	<ul style="list-style-type: none"> • Bubna Commodities (P) Ltd
55.	Rock Wool	<ul style="list-style-type: none"> • Lloyd Insulation (India) Ltd • ROCKWOOL
56.	Cavity Block	<ul style="list-style-type: none"> • Apco Concrete Block • Besser Concrete Systems Ltd • Sobha Concrete Products
57.	AAC Blocks	<ul style="list-style-type: none"> • Hyderabad Industries Ltd • Ballarpur Industries Ltd • Ultratech • Duralite • Airolite • Apex
58.	Cement concrete designer tile	<ul style="list-style-type: none"> • Eurocon tiles, • Duracrete • Ultra tiles. • NITCO • Johnson • Somani
59.	Polycarbonate sheets	<ul style="list-style-type: none"> • GE Plastics (Lexan) • M/s Gallina Acroplus. • Coxwell • Poly U • Fabic • SABIC I.DANPALON • Tuflite
60.	Iron Mongery	<ul style="list-style-type: none"> • Dorma • Ozone • Kich • Yale • Dorset • Henderson • Ebco • Godrej
61.	AAC Block joint adhesive	<ul style="list-style-type: none"> • Ultratech • Apple Chemie

No.	Details of Materials/Products	Manufacturer's Name
62.	Readymade Plastering	<ul style="list-style-type: none"> • Ultratech • Apple Chemie • FOSROC
63.	Cement base grouting	<ul style="list-style-type: none"> • Ultratech • Apple Chemie • BASF • Fosroc • Perma • Supreme
64.	Baffle Ceiling	<ul style="list-style-type: none"> • Armstrong • Hunter Douglas
65.	Exterior cladding	<ul style="list-style-type: none"> • Hunter Douglas • Fundermax
66.	Perforated metal ceiling	<ul style="list-style-type: none"> • Hunter Douglas • Fundermax • Armstrong
67.	Glass Dome	<ul style="list-style-type: none"> • Entrachcon Infratech Pvt. Ltd.
68.	Tensile Roofing	<ul style="list-style-type: none"> • Saint Gobain • Serge Ferrari
69.	Roof Latches	<ul style="list-style-type: none"> • LATCHWAYS
70.	AL Roof Vents	<ul style="list-style-type: none"> • Agaris Airvent Systems
71.	Roofing 1. Galvalume 2. Zinalume	<ul style="list-style-type: none"> • Tata Blue Scope • JSW Steel • SAIL • LLYOD Insulations (INDIA) Ltd. • VM Zinc • VIJAYANATH • LLYOD Insulations (INDIA) Ltd. • Tata Blue Scope
72.	Toilet Cubicles	<ul style="list-style-type: none"> • Macro Enterprises • Merino • Greemlam
73.	Tactile Flooring	<ul style="list-style-type: none"> • Johnson Tiles • NITCO
74.	CEM Board	<ul style="list-style-type: none"> • USG Boral • NCL
75.	Calcium Silicate Board	<ul style="list-style-type: none"> • Promat • Armstrong • Hilux
76.	AL windows & Glazing	<ul style="list-style-type: none"> • AJIT INDIA (Madras) Pvt. Ltd.
77.	Cement	<ul style="list-style-type: none"> ➤ <u>Viaduct Work & Station</u> • ACC, Ultratech, ➤ <u>Other works:</u> • Gujarat-Ambuja, Grasim, JK Lakshmi, Birla. Dalmia, JSW, Bharati Cement, RAMCO

No.	Details of Materials/Products	Manufacturer's Name
78.	Reinforcement Bars (TMT Bars)	<ul style="list-style-type: none"> • SAIL, Rastriya Ispat Nigam Ltd, Tata Tiscon, JSW Steel, VIZAG STEEL
79.	Epoxy	<ul style="list-style-type: none"> • FOSROC, SIKAL QUALCRETE, Araldite, BASF, Fairmate.
80.	Expansion Joints	<ul style="list-style-type: none"> • Prequalified Manufacturers as per RDSO's latest approved list or as approved by the Employer. • Fair Mate Chemical Pvt. Ltd • Chembond Chemical Ltd. • Kantaflex (India) Pvt Ltd.
81.	Admixtures	<ul style="list-style-type: none"> • FOSROC, MBT. MC Baucheme, Sika, • Pidilite, BASF • Fairmate • ADO Additives Technologies Ltd. • Concrete Additives & Chemicals Pvt Ltd. (CAC Admixture).
82.	Pile Integrity Testing Agency	<ul style="list-style-type: none"> • CBRI. Pile Dynamic. AIMIL, Geo dynamic or NABL Accredited Agency
83.	Anchor Fastener	<ul style="list-style-type: none"> • HILTI. FISHER, BAUCH • Canon Fasteners
84.	Structural Steel	<ul style="list-style-type: none"> • TATA, SAIL, ESSAR, Jindal Steel & Power Ltd, JSW
85.	Stainless Steel	<ul style="list-style-type: none"> • Jindal. • JSW.
86.	Pre-stressing Strand (LRPC)	<ul style="list-style-type: none"> • TATA SSL Ltd, USHA Martin
87.	Welding Electrodes	<ul style="list-style-type: none"> • ESAB. Advani - Orlikon Weld Alloy. Modi L&T Eutectic. (RDSO approved manufactures.)
88.	Pot/Elastomeric Bearings	<ul style="list-style-type: none"> • Prequalified Manufacturers as per RDSO's latest approved list
89.	Horizontal Tie Bars/Shear Bars	<ul style="list-style-type: none"> • BB Bars System, BBV Systems, Dextra
90.	HDPE Sheathing	<ul style="list-style-type: none"> • Rex Polyextrusion, Gwalior Polypipes Ltd, M/s Dynamic Prestress
91.	Formwork Release Agent	<ul style="list-style-type: none"> • FOSROC, MBT, MC Baucheme, Ado Conmat, • CICO, SWC, Choksey, BASF, Adoadditives, STP • Fair Mate Chemical Pvt Ltd. • Chembond Chemical Ltd.
92.	Prestressing System	<ul style="list-style-type: none"> • Freyssinet, BBR, VSL, Dynamic, Killick Nixon, Tensacciai (India Ltd.), Usha Martin, Posten, VSIL
93.	Reinforcement Couplers	<ul style="list-style-type: none"> • Dextra, Moment • SANFIELD India Pvt Ltd.
94.	Drainage Pipes	<ul style="list-style-type: none"> • Tirupati Plastomatics, Duraline, REX, STIPL • Ashirvad pipes Pvt Ltd. • Prakash Surya • Prince
95.	Acrylic Textured Coatings	<ul style="list-style-type: none"> • Spectrum, Renova, Wallz, Surfa Nova, Jotun, Asian Paints
96.	Non shrink Grout	<ul style="list-style-type: none"> • Fosroc Chemical (India). SIKAL BASF, ELCHEM, • MBT. Sika. • Chryso India Pvt Ltd. • Hindcon Chemicals Limited • APPLE CHEMIE INDIA PVT. LTD • Flaminco Refractories Pvt Ltd.

No.	Details of Materials/Products	Manufacturer's Name
		<ul style="list-style-type: none"> • Ultratech. • BASF • Fairmate
97.	Bonding Coat	<ul style="list-style-type: none"> • CICO, FOSROC, Sunanda specialty coating Pvt. Ltd., BASF, SWC. TAM, Fairmate
98.	Polysuphide Sealant	<ul style="list-style-type: none"> • CICO. Pidilite. BASF. FOSROC. SWC, STP, • SIKA, Fairmate
99.	Steel Structural Fasteners	<ul style="list-style-type: none"> • Pooja Forge, Sundram Fasteners, Unbrako, Nelson, Panchsheel, karamtara.
100.	Micro Silica	<ul style="list-style-type: none"> • Sika, Elkem, FOSROC. MAPEI. Comiche, Star Silica, TAM, CICO, CAC, BASF, Buildetech, Ashtech, Alcofine.
101	Fire Resistant Paints	<ul style="list-style-type: none"> • Akzo Noble, PPG or equivalent, Jotun
102.	Integral Crystalline Waterproofing Method	<ul style="list-style-type: none"> • APPLE CHEMIE INDIA PVT. LTD • Fosroc • Perma • Cryton • Sika • Fairmate • TREMCO (Vandex)
103.	Water stopper/Bar	<ul style="list-style-type: none"> • Kanta Rubber. Greenstreak, Maruti, Duron • Fair Mate Chemical Pvt Ltd. • Supreme • Fairmate
104.	Liquid polymer membrane waterproofing	<ul style="list-style-type: none"> • INTEGRITANK, BASF. MAPEI, PIDILITE. DAVCO, CICO • APPLE CHEMIE India Pvt. Ltd, FOSROC, Asian Paints, MC-Bauchemie, Fairmate
105.	Curing Compound	<ul style="list-style-type: none"> • Clean tech concure, SINAK, FOSROC, ATPL • TAM, STP SWC.CICO • SUPREME BITUCHEM INDIA PVT. LTD. • Fair Mate Chemical Pvt Ltd. • Chembond Chemical Ltd. • Chryso India Pvt Ltd. • Rheoplast Technology Pvt Ltd. • Polygon Chemicals Pvt Ltd. • BASF • Pidilite • FOSROC • Sika • BASF • ATPL • Asian Paints • Fairmate • MC-Bauchemie
106.	Fly ash	<ul style="list-style-type: none"> • Thermal plant. Ashcrete, Ultra pozz, star pozz, (the fly ash shall be as per our specifications)

No.	Details of Materials/Products	Manufacturer's Name
107.	False Ceiling	<ul style="list-style-type: none"> • Hunter Douglas • Fundermax • Armstrong
108	Aluminum Louvers	<ul style="list-style-type: none"> • Hunter Douglas-LUXALON H-3 , CS-RS-1605 • Jindal • Hindalco
109.	Barbed Wire / Chain-link fencing	<ul style="list-style-type: none"> • Krishna Industries Bhilwara, / Concertina Coils New Delhi,
110.	PEB/Steel Structures/Pipe Structure	<ul style="list-style-type: none"> • Fabtech • Fabrimax • Framacad, • Voltagreen, • Everest, • ZAMIL • Renuka Equipments Pvt Ltd • Bajaj steels industries Ltd. • MetalFAB
111.	Cement (For Brick Works, & General Work, Wall/Boundary Wall only)	<ul style="list-style-type: none"> • Birla Gold (Manikgarh Cements) • Chettinad Cement Corporation Pvt Ltd. • JSW Cement Limited. • Dalmia Cement (Bharat) Limited. • Ultratech • Ambuja
112.	MS Angles & Flats	<ul style="list-style-type: none"> • Ramson Steel (For general purpose only, not for dynamic & heavy loading structures)
113.	Corrosion inhibiting admixture	<ul style="list-style-type: none"> • EPCO-KP 200 from Krishna Conchem Product Pvt. Ltd. • SUPREME BITUCHEM INDIA PVT. LTD. • ADO Additives Technologies Ltd. • BASF India Limited. (Construction Chemical Division). • Silka • Pidilite
114.	Coal tar epoxy for sub-structure protection.	<ul style="list-style-type: none"> • Krishna Conchem Product Pvt. Ltd.
115.	Coating of PSC Girders and RCC Substructures	<ul style="list-style-type: none"> • IPNet from Krishna Conchem Product Pvt. Ltd. • Nerolac • Berger
116	Solid Concrete Blocks	<ul style="list-style-type: none"> • Punjab Bricks • Apex • Grams

The above list is not exhaustive. Contractor may propose similar product of other reputed vendor too for the works. However, the approval /acceptance / rejection of proposed vendor rest with the Employer.

SECTION - 8C

SAFETY, HEALTH AND ENVIRONMENT (SHE) MANUAL

SAFETY HEALTH & ENVIRONMENT (SHE) MANUAL

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Name of the Project:**PACKAGE – LC Elimination at Corridor 4**

“Design & Construction of Single Cell Closed RCC Box at Channasandra Station location from ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore.”

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 an 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-Pascal) as measured with A-weighting network of standard sound level meter, abbreviated dB (A).
- j) Energy Equivalent Level (Leq) 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) L10 and L90 is the percentile exceeding levels of sound which exceeds 10% and 90% of the time of measurement.
- l) Waste is unwanted surplus substances arising from the application of all construction operations and 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:
- Zero total recordable injuries.
 - Zero reportable environmental incidents
 - All personnel inducted in accordance with the approved contractor SHE plan
 - Total compliance of conducting inspections and audits as per approved SHE plan
 - 100% incident recording and reporting
 - 100% adherence of usage of appropriate PPEs at work.
 - 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

- 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:

- Electricity Act 2003 and Rules therein
- National Building Code of India, 2016
- Factories Act, 1948.
- Motor Vehicles Act 1988 and The Central Motor Vehicles Rules, 1989.
- Indian Road Congress Code IRC: SP: 55-2001 'Guidelines on Safety in Road Construction Zones.
- 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.
- xxxviii. 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.

3.3.4.1 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, Hind/ 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, organization and arrangements for SHE
- ii) The name(s) and experience of person(s) within the Contractor's proposed management who shall be responsible for coordinating 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

5.1 DESIGNER'S ROLE IN SAFETY, HEALTH AND ENVIRONMENT

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 fails 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 VII/ 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 VII/ of BOCWR, the contractor shall provide all SHE personnel with such facilities, equipment and information that are necessary to enable him to dispatch 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 5001

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	Labour Welfare Officer In charge of plant and machinery In charge of site electrics In charge of stores Senior Managers/ Engineers heading different sub functions Sub - contractor's representative Labour Contractor's representative Workers' representative Co-contractor representative 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	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
- i) Safety presentation by Members
- ii) Report from Employer
- viii) Matters arising
- ix) 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 SITE 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/CE0/006
- 9.6 The contents of SHE training to Managers/Supervisors as given in general instruction K-RIDE/SHE/CE0/007 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 is 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.
- ii) Inspection performed before and after a welding and gas cutting operation.
- iii) 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 legalization 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:

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.

- Electrical accidents investigation findings and remedy
- Adequacy of power generation and power requirements
- Power distribution and transmission system in place
- 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
- vi) Education and training of electrical personnel undertaken
- vii) 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

11.4.6 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
- vii) 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 equipment's, 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 are 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 4B 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
- Establish the chain of events leading to the accident or incident
 - Find out at what stage the accident took place
 - 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
 - Publicize 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 utilize the services of experts/agencies empaneled 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, firefighting 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 odor impact shall be covered while moving.
- The tires 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 fall prevention, work restraint, work positioning, fall arrest or rescue system, other than a system in which the only safeguards are collective safeguards; or
 - Rope access and positioning techniques;
- 18.1.5 "Work at height" means -
- Work in any place, including a place at or below ground level;
 - 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 guard-rail, toe-board, barrier or similar collective means of protection
 - A working platform
 - 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 Organization 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 subparagraph (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 unauthorized 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 be 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
 - i. be stable and of sufficient strength and rigidity for the purpose for which it is intended to be or is being used;
 - ii. where applicable, rest on a stable, sufficiently strong surface;
 - iii. 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;
 - iv. possess suitable and sufficient means for preventing a fall;
 - v. 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;
 - vi. 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;
 - vii. 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 platform 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 dimension's 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 be 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 minimize 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 meters 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 200 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 events 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.
- 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 license 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 VI/ of BOCWR.
- 21.10 General requirements of appliances
- 21.10.1 Outdo 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 tires 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, license, 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 be 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 Mac-alloy 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 contractor's 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 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 tires 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 1800 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/CE0/001.

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, RR/ 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 laying 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 laying 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 is 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
 - a) Detailed cable route plan as per clause C-1 not provided by concerned department or cable is not protected as per laid down procedures.
 - b) The alignment of the cable does not tally with the information provided to the contractor.
 - c) The cable depth is found to be less than 800 mm from normal ground level.
 - d) No representative of S&T department/RailTel was available at site guarding the cables on the fixed pre-determined date and time.

26.8 Penalty to be imposed for damages to cable shall be as under: -

Cable damaged	Penalty per location
Only Quad cable or Signaling cable	Rs.1.00 Lakh
Only OFC	Rs.1.25 Lakh
Both OFC & Quad	Rs.1.50 Lakh
Electrical Cable	Rs.1.00 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.
- 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 EN60529.

- 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) 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 equipment's:
- 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 equipment's:
- 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 unauthorized 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 kVA 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 kVA 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 B m away from the center 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 kVA 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-/ 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 -V/ of volume-II, part - / 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:

	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, corridors, scaffold access routes, etc.	Well glass unit Bulkhead unit (tungsten filament) Bulk head unit (Florence
5.	Local lighting	Lighting on sites and fittings are generally accessible to operatives	PAR (Parabolic Aluminis Reflector) lamp cluster Festoons (with or without shades) Adjustable florescent wo lamp Portable flood lamp (mounted on own cable drum)

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, chiseling 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 equipment's, 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 needs 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 1800 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 move 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 vapors 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 / vapors 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 tunneling 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 of 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 meters 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 DEMOLITION

- 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
 - viii) 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 Tunneling

34.2.1 The contractor shall inform in writing to the Director General within 30 days, prior to the commencement of any tunneling work.

34.2.2 The contractor shall appoint a responsible person for safe operation for tunneling 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 tunneling 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 tunneling 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 tunneling
- vii. Adequate number of water outlets provided for firefighting 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 tunneling 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 tunneling, shall be displayed or erected at conspicuous places in Hind/ and in a language understood by majority of such building workers at such building such excavation or tunneling 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 authorization 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 /tunneling 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
- Warn the road user clearly and sufficiently in advance.
 - Provide safe and clearly marked lanes for guiding road users.
 - Provide safe and clearly marked buffer and work zones
 - Provide adequate measures that control driver behavior 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 utilized 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:
- 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-reflectorized 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 channelizing 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 an 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:

Provision of IRPWM (Indian Railways Permanent Way Manual) related to block protection; safety precaution for protection of track must be followed.

- a. 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
- b. 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.
- c. 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.
- d. 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.
- e. 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.
- f. 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.
- g. 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.
- h. 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.
- i. 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.
- j. 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.
- k. For construction of new bridge over major drain / drain / nallaha / rajakaluve / 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

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.

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.

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.

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.

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.

Notwithstanding the above, the contractor shall not, however, be relieved of his responsibility and obligation as aforesaid.

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 penalized 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

- i. Head Protection (Safety helmets)
- ii. Foot Protection (Safety footwear, Gumboot, etc.)
- iii. Body Protection (High visibility clothing (waistcoat/jacket), Apron, etc.)
- iv. Personal fall protection (Full body harness, Rope-grape fall arrester, etc.)
- v. Eye Protection (Goggles, Welders glasses, etc.)
- vi. Hand Protection (Gloves, Finger coats, etc.)

- vii. Respiratory Protection. (Nose mask, SCBAs, etc.)
- viii. 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
<ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 cm² c. Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 570cm² d. Horizontal strips not less than 5cm wide running around the bottom of the vertical Strip in front and 'X' pattern at back. e. The bottom strip shall be at a distance of 5cm from the bottom of the vest. f. Strips must be retro reflective and fluorescent g. Waistcoat shall have a side adjustable fit and a side and front tear-away feature on Vests made of nylon. 	<ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 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. c. Two vertical green strips of 5cm wide on front side, covering the torso at least 500 cm² d. Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 570cm² e. Horizontal strips not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back. f. The bottom strip shall be at a distance of 5cm from the bottom of the vest.

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

Notes: 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, tunneling 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.
- ii. All vehicles used by the contractor shall be clearly marked with the Contractor's name or identification mark.
- iii. 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.
- iv. 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 ensured:

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 driver's/machine operators should have competency certificate issued by PMC after examining their knowledge about safety. Only authorized drivers can play 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 authorized 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 II/ 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 play along the track after suitable cordoning off track with minimum distance of 6 meters from the center 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' 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 center, 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 center. 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 an 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 B26 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

40.25 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.

40.26 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.

40.27 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

40.28 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.

40.29 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.
- 40.30 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
- 40.31 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 center 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.
- 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.
4. Reducing number and length of such stretches by providing cross barricades should be done.
 5. 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.

6. Periodical formal counseling of all contractor's staff and PMC officials regarding safety instructions and review violations coming to light and taking appropriate action.
7. Counseling of drivers and operators of machinery regarding safety aspect during routine inspection of PMC official's contractors Engineers.
8. All the driver's/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.
9. Necessary caution orders to Drivers of trains wherever required in terms of Railway Board's instructions/PCE circulars.
10. 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

40.32 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 equipment's/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 Orth orator 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 center, 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 center, shall possess the qualification as laid down in Schedule X/ 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 II/ 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 programme.

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 BSRP, 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 (Leq) measured in decibels (dB). The two statistical sound levels L10 and L90; the level exceeded for 10 and 90 percent of the time respectively, shall also be recorded during monitoring. The L90 may be considered as the ambient level into which the L10 as average peak level intrudes. The Lmax, Leq, L10 and L90 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- Lmax 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	Lmax 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)

Distance (Feet)	Level to Estimate Sound Level at 50 Feet dB
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 PERMISSIBLE

AGGREGATE DURATION	LIMIT
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:
1. Indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
 2. 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-1 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.

43.5 Vibration Level

43.5.1 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.
- 46.1.4.2 In case if the contractor fails 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 charges 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 liters 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 meters 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. Forests (Conservation) Act, 1980
- vi. Coastal Regulation Zone Notification, 2011
- vii. The Wetlands (Conservation and Management) Rules, 2010
- viii. Karnataka Preservation of tress Act 1976
- ix. Noise Pollution (Regulation and Control) Rules, 2000
- x. Public Liability Insurance Act, 1991
- xi. Explosive Act, 1884
- xii. Hazardous and other Wastes (Management and Transboundary Movement) Rules, 2016
- xiii. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- xiv. The Petroleum Rules, 2002
- xv. Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and
- xvi. 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.
- 47.1.3 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.
- 47.1.4 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
- 47.1.5 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.
- 47.1.6 The minimum requirements to the specifications of sound level meter should be as given in IS: 9779-1981
- 47.1.7 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.
- 47.1.8 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 AM to 9 PM) 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 BAM to BPM.
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	Adhoc 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 minimize 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 minimize 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-utilized 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 minimize 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:
- 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 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, tunneling, 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 smoothened 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 translocated.
- 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:
- Identification of disposal sites.
 - Identification of quantities to be excavated and disposed of.
 - Identification of split between waste and inert material
 - Identification of amounts intended to be stored temporarily on site location of such storage.
 - 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 Authorization' 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 Authorized 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.

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 organization. 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 organization. The cost of established such organization 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
		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	Rs.1,00,000 per single violation, compounded to a maximum of Rs.2,00,000 at any single instance.
2	SHE Organization	i. Not complying to the minimum manpower requirements as mentioned in General Instruction K- RIDE /SHE/CEO/ 001(clause 6.1.1) ii. Not filling up the vacancies created due to SHE personnel leaving the contractor within 14 days. (clause 6.7) iii. SHE organization not provided with required Audio-visual and other equipment's as per General Instruction K-RIDE / SHE/ CEO/03 (clause 6.9.2) iv. Employing through outsourcing agencies and SHE personal are not in the payroll of the main contractor (Clause 6.5.1) v. Disobedience / Improper conduct of any SHE personnel. (clause 6.2) vi. Chief SHE Manager not reporting directly to CPM of contractor. (Clause 6.6)	Rs.1,00,000 per month for first month and Rs.2,00,000 for subsequent months Rs. 50,000 per month for first month and Rs.1,00,000 for subsequent months For items iii), iv), v) and vi) Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations
3.	SHE Committee	i. Failed to formulate or conduct SHE Committee meeting for any month (clause 7.4) ii. Contractor and Sub-contractor representatives not attending SHE Committee meetings (clause 7.10) iii. Failed to conduct Site inspection before conducting SHE Committee meeting (clause 7.2.1 (viii)) iv. Failed to send SHE Committee Meeting minutes or Agenda to Employer in time (clause 7.8.1, 7.9.1) v. Non-adherence of clause 7.7.1 vi. Non-adherence of clause 7.9	Rs.1,00,000 for the first violation and Rs.5,00,000 for the subsequent violations 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. For item iii), iv), v) and vi) Rs.25,000 for first violation and Rs.50,000 for subsequent violations
4.	ID card	Non-adherence of clause 8.1, 8.2 and 8.3	Rs.1,00,000 for first violation and Rs.2,00,000 for subsequent violations
5.	SHE Training	i. not complying to the requirements as mentioned in conditions of contract on SHE and project SHE manual with regard to: ii. Induction training not given (clause 8.1) iii. Supervisor/engineer/manager training not conducted as per clause 9.6 iv. Refresher training as per clause 9.7 and 9.11 not conducted v. Tool-box talk not conducted as per clause 9.8 vi. Skill development training not conducted as clause 9.9 vii. Daily Safety Oath not conducted as per clause 9.10 viii. Top management behavior based SHE training conducted (clause 9.4)	For item 1 a) to g) Rs.50,000 for first violation on and Rs.1,00,000 for subsequent violations
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 1.2.6) 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

SL. NO	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
		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	i. Important days to be observed for SHE awareness as furnished by employer not observed (clause 12.2) ii. 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	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 / tires 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

SL. NO	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
13	Working at Height / Ladders and Scaffolds	<ul style="list-style-type: none"> i. Not using or anchoring Safety Belt (clause 18.9) 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 Improper usage (less than 1m extension above landing point, not maintaining 1:4 ratio) (clause 18.20) vii. Aluminium ladders without base rubber bush (clause 18.20) viii. Usage of broken / weak ladders (clause 18.20) ix. Usage of re-bar welded ladders (clause 18.20) x. Improper guardrail, toe board, barriers and other means of collective protection (clause 18.16) xi. Improper working platform (clause 18.17) xii. Working at unprotected fragile surface (clause 18.9) xiii. Working at unprotected edges (clause 20.0) 	Rs. 10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
4	Lifting appliances and gear	<ul style="list-style-type: none"> i. Non availability of fitness certificate 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 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 license 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 requirements as per clause 21.11 x. Failure to submit method statement in case of all critical lifting clause 21.3 xi. Person riding on crane (clause 23.4 xii. Creating more noise and smoke – clause 43.1.1 xiii. Absence of portable fire extinguisher in driver cabin – clause 31.5 xiv. Fail to guard hoist platform (clause 24.0) xv. No fencing of hoist rope movement is (clause 24.0) xvi. Hoist platform not in the horizontal position (clause 21.2) 	Rs. 50,000 per single violation Compounded to a maximum of Rs.5,00,000 at any single instance
15	Launching Operation / Erection	Non-adherence of any of the provisions mentioned in clause 22.2	Rest. 50,000 for first violation and Rs.1,00,000 for subsequent violation
16	Site Electrical safety	<ul style="list-style-type: none"> i. Non-compliance of clause 26.1.1 ii. Non-compliance of clause 26.2.3, 26.2.4 & 26.2.5 iii. Non-compliance of clause 26.3.1 iv. Non-compliance of clause 26.7, 26.8 and 26.9.1 v. Non-compliance of clause 26.10 and 26.13 vi. Non-compliance of clause 28.3.2 vii. Exposed electric lines (fermentative damage) and circuits in the workplace. (Clause 26.5.1) viii. Inserting of wires directly into the socket ix. Improper grounding for the electrical appliances (clause 26.7.1) xi. Electrical cables running on the ground (clause 26.8.5 & 26.8.6) xii. Non-compliance clause 27.0 	Rs. 10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance

SL. NO	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
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	i. Wrong colour coding of cylinder. ii. Cylinders not stored in upright position. (clause 29.1) iii. Flash back arrester, non-return valve and regulator not present or not in working condition. (Clause 29.3 & 29.4) iv. Fail to put cylinders in a cylinder trolley. (Clause 29.1) v. Damaged hose and fail to use hose clamps (clause 29.2) vi. Using domestic LPG cylinders (clause 29.5) vii. Fail to store cylinder 6.6m away from fire prone materials (clause 29.8) viii. VIII. Fire extinguisher not placed in the vicinity during operation (clause 29.6)	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance
19	Welding	i. Voltmeter and Ammeter not working (clause 29.9) ii. Non-availability of separate switch in the transformer (clause 29.9) iii. Improper grounding and return path. (Clause 29.10) iv. Damaged and bare openings in the welding cable. (Clause 29.10) v. Damaged holder (clause 29.10) vi. Fire extinguisher not placed in the (clause 6.5.1)	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance
20	Fire precaution	i. Smoking and open flames in fire prone area (clause 31.6) ii. Using more than 24V portable electrical appliances in the fire prone area (clause 34.2.3) iii. Not proper ventilation in cylinder storage area. (Clause 29.8) iv. Absence of fire extinguishers (clause 31.1) v. Fire extinguishers not refilled once in a year (Clause 31.2) vi. Fire extinguisher placed in a not easily accessible location	Rs.5,000 per single violation Compounded to a maximum of Rs.25,000 at any single instance
21.	Excavation, Tunneling and confined Space	i. Non-compliance of clause 34.1.1 ii. Non-compliance of clause 34.2.3 iii. Non-compliance of clause 34.3	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

SL. NO	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
		i. Barricades (clause 36.9.4) ii. Not cleared iii. Not in alignment iv. Not numbered v. Not painted vi. Red lights / reflectors not working vii. Damages not repaired viii. Not Secured properly ix. Barricade inspector not employed x. Protruding Parts / portion repaired xi. Barricades maintaining register not properly maintained upto 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 Condition.	Rs.25,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
		i. non-cleaning of tires of dumpers and transit mixers (clause 17.11 & 17.14) ii. Mishandling of bentonite like splashing of bentonite outside specified width of barricading iii. Non-cleaning of tires of dumpers and transit mixers before leaving the site and thereby creating a traffic safety hazard to road users	For item i) and ii) Rs.1,00,000 on first observation. Rs. 2,00,000 on second observation Rs. 3,00,000 on third and subsequent observations
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	i. Not having (clause 39.1) ii. Not wearing (or) using and kept it elsewhere (clause 39.1) iii. Using damaged one (clause 39.2) Using wrong type (clause 39.5) iv. Using wrong colour helmet or helmet without logo (clause 39.4.1) v. Using for other operation (e.g. Using safety helmet for storing materials or carrying water from one place to other) (clause 39.5) vi. Not conforming to BIS standard (clause 39.2) vii. Non-compliance of clause 39.6, 39.7 and 39.8	For item vii) Rs. 10,000 for first violation and Rs. 50,000 for subsequent violations For item viii) Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations
26	Occupational health	i. Fail to conduct medical examination to workers (clause 42.1) ii. Absence of ambulance van & room (clause 42.3) iii. Workers not having ID card (clause 8.2) iv. Absence of first-aid person in work site. (Clause 42.4) v. Absence or inadequacy of first-aid box. (Clause 42.4) vi. Misuse of first-aid box. (Clause 42.4) vii. First-aid box not satisfy the minimum Indian standard. (Clause 42.4) viii. Smoking inside the construction site (clause 42.7.2) ix. Drink and drive or work (clause 42.7.1) x. Fumigation / insecticides not sprayed to prevent Mosquito breeding (clause 42.6.3) xi. Non-compliance of clause 44.1 and 44.2	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance

SL. NO	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
27	Labour Welfare measures	<ul style="list-style-type: none"> i. Inadequate number of toilets (clause 46.1.1) ii. Toilets not cleaned properly (clause 46.1.3) iii. Absence of water facilities for toilets and washing places (clause 46.1.3) iv. Toilet placed more than 500m from the work site (clause 46.1.3) v. Accommodation not provided as per BOCWA (Clause 46.5.1) vi. Absence of drinking water (clause 46.4) vii. Excessive noise and vibration (clause 43.0) viii. Canteen not provided (clause 46.2) ix. Food stuff no served on no loss no profit basis (clause 46.3) x. Crèche not provided (clause 46.6) xi. Non adherence of labour welfare provisions of BOCWA (clause 3.3.1.2) xii. Fail to register establishment and display the registration certificate at workplace (clause 3.3.1.2) xiii. Absence of worker register and record (clause 3.3.1.2) xiv. Fail to display an abstract of BOCWA and BOCWR (clause 3.3.1.2) 	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance
28	Environment Management	<ul style="list-style-type: none"> i. Tire wash facility not provided (clause 47.12) ii. Spillage from vehicles not arrest (clause 48.9) iii. Air monitoring not practiced (clause 47.17) iv. Noise monitoring nor practiced (clause 43.2.1) v. The values of air monitoring and noise monitoring not within acceptable limits (clause 47.12, 43.2.1) vi. Dust control measures at sites not practiced 9clause 47.13) vii. Improper disposal of debris / residues viii. Non-compliance of clause 53.0 & 54. 	Rs. 10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance.
29.	Working near existing railway track	<ul style="list-style-type: none"> i. To start work without erecting barricading as per requirement. ii. To start work in station area without permit to work or without approved plan. iii. To launch girder for RFO/ROB without approved plan and work permit. iv. Infringement of moving dimension by any vehicle / construction equipment with running train causing disruption of traffic, injury to passenger / fatal incident 	Rs. 5,00,000 for first violation and Rs.10,00,000 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: 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 endeavor.

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
- 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
- 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

In witness thereof the Parties hereto by representatives duly authorized have executed this Memorandum of Understanding on _____ day of _____ 20_____.

Signed on

For and on behalf of KRIDE

Signature:

Name :

Title :

Signed On

For and on behalf of (Contractor)

Signature:

Name :

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

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 XV/ and
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,
14.	Issue of wages book	R - 241(2)(a); Form XXIII
15.	Service certificate for each worker	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 agencies	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.	Crèches	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 and nets	C - XVI; R - 175 to 180
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 and 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	Project Highlights 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	Site Organization Chart Chart indicating reporting of SHE personnel
4	Roles & Responsibility Individual responsibility of the vi) Project Manager vii) Construction Manager viii) Construction Supervisors ix) SHE Committee Members x) SHE in charge xi) Site Engineers xii) First Line Supervisors xiii) Sub-contractors
5	SHE Committee xiv) Details - Chairman, Members, Secretary and Employer's representative, xv) 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	Safe work procedures 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 xiii) Hazardous Chemicals and Solvents xiv) Ionizing Radiation xv) Lighting xvi) 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 Machine
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 behaviors 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	-	-	1
Up to 10	-	1	Refer Note 1	Refer Note 1	1	Refer Note 1
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: 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 CL/ / RL/ Mumba/ / Chennai / Kolkata and Kanpur. vi) B.E / B.Arch., with one-year Full Time 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 CL/ / RL/ / Mumba/ / 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 Public Sector / Leading Private Sector / MNC / with prior approval of employer on 	2 {for category (i), (ii) and (iii) only}

Sl. No	Designation	Qualification	Experience (in years)
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	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 License holder	2
6	Junior SHE (Electrical) Manager	Diploma in Electrical Engineering + Govt. recognized Electrical License 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)	Govt. recognized PG Degree / Degree / Diploma in Traffic / Transportation	1
	Engineer	Engineering or Planning	
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:

- Senior SHE Manager
- Junior SHE Manager
- 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.

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 equipment's are a must for conducting periodical in-house safety presentations in the training programme.				
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

<u>SUGGESTIVE REQUIREMENTS OF SHE MONITORING AND AUDIO-VISUAL EQUIPMENTS</u>					
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:	<div style="text-align: center;">Photo</div> <div style="text-align: center; margin-top: 10px;">Authorized Signatory</div>

BACKSIDE OF ID CARD:

Employee Address: <hr style="border: 0; border-top: 1px solid black; margin-top: 5px;"/>
<div style="border: 1px solid black; padding: 5px;"> <ol style="list-style-type: none"> 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 </div>
<div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: 80%;">Main contractors' Address</div>

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
i) Statutory requirement ii) Appropriate regulations iii) Duties of employer and employee	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
i) i) Safety and efficient production go together ii) Accidents affect morale and public relations	v) Attitudes of management, supervision & operation vi) Methods of achieving safe vii) Operations viii) Accident and injury causes
5. Site Inspection	6. Human Behavior
i) The role of management ii) Hazard Identification Procedure iii) Records results iv) Follow-up procedures v) Feedback	i) Motivating agencies ii) Individual behavior vi) Environmental effects vii) Techniques of persuasion
7. Site housekeeping	8. Health
i) Site organization ii) Relationship of site housekeeping to accident iii) Occurrence iv) Site access v) Equipment storage vi) Material stacking vii) Materials handling	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
i) Eye, face, hands, feet and legs ii) Respiratory protective equipment iii) Protection against ionizing radiation	i) Appreciation of electrical hazards ii) Power tools iii) Arc welding iv) Low voltage system v) Lighting and power system on sites vi) vi) ELCB, RRCB, Grounding/Ground fault circuit interrupters (GFCIs)
11. Oxygen and Acetylene Equipment	12. Equipment
i) Cylinder storage and maintenance ii) Condition and maintenance of valves, regulators, gauges iii) Condition and maintenance of hoses and fittings iv) Pressures	i) Accidents related to moving parts of machinery ii) Appreciation of principles of guarding iii) Importance of regular maintenance
13. Transportation	14. Excavations
i) Transport to and from site ii) Hazard connected with site transport iii) Competent drivers iv) Dumpers v) Tipping trucks vi) Movement near excavations	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) Slings 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) 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/007
SHE TRAINING MATRIX**

Types of training	Management																			Supervisor										Specific																		
	SHE Leadership	SHE Plan	SHE Improvement Plan	Management of Change	SHE Audit & Inspection	SHE Emergency Response & Preparedness	Incident/Accident Investigation & Reporting	SHE Communication	SHE Promotion & Incentives	Traffic Management	Hazard Identification & Risk Analysis	Permit to work system	Confined space entry	scaffolding	Waste Management	Environment Monitoring	Labour welfare measures	Behavioral Based Safety Management (BBSM)	Job/Task Safety Analysis (JSA)	Safety Training Observation Programme (STOP)	Industrial First Aid & CPR	Incident / Accident Investigation & Reporting	Fire fighting	Confined Space Testing & Certification	Scaffold Erection & Inspection	Rigging	Wire Rope Inspection	Crane Inspection	Electrical/Mechanical Isolation	Permit to Work System	Confined Space Working	Explosive Handling & Control	Heavy Lifting Operation	Radiography (X-Ray)	HAZMAT Handling & Control	Welding, Cutting & Bracing	Power Actuated Hand Tool	Electrical/Mechanical Isolation	Roofing Work	Steel erection work	Scaffold Erection/Dismantling	False-work Erection / Dismantling	Painting in Confined Area					
Project Manager	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•																											
Sr. Construct ion Manager	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•					•							•															
Quality Manager	•	•	•	•	•	•	•	•		•	•	•	•	•	•		•	•	•	•	•																											
Planning engineer	•	•	•	•	•	•	•	•			•		•							•																												
Construct ion Manager	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•																		



Types of training	Management																	Supervisor										Specific																		
	SHE Leadership	SHE Plan	SHE Improvement Plan	Management of Change	SHE Audit & Inspection	SHE Emergency Response & Preparedness	Incident/Accident Investigation & Reporting	SHE Communication	SHE Promotion & Incentives	Traffic Management	Hazard Identification & Risk Analysis	Permit to work system	Confined space entry	scaffolding	Waste Management	Environment Monitoring	Labour welfare measures	Behavioral Based Safety Management (BBSM)	Job/Task Safety Analysis (JSA)	Safety Training Observation Programme (STOP)	Industrial First Aid & CPR	Incident / Accident Investigation & Reporting	Fire fighting	Confined Space Testing & Certification	Scaffold Erection & Inspection	Rigging	Wire Rope Inspection	Crane Inspection	Electrical/Mechanical Isolation	Permit to Work System	Confined Space Working	Explosive Handling & Control	Heavy Lifting Operation	Radiography (X-Ray)	HAZMAT Handling & Control	Welding, Cutting & Bracing	Power Actuated Hand Tool	Electrical/Mechanical Isolation	Roofing Work	Steel erection work	Scaffold Erection/Dismantling	False-work Erection / Dismantling	Painting in Confined Area			
Constru tion Supervis	•		•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Constru ction Forema	•	•				•	•				•	•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Machine ry Operator	•					•				•					•						•	•	•			•																				
Material Handler	•					•					•	•	•								•	•	•			•																				
Station Building Workers	•					•						•	•	•	•						•	•	•						•			•				•			•	•	•	•	•	•	•	
Steel workers	•					•						•		•	•						•	•	•			•	•			•			•		•	•		•	•	•	•	•	•	•	•	
Mechani cal workers	•					•									•						•	•	•			•	•			•	•		•			•	•		•	•	•	•	•	•	•	
Other Civil workers	•					•									•						•	•	•			•	•			•	•	•	•		•	•		•	•	•	•	•	•	•	•	•



Types of training	Management																			Supervisor										Specific																			
	SHE Leadership	SHE Plan	SHE Improvement Plan	Management of Change	SHE Audit & Inspection	SHE Emergency Response & Preparedness	Incident/Accident Investigation & Reporting	SHE Communication	SHE Promotion & Incentives	Traffic Management	Hazard Identification & Risk Analysis	Permit to work system	Confined space entry	scaffolding	Waste Management	Environment Monitoring	Labour welfare measures	Behavioral Based Safety Management (BBSM)	Job/Task Safety Analysis (JSA)	Safety Training Observation Programme (STOP)	Industrial First Aid & CPR	Incident / Accident Investigation & Reporting	Fire fighting	Confined Space Testing & Certification	Scaffold Erection & Inspection	Rigging	Wire Rope Inspection	Crane Inspection	Electrical/Mechanical Isolation	Permit to Work System	Confined Space Working	Explosive Handling & Control	Heavy Lifting Operation	Radiography (X-Ray)	HAZMAT Handling & Control	Welding, Cutting & Bracing	Power Actuated Hand Tool	Electrical/Mechanical Isolation	Roofing Work	Steel erection work	Scaffold Erection/Dismantling	False-work Erection / Dismantling	Painting in Confined Area						
Electrical workers	•					•									•						•		•			•				•	•		•									•							
Radiographers	•					•									•						•		•							•	•			•							•								
Transportation	•					•				•					•						•		•											•															
Drivers																																																	
Security Officers	•					•	•			•	•	•		•	•						•	•	•																										
Clerical	•					•									•	•					•	•	•																										
Medical Doctor	•	•	•			•	•							•	•		•				•																												
Sr. SHE Manager		•				•								•		•				•																													
Jr. SHE Manager	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
SHE Supervisors	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

**K-RIDE: RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED GENERAL
INSTRUCTION: K-RIDE/SHE/CEO/008
DAYS TO BE OBSERVED FOR CREATING SHE AWARENESS**

1st Monday to Sunday of January	Road Safety Week (Subjected to confirmation from Ministry of Road Transport, Govt. of India every year.)
16th February	Kyoto Protocol Day
March	Red Cross Month
4th March	National Safety Day
7th April	World Health Day
14th April	Fire Safety Day
April 18 to 22	Earth Week
20th April	Earth Day
20th April	Noise Awareness Day
28th April	ILO World Day for Safety and Health at Work
May 1 to 7	Emergency Preparedness Week
5th June	World Environmental Day
12th June	World Day against Child Labors
9th July	Occupational Health Day
17th October	World Trauma Day
1st 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-V/ Jacket	5	Each 25	Each 50	Each 75	Each 200

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
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	5 types of sizes	Each 25	Each 50	Each 75	Each 200
	messages like SAFE, UNSAFE, FIT FOR USE, AVOID USE etc.	made up of metal sheet to be mounted at different locations				
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
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 Hind/ 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: 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. Moniker Marg Sion, Mumbai- 400 022 Tel: 022- 4092203 Fax: 022 - 4071986 E-mail: cli@dglasli.nic.in	<ul style="list-style-type: none"> • SHE Management / Technical Training
3.	Construction Industry Development Council 801, 8th 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, Swam/ Ramtirath Nagar New Delhi - 110 055 Tel.: 23522835	<ul style="list-style-type: none"> • SHE Management / Technical Training
5.	Det Norske Veritas AS, 203, Savitr/ 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 Link House, Bagadur Shah Zafar Marg Press Area New Delhi - 110 002 Phone: 011 - 23311119	<ul style="list-style-type: none"> • HIV / AIDS 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 6th Floor,	<ul style="list-style-type: none"> • SHE Management Training

Sl. No.	Organization	Services
	90, Dr. Radhakrishnan Salai, Mylapore, Chennai-600 004 Phone: 044-2847 2800, 2847 3752 Fax: 044-2847 3800 Mobile: 9381201040 Website: in.dupont.com	
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 59, 7th Cross, 1st Floor, Ja/ Bharath Nagar, Bangalore-560 033 Phone: 080-2549 6782 E-mail: etgrangan@yahoo.com	<ul style="list-style-type: none"> • SHE Management / Technical Training
11.	HSRTC, PENTASAFE 201, 2nd 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 Lon/ 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, 1st 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 32, Sivaji Marg, New Delhi - 110 015	<ul style="list-style-type: none"> • SHE Practical Field • Training for Welding Safety

Sl. No.	Organization	Services
	Phone: 011 - 51419538, 51419539 Fax: 011 - 51419600 Website: www.Inteutecticwelding.com	
16.	Loss Prevention Association of India Ltd. Warden House, Sir P.M. Road, Mumba/ - 400 001 Website: www.lpaindia.org	• SHE Management / Technical Training
17.	MFA Crucial Moments Healthcare Pvt. Ltd., 42, Okhla Industrial Estate, Phase - I/ New Delhi - 110 020 Phone: 011 - 55624000 Fax: 011 - 55624010 E-mail: contact@crucialmoments.net	• 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	• HIV / AIDS awareness
19.	National Safety Council HQ and Institute Building 98A, Sector 15, industrial Area C.B.D Belapur, Navi Mumba/ - 400614 Phone: 27579924	• SHE Management / Technical Training
20.	NICMAR (National Institute of Construction Management and Research) 910,9th Floor, Hemkunt Chambers, 89, Nehru Place, New Delhi - 110 019 Phone: 011 - 51618415, 51618417, 51618418 Fax: 011 - 51618416	• SHE Management / Technical Training
21.	Quality Growth Services Pvt. Ltd. H-13, Kirti Nagar, New Delhi - 110 015 Fax: 011 - 25431737 / 25438598 / 25918332 E-mail: qgs@qgspl.com Website: www.qgspl.com	• ISO Certification
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	• 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	• SHE Management / Technical Training

Sl. No.	Organization	Services
	Mobile: 9811153873 E-mail: r_k_p@vsnl.net	
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, Savitr/ 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

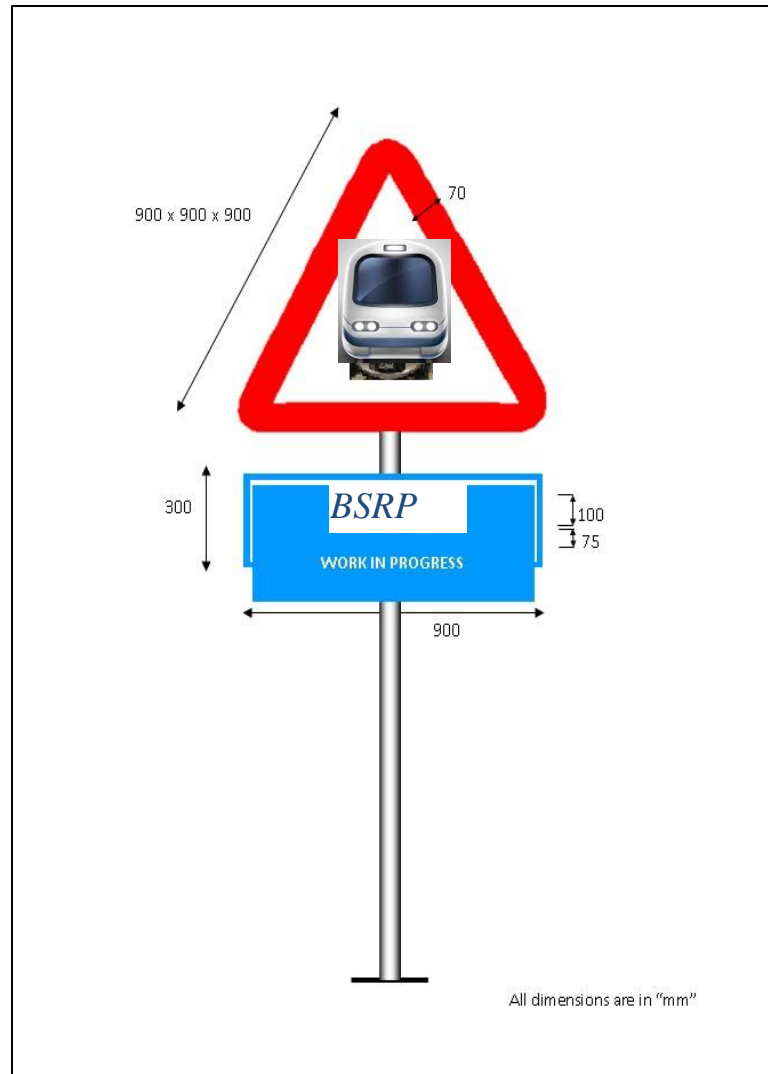
K-RIDE: RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED GENERAL**INSTRUCTION: K-RIDE/SHE/CEO/011****MINIMUM LIGHTING REQUIREMENTS**

Sl. No.	Facility or Function	Luminance - lx (lm/ft²)
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	

CIRCULAR
Committee

The following SHE Committee is constituted with immediate effect: Chairman:

Members:

- 1)
- 2)
- 3)

Secretary:

Periodicity

The committee will meet at least once in a month on the day (specify date)

Agenda

Secretary will circulate agenda of the meeting at least two days in advance of the schedule date of the meeting.

Circulation**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

Date:

Signed By:

CHAIRMAN

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:
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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)

SI No	Item	Done	Not Req'd.	S. No.	Item	Done	Not Req'd.
1	Equipment / Work			1	Equipment water		
2	Surrounding area checked, cleaned and coved			2	Equipment properly steamed / purged		
3	Equipment blinded disconnected / closed isolated / wedge, opened			3	Proper ventilation and lighting provided		
4	Equipment 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:

- 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 __
- 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)**

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 Req.	S. No.	Item	Done	Not Req.
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.		
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.		

Sl. No.	Item	Done	Not Reqd.	S. No.	Item	Done	Not Reqd.
11	Gas test: HCs = %LEL Toxic gas = ppm, O ₂						
12*	Running water hose / Fire extinguisher provided. Fire water system available.			D	For Excavation works		
13*	Area cordoned off and 1 Precautionary tags / Boards provided.				Clearance obtained for excavation / road cutting / Dyke cutting from concerned dept.		

REMARKS:

- 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
- 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.
- 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 jobs 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 anew 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 live conductors to carry out the maintenance work by Section for operational requirement.

Issuer Name_____
Designation_____
Signature-----
Certificate of Isolation: _____ Date: _____ Time: _____

Circuit no. _____ Of _____

Certified that equipment / 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.

S.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 Energization:

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 suppression 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 meters from schools, educational institutions and religious places.
 - 2. Establish green belt zone as required by applicable local requirements;
 - 3. Residential areas and temporary employee housing must be located a minimum of 200 meters from any stone crushing equipment or operations;
 - 4. 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;
 - 5. Operator must establish a reliable source of electricity for powering all mechanical equipment and pollution controls installed at the stone crusher site;
 - 6. 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.
 - 8. Crushing, screening, and conveying operations must be enclosed with sheet metal or other rigid material. Do not use cloth or plastic enclosures.
 - 9. Roadways inside the crusher mill shall be metaled, paved or otherwise treated with chemical suppressants for dust suppression.
 - 10. Waste dust materials from stone crushing operations shall be stored in close containers or closed structures.
 - 11. Lorries exiting the site must be cleaned with shovel and broom to minimize dust being tracked off site.
 - 12. Minimize drop heights to storage piles;
 - 13. Windbreak walls that are at least six times longer than its height shall be in place.
 - 14. Regularly remove and safely dispose of waste materials (rock dust) from the plant site in covered lorries;
 - 15. Fugitive emissions including emissions from stockpiles, conveyors and other areas shall be minimized as far as practicable.
 - 16. 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 suppression	Chemical stabilization	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 hope

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 to allow 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).
 - B. Capture hoods shall be installed over all crusher units and screens. Enclosures shall surround all sources for dust to the extent possible.
 - C. Dust collector shall be connected in-line via an enclosed duct to a cyclone and bag house 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
- 2.4 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. 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.

2.5 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:

- ii) Acrylic polymers;
- iii) Solid recycled asphalt;
- iv) Chloride compounds (calcium chloride and magnesium chloride);
- v) Lignin compounds (lignin sulfate and lignin sulfonate powders);
- vi) Natural oil resins (soybean oil); and
- vii) 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.

2.6 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 area 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.

2.7 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.

2.8 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 at 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:

2.4.2 Whether worker has any detected medical conditions that would place the worker at an increased risk of material health impairment from exposure to silica.

2.4.3 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.

2.4.4 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.

3.3 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 meter (up/Nm³).

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-grams per cubic meter (150 ug/Nm³). 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;
- viii) Location and name of the quarry;
- ix) Proof of registration and consent from the applicable Mining Department;
- x) Proof of registration and consent for operation from applicable Pollution Control Board;
- xi) The supplied material size and quantity (by weight or volume);
- xii) 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

8.3 Temporary equipment shall be cleaned before being taken down and prepared for off- site transport. Clear off all temporary structures and garbage.

8.4 Site restoration

8.5 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

ITEM RATE BOQ PRICE SCHEDULES (FINANCIAL BID)

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**BENGALURU SUBURBAN RAIL PROJECT (BSRP)
PRICE SCHEDULES (FINANCIAL BID)
ITEM RATE TENDER**

Name of Work:**PACKAGE - C4 (Part Work 03)**

“Design & Construction of RCC Box by Cut & Cover method at Channasandra Station location from ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore.”

PREAMBLE TO BILL OF QUANTITIES**1. GENERAL REQUIREMENTS:**

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, Conditions of Contract, Notice Inviting Tender, Particular Specifications, Tender Drawings, Schedule, Annexure, Addendums and corrigendum.
2. The quantities given in the "Bill of Quantities" are approximate and provisional and are given to provide a common basis for Bidding. The basis of payment will be the actual quantities of work executed at site, as measured and verified by the Engineer and valued at the accepted rates in the priced "Bill of Quantities", where applicable.
3. The bidder should quote his rate only in the Financial Bid / Price Bid Summary sheet provided in the Price bid section of the E-Tender Portal and nowhere else in the technical bid section.
4. The same shall be in Indian Rupees both in figures and in words.
5. If knowingly or unknowingly the rate is quoted / indicated anywhere in the Technical submission / uploading of the entire Bid document / Corrigendum / Addendum, the bid will be rejected outright and will not be considered for any further evaluation.
6. The quoted rates are 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, facilities for quality control, 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, preparation of design and drawings pertaining to the 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 and other levies will be payable, Custom tariff act etc. 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 BOQ. Applicable GST shall be paid extra.
7. 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, facilities for quality control, machinery required for execution of work complete in all respects including de-shuttering after completion of work.

8. The entire cost of complying with the provisions of the Contract shall be deemed to have been included in the quoted rates.
9. General directions and description of works and materials are not necessarily repeated or summarized in the Bill of Quantities.
10. The method of measurement of completed work for payment shall be in accordance with the requirements as stated in the individual sections of the Particular Specifications, Employer Requirements & Technical Specifications.
11. Errors will be corrected by the Employer for any arithmetical errors in computation or summation as indicated in Contract Document.
12. Bidder 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.
13. Geo technical data given in is an indicative only for bidding purpose.
14. Identified utilities & unidentified/ buried / hidden utilities (if any left-over) shall be shifted by contractors. Payment for such diversion will be made under relevant payment Schedule. If work is stopped due to unidentified / buried / hidden utilities, no claim shall be entertained on this account.
15. The Bidder's offer shall be inclusive of all taxes and duties payable by them, income Tax and any other statutory taxes (If any) excluding GST, will be deducted by the Employer in accordance with the prevailing taxation act, Income Tax Act and any other acts in force and in accordance with instructions issued by the Authorities, from time to time.
16. Rate quoted shall be exclusive of GST.
17. The item description is intended to briefly describe the work to be performed under that item and to identify associated work. It is not a full and complete description of the work to be performed. The Contractor shall carry out all the work necessary to meet the requirements of the Specification to achieve the intended performance.
18. All items of work mentioned in the Bill of Quantities shall be read and executed strictly in accordance with the description of the item in the Bill of Quantities, Technical Specifications, codes, requirement of the Statutory Authorities etc.
19. The Contractor is required to comply with all the applicable & latest codes and standards, statutory requirement, local, State & Central regulatory authorities as applicable. Complete liaison work related to all approvals, visits, documentation, drawings, expenses, official charges, handling charges etc., is deemed to be included in the offer and no extra payment shall be entertained under any pretext.
20. The rate for each item of work and percentage (above or below or at par) quoted included in the bill of quantities shall unless expressly stated otherwise includes cost of:
 - 20.1 All materials, fixing materials, accessories, hardware, operations, tools, equipment, consumables, and civil works wherever involved and incidentals required in preparation for in the full and entire execution and completion of the work called for in the item as per specification and drawings completely including any wastage of materials and labour.
 - 20.2 Making good all the damages, openings etc., to the civil works/structures done and cleaning while executing the works under this Contract.
 - 20.3 The rate also includes all charges like packing and forwarding charges, handling, loading, unloading, transportation, transit and other insurance, hoisting to all levels, setting and fixing in position, disposal of debris including all other labour, Liabilities, obligations and risks arising out of conditions of contract and Liasoning for obtaining approval from statutory & Local authorities.

- 20.4 -Deleted-
- 20.5 In the event of conflict between the bill of quantities and other documents, the order of priority as indicated in clause 1.5 of Part B – Specific provisions of bid document Section 7 shall be applicable and interpretation of the Engineer in this shall be final and binding.
- 20.6 -Deleted-
- 20.7 Supply of materials shall mean supply of materials at site. The rate for supply shall include all taxes, duties, octroi, and insurance, packing and forwarding charges, transportation and unloading at site.
- 20.8 The contractor shall submit the shop drawings, fabrication drawings with details., to the Engineer for approval prior to supply/commencement of such works. The approval of these drawings will be general and will not absolve the contractor of the responsibility of the correctness of these drawings. At least six copies of the approved drawings shall be submitted to the Engineer for their distribution to various agencies at site at no cost to the Employer.
- 20.9 The contractor must see the site conditions such as type of soil, locations etc., and take all factors into consideration while quoting in the BOQ as no extra cost will be allowed on any ground arising out of or relating to the site conditions.
- 20.10 Any error in description or in quantity or omission of items from the contract shall not violate this contract but shall be corrected and deemed to be a variation required by the Engineer.
- 20.11 All testing and calibrating charges for the Meters shall be included in the installation price of the Meter Cubicle.
- 20.12 -Deleted-
- 20.13 The contractor shall take into account the expenses of pre-commissioning tests to be conducted as per specification of the complete installation by licensed agencies.
- 20.14 The stages of Schedule F to be considered for design and drawing submission and Approval.
21. Important Notes to Bidders:
1. The bidder should quote his total amount in Summary of Price Schedule against Schedule -A, Schedule - B, Schedule - C, Schedule –D, Schedule -E and Schedule -F. In the financial bid section, the bidders should enter in the template provided for abstract of amount of all schedules (Summary sheet) by filling in the last column of quoted INR against each of the schedules which shall be inclusive of all the taxes, duties, levies, cess, etc. Excluding GST.
 2. The bidder should quote the amount in **Schedule - A to F (Schedule E will be the Fixed Provisional cost)** in the "Financial Bid" envelope of e-tender portal.
 3. The **Schedule “E”** is **Fixed Lump sum** provision for incidental and unforeseen items likely to occur during the execution of work. Whenever KPWD items are not available other department items (i.e. SWR -USSOR / CPWD / BESCOM / KPTCL / BWSSB) shall be considered as per sequence of priority and with the approval of Employer. If the same item is available in all schedules of rates given above, then the priority of schedule of rates is as follows: a) KPWD; b) SWR-USSOR; c) CPWD; d) BESCOM; e) KPTCL; f) BWSSB If SR rate 2021-22 or latest.
 4. The **Schedule “F”** is Lumpsum cost for Detailed Design & Engineering of all Civil and Structural works.
 5. For comparison of the quoted bid price by the bidders, the grand total of the quoted amount from all Schedules (i.e. **schedule “A” to Schedule “F”**) shall be taken into consideration.
 6. Employer reserves the right to omit / partially execute any items in any of the **Schedules** during construction without any liability to either party.
 7. In the financial bid section, the bidders should enter in the template provided for abstract of amount of all schedules (Summary sheet) by filling in the last column of quoted INR against each of the schedules which shall be inclusive of all the taxes, duties, levies, cess, etc. (Excluding GST).

2. EXPLANATORY NOTES FOR 'BILL OF QUANTITIES' (BOQ)

2.1 General

- 2.1.1 The Contract includes the following but is not limited to:
The revision of design, verification of site data, drawings, programs for execution, schedule of ordering, schedule of receipt.

2.2 – Deleted -

2.3 Tender Prices

The Tenderer's attention is drawn to the following facts while quoting the prices for the Contract:

- 2.3.1 The prices (including percentage above or below or at par) quoted in the Bill of Quantities shall be inclusive of all applicable duties and any other charges leviable excluding GST.

A BOCW cess at the rate as specified by 'The Building and Other Construction Workers Welfare Cess Act, 1996, of the Total Bill Amount shall be deducted from each Interim Payment Certificate (IPC) of the Contractor.

- 2.3.2 The prices (including percentage above or below or at par) quoted in the Bill of Quantities and accepted by the Employer shall be 'fixed' throughout the Contract Period and are not subject to variation on any account.

2.3.3 **DELETED**

2.3.4 **DELETED**

2.3.5 **DELETED**

2.3.6 **Record of Taxes & Duties**

The Contractor shall maintain complete records in respect of payments made by them for taxes and duties payable to various authorities (except Income Tax or Corporate Tax) and advise the Employer the summary of such payment every month in a format advised by the Employer during execution of the contract.

The detailed records shall however remain open for inspection by the Employer/ Engineer at any time and copies of the records shall be furnished as required by the Employer.

The amount payable/recoverable from the Contractor will generally be calculated based on these records along with supporting documents. However, Employer at his sole discretion, if not satisfied with the veracity of records or records are incomplete or otherwise, may separately determine the amount payable/recoverable from the contractor in accordance with the conditions of the Tender, which shall be final and binding.

The Contractor shall also maintain records of the imported components supplied to local manufacturers and actual utilization of the same in the manufacture of complete equipment. The Contractor shall be fully responsible for any loss or misuse of these components in manufacture of equipment's.

The contractor shall submit the copies of the monthly returns filed, once in three (3) months to ascertain the status of GST refunded claimed on account of inverted duty structure.

The Contractor shall furnish along with the 2nd and subsequent IPCs copies of all the purchases of Goods and Services made within the State of Karnataka in the format prescribed and furnish the details to the Employer, if any required, for claiming reimbursement of state taxes from the Govt. of Karnataka as per approved funding pattern for the project.

2.3.7 **Statutory Clearance**

The Contractor shall be solely responsible for discharging all the statutory payments to the authorities concerned including custom duty, IGST, GST and Income tax, etc.

2.4 Quantities

- 2.4.1 For the purpose of this Contract, all unit quantities given in the Bills of Quantities and in tender drawings are the estimated quantities (Tentative) of the Works and are intended in the first instance to provide a common basis for Tendering and Tender Evaluation. Quantities may vary as per the site conditions and actual quantity to be procured after preparation of shop drawings and approval of the same. When a Contract has been entered into, the function of the Priced Bill of Quantities is to provide for the valuation of the work executed. No alteration of any rate or price shall be allowed on account of any difference between the quantities billed and the actual quantities measured from the drawings.
- 2.4.2 The Tenderer shall make himself completely acquainted with all conditions, obligations, specifications, drawings, etc.; of the Tender Documents before quoting his prices. He shall have no right to claim any price revision on the basis of ignorance of the Tender Documents or local conditions, or to make any claims as regards the integrity of the unit prices of the Bill of Quantities.

2.5 Units and Currency

- 2.5.1 All sizes and quantities entered in the Bills of Quantities are in metric units.
- 2.5.2 The currency to be used in the Contract will be Indian Rupees only. The Tenderer shall fill in each column with unit rate or lump-sum as the case may be, for each item of the Bill of Quantity, on the basis of the Tender documents and pre-tender survey. The prices (including percentage above or below or at par) quoted in the Bill of Quantities are for completed and finished items of work and complete in all respects, it is considered to have included all constructional plant, tools, materials, machinery, labour, supervision, fuel, oil, consumables, electric power, water, transportation, all leads and lifts, dewatering, all temporary works, false work, form work, construction of temporary stores and buildings, fencing, watering, lighting, erection, maintenance, night working, inspection facilities, safety measures at worksites, road users overhead charges, labour camps, insurance costs for labour and works, overheads, profits etc.;
- 2.5.3 Any cutting/overwriting/striking off in Bill of Quantities shall be initialled by the authorized representative of the Tenderer before submission of Tender without which it will not be taken into consideration by the Employer.

2.6 Rates & Sums to be for Work Finished Complete

- 2.6.1 Tenderers shall be deemed to have read the Employer's Requirements and other parts of the Tender Documents and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices and shall be deemed to include the full scope of the Contract, including overheads and profits and shall bear a proper relationship to the cost of carrying out the work described.
- 2.6.2 Notwithstanding any limits that may be implied by the wording of the individual items and/or the explanations in the Preamble, the rates and prices, which are entered in the Bill of Quantities, shall be for the work finished complete in every respect.
- 2.6.3 The Tenderer shall be deemed to have taken full account of all requirements, liabilities, obligations and risks, whether expressed or implied, and to have priced the items accordingly. The Items in the Bills of Quantities are the only items against which payment will be made. The cost of any item of work not specifically described or measured in the Bills of Quantities but required for the execution of the Contract shall be included in the rates and prices for the measured items in the Bills of Quantities. The rates and prices shall therefore include for all incidental and contingent expenses and risks of every kind necessary to supply, install, test and commission (including Integrated Testing and Commissioning) complete, and remedying any defects in the whole of the Works in accordance with the Contract.

2.7 Allowances in Rates and Prices

- 2.7.1 Full allowance shall be made in the prices against the various items in the Bills of Quantities for all costs involved in performing the following except to the extent that work is specifically described and paid for in the Bills of

Quantities. The list below is not exhaustive and the Tenderers are expected to take all costs involved while quoting the rates and prices that will not be subject to variation on any account.

- a) all setting out and final survey work;
- b) temporary access roads and bridges, fencing, watching and security, lighting.
- c) paying fees (subject to GCC / PCC clauses) and giving notices to Authorities;
- d) payment of all patent rights and royalties;
- e) reinstatement of the Site;
- f) safety precautions and all measures to prevent erosion and suppress fire and other hazards;
- g) interference to the Works by persons, vehicles, and the like being legitimate users of the facilities on or in the vicinity of the Site;
- h) the protection and safety of the Employer trains and services;
- i) the protection and safety of Railway trains and services on adjacent tracks;
- j) supplying, maintaining and removing on completion, the Contractors own accommodation, offices, depots, stores, workshops, transport, welfare services and other facilities including telephones and facsimile machines and all charges in connection therewith;
- k) the supply, inspection, testing, packaging and transportation of materials and of the Works as specified including the provision and use of equipment and arrangements for the Engineer's Inspectors and others;
- l) maintaining public thoroughfares and footpaths, and maintaining access upon existing recognised routes;
- m) providing, transporting to the Site, setting to work, operating (including all fuel and consumable stores), maintaining and removing from the Site upon completion all Construction Plant and Contractor's Equipment necessary for the execution of the Works and including the cost of all tests and other requirements in respect of such; plant and equipment;
- n) working adjacent to or across existing services and installations;
- o) complying with the requirements of the Employer in regard to Safety and Health, Quality Assurance, Environmental and project implementation plans and making periodical submissions;
- p) co-ordination and interference to the Works by the works of Designated Contractors and others employed by the Employer being legitimate users of the facilities on or in the vicinity of the Site;
- q) remedying of defects and shrinkage, and works of amendment, reconstruction, replacement of other faults, fair wear and tear excepted, during Defects Liability Periods;
- r) Insurance, including all risks in supply, erection, storage, transit, third party, Workmen's Compensation and others;
- s) All tools, and equipment required for all tests prior and after delivery and for testing and commissioning installed systems;
- t) Carrying out all modifications to the given drawings, preparing construction detailed drawings and supplying originals, copies, and electronic files in accordance with employer's requirement.
- u) Marine Insurance
- v) All risk Insurance after arrival of goods in India
- w) Custom clearance / Port Clearance (if applicable)
- x) Handling at Port of arrival in India (if applicable)
- y) Inland transportation from port of arrival or manufacturer's works to site of work
- z) Various bank guarantees / warranties/undertakings.

2.8 Tender Pricing

2.8.1 The Tenderer shall take regard of the actual site conditions and the estimated quantities entered in the Bill of Quantities. The Tenderer shall price his tender accordingly and the rates and prices entered against a line item shall be the full and only price paid for all work performed against that item except as described in the Tender Documents.

- 2.8.2 Not used.
- 2.8.3 The Tenderer shall quote the rates and prices in words as well as in figures. Any cutting/overwriting in Bill of Quantities shall be initialled by the authorized representative of the Tender.
- 2.8.4 Items against which no rates or prices are indicated in the Bill of Quantities, will not be paid for by Employer when executed and shall be deemed to have been covered in the rates of other item/s and prices in the Bill of Quantities.
- 2.9 Measurement and Payment**
- 2.9.1 This Contract is primarily a re-measure contract with items that are described herein. For the re-measure items, the total price paid for a work item will be varied by the quantities actually performed. The quantities indicated in the BOQ and tender drawings are tentative quantity may vary as per the site conditions and actual quantity to be procured after preparation of shop drawings and approval of the same. The final quantities shall be based on quantities actually executed, measured and certified as per approved built drawings by the Engineer.
- 2.9.2 The measurement and payment described is for the purpose of making a valuation of the work acceptable to the Engineer, and Interim Payments to the Contractor, as work proceeds. All interim payments shall be without prejudice in accordance with relevant clause of GCC and PCC. The Works as executed will be measured for assessment of progress for interim payments in accordance with the method adopted in the relevant standard/Specification, the Bills of Quantities and under the items as set forth notwithstanding any custom to the contrary.
- 2.9.3 Deleted.
- 2.9.4 Notwithstanding anything stated herein, the Engineer retains the right to withhold payment on any pay item due for payment when the works to be performed are not performed or are not carried out to the Engineer's satisfaction in accordance with Specifications and Drawings.
- 2.9.5 Payment for items shall include for all costs incurred in procurement/manufacture, testing, inspection, shipping, hauling, off-loading, storing at site in Bangalore, installation, testing and commissioning including integrated testing and commissioning.
- 2.9.6 -Deleted-
- 2.9.7 -Deleted-.
- 2.10 -Deleted-.

--- XXX ---

Section 9: Price Schedule (Financial Bid)

Name of Work:

PACKAGE - C4 (Part Work 03)

“Design & Construction of RCC Box by Cut & Cover method at Channasandra Station location from Ch:24+242 to 24+600 along the Corridor-4 Heelalige to Rajankunte. Bangalore.”

PROPOSED CONSTRUCTION OF SINGLE CELL CLOSED RCC BOX BY CUT & COVER METHOD AT CHANNASANDRA STATION LOCATION FROM CH:24+242 TO 24+600						
Summary Of Abstract						
			Total of Each Schedule	Total Amount		
Sr. No.	Schedule	Unit	Amount	In Figure	In Words	Remarks
1	Schedule-A - Earthwork / Piling Excavation, Haulage, Ground Improvement, etc.	Rs	6,10,53,539			
2	Schedule-B - Cast-In-Situ Concrete works Concrete, Erection, etc.	Rs	11,51,82,549			
3	Schedule-C - Steel / Structural Steel works Reinforcement Steel.	Rs	19,93,94,223			
4	Schedule-D - Other Works. Dismantling, DBM, BC, WMM, GSB, Water Proofing, Culvert Protection, etc.	Rs	1,03,88,199			
5	Schedule-E - Items Not Covered in Schedule A to D. Any other items not covered in above Schedules are to be executed under Common SR for year 2023-24 or latest applicable published by IR-USSOR (2021-22) / KPWD / CPWD / BESCOM / KPTCL / BWSSB as per order of priority.	Rs	84,74,576	84,74,576		
	Total (A+B+C+D+E)-BOQ Items	Rs	39,44,93,086			
6	Schedule-F - Design Charges	Rs	71,00,876			
	Total (A+B+C+D+E+F)-BOQ Items	Rs	40,15,93,962			

PROPOSED CONSTRUCTION OF SINGLE CELL CLOSED RCC BOX AT CHANNASANDRA STATION LOCATION FROM CH:24+242 TO 24+600					
Item no.	Description of items	UO M	Estimated Qty	Estimated Rate	AMOUNT
	SCHEDULE-A - EARTHWORK / PILING				
1	Diagonal Cross trenching works for identifying underground utility at every Pier locations to the required length, width and depth, as per drawing, 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 rate 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.				
	Taking the trial pit for roads, alignment, C.D. Works in earth soil of all sorts, sands gravel, or soft murum, including stacking the excavated material including all lifts and necessary back filling upto depth 3.0 m	Cum	1,709.0	490.00	8,37,410
2	Earthwork in excavation by mechanical means (Hydraulic Excavator)/Manual Means for foundations and floors of the bridges, retaining walls etc. including setting out, dressing of sides, ramming of bottom, getting out the excavated material, back filling in layers with approved material and consolidation of the layers by ramming and watering etc. including all lift, disposal of surplus soil up to a lead of 300m , all types of shoring and strutting with all labour and material complete as per drawing and technical specification as directed by Engineer in charge. Note: This item will be used for excavation work in connection with other miscellaneous works also like side drains, foundation for OHE masts and other miscellaneous structures in connection with Gauge Conversion, Doubling, New lines.				
2.1	All kinds of soils	Cum	45,365.18	188.75	85,62,678
2.2	Soft rock (not requiring blasting)	Cum	5,041.06	390.47	19,68,381
3.0	Haulage of Excavated Soil - 10 KM Considered				
3.1	Cost of Haulage excluding loading and Unloading (1cum = 1.8t)	T.KM	6,26,368.00	13.20	82,68,058
	Taking output 10 t load and lead 10 km = 100 t.km				
3.2	Loading and Unloading of Stone Boulder/Stone aggregates/Sand/ Kankar/Moorum. (Tipper 10 m3)	cum	34,798.20	130.90	45,55,084
	Conducting in-situ full size Plate Load Test (PLT) at selected location as per IS:1888 including making loading arrangements & casting of RCC/cast in-situ concrete footing as per codal provisions including				

	excavation and refilling of trial pit. Conducting SCPT for soil as per IS:4968				
3.3	Plate Load Test	Nos	2.00	55,000.00	1,10,000
4	Ground Improvement				
4.1	Boulder Laying Providing and laying 300mm thick (average) Dry Stone flooring with boulders of not less than 35kg each in weight, hand packed with surface levelled off to the correct section with hammer dressing as necessary on the ground including filling the gaps with quarry spalls and ordinary sand complete including cost of supply of all materials, labour, lead, lift, tools, plants, crossing of tracks and the like as per drawing and technical specification as directed by Engineer in charge.	Cum	2,535.00	1,940.60	49,19,421
4.2	Coarse Sand Laying Supply and laying of coarse sand including consolidation with all Slabour, lead, lift, tools, plants, crossing of tracks as per drawing and technical specification as directed by the Engineer in charge in case loose slush is encountered at site of foundation before casting the foundation or laying the filtering media.	Cum	1,267.00	2,309.52	29,26,162
5	Bored cast-in-situ M35 grade R.C.C. Pile excluding Reinforcement complete as per Drawing and Technical Specifications and removal of excavated earth with all lifts and lead upto 1000 m.				
5.1	Pile diameter-750 mm	m	2,848.00	10,149.70	2,89,06,346
	Total of Schedule-"A"				6,10,53,539
	SCHEDULE-B: CAST-IN-SITU WORKS				
1	Providing and laying in position Cement Concrete for all Sub structures of building, Irrigation works, Sub structure works of bridges, Drain works & other parallel works from 0.50m to 3.50 m height. The granite/trap/basalt crushed graded coarse aggregates and fine aggregates as per relevant IS Codes machine mixed with super plasticisers, laid in layers, well compacted using needle vibrators, providing weep holes wherever necessary, including all lead & lifts, cost of all materials of quality, confirming to the requirements of relevant IS codes, labour, Usage charges of machinery, curing and all other appurtenances required to complete the work as per technical specifications.				
1.1	M20 Design Mix Using 20 mm nominal size graded crushed coarse aggregates (PCC)	Cum	612.00	6,955.30	42,56,644
1.2	M35 Design Mix Using 20 mm nominal size graded crushed coarse aggregates (Reinforced Cement Concrete M35 Substructure (upto 3.5m height)	Cum	5,599.00	7,792.40	4,36,29,648
	Formwork For Staging				
	Bottom Raft (Add Centering - Open Foundation 4%)	Cum	3,865.98	311.70	12,05,024
	Bottom Haunch (Add Centering - Open Foundation 4%)	Cum	22.00	311.70	6,857
	Wall After Raft (Add Centering - Culverts (Head walls) 8%)	Cum	1,489.00	623.39	9,28,228
	Drain Wall (Add Centering - Cement Concrete Drain Walls 35%)	Cum	64.00	2,727.34	1,74,550

1.3	M35 Design Mix Using 20 mm nominal size graded crushed coarse aggregates (Reinforced Cement Concrete M35 Substructure (above 3.5m height)	Cum	2,320.00	7,792.40	1,80,78,368
	Formwork For Staging				
	Wall After 3.5m Height to 5m (Add Centering - Culverts (Head walls) 8%)	Cum	2,320.00	623.39	14,46,265
1.4	M35 Design Mix Using 20 mm nominal size graded crushed coarse aggregates	Cum	3,889.00	7,792.40	3,03,04,644
	Formwork For Staging				
	Top Slab & Haunch (Add Centering - RCC Roof Slabs 50%)	Cum	3,889.00	3,896.20	1,51,52,322
	Total of Schedule-"B"				11,51,82,549
SCHEDULE-C: STEEL / STRUCTURAL STEEL WORKS					
1	Supplying, fitting and placing TMT FE 550 / 550D Steel Reinforcement including cost of all materials, machinery, labour, cleaning, straightening, cutting, bending, hooking, laping/welding joints, tying with binding wire / soft annealed steel wire and other ancillary operations complete as per drawing and technical specification.				
1.1	Sub structure of Bridges - Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete. Thermo-Mechanically Treated bars of grade Fe-500D or more.	MT	1,542.78	95,076.30	14,66,81,890
2	Supplying fabricating and erecting welded and/or bolted and/or riveted steel work in built up sections, trusses and framed work, staging, racks, Height Gauge etc. for Steel Structures other than bridge girders, using RSJ, tees, angles and channels/flats, plates, ussets, round or square bars, cleats, bolts etc., with contractors own steel including cutting, bending, straightening, drilling, riveting, hoisting, fixing, erecting, welding, bolting etc., with Providing stiffeners wherever required as per approved drawing including applying a priming coat of a approved steel primer with all contractor's materials, labour, tools & plants, lead & lift including crossing of tracks if required etc., complete as per specification and as directed by Engineer-in-charge. Note: The payment shall be made on the theoretical weight of main components and gusset plates only.	MT	520.00	1,01,369.87	5,27,12,332
	Total of Schedule-"C"				19,93,94,223
SCHEDULE-D: OTHER WORKS					
PRELIMINARIES AND GENERAL					
1	Providing and applying two coats of coal tar or bitumen conforming to IS:3117- latest version on the top and sides of RCC box/slabs @ 1.70 kg/sqm after cleaning the surface with all labour and materials complete job as directed by the Engineer.	Sqm	10,059.76	168.85	16,98,591
2	High Density polyethylene Membrane water proofing: Providing and laying water proofing treatment to the Rafts, Below grade slab, Lift pits, water retaining structures with fully bonded High Density Polyethylene Membrane (HDPE) of 1.2mm composite thickness and	Sqm	3,866.00	665.50	25,72,823

	having tensile strength of >25 MPa (as per ASTM D 412), elongation of >500% (as per ASTM D 412), puncture resistance of >1000N (as per ASTM E 154), peel adhesion to concrete >1200N/m (as per ASTM D 903), hydrostatic head resistance >70m (as per ASTM D 5385). The system should be fully bonded to the RCC thereby conforming to IS 16471:2017 requirements of UG waterproofing structures. The membrane should be minimum 2.4m wide to reduce the number of joints with minimum 75mm factory made selvedge's and comprising of an HDPE layer and a pressure sensitive adhesive layer which is covered by a weather proof protective and trafficable granular layer to protect self-adhesive polymer layer, etc, including surface preparation completely as per specification.				
3	Prime Coat over WMM/WBM: Providing and applying primer coat with SS1 grade Bitumen Emulsion on prepared surface of granular base including cleaning of road surface and spraying primer at the rate of 0.70 kg/m ² using mechanical means.	Sqm	1,400.00	45.10	63,140
4	Tack coat on Bituminous surface: Providing and applying tack coat with RS1 Bituminous Emulsion using emulsion pressure distributor at the rate of 0.20 kg/m ² on the prepared bituminous surface cleaned with mechanical broom	Sqm	1,400.00	13.20	18,480
5	Bituminous Concrete Grading ii for traffic >20 MSA: Providing and laying Bituminous Concrete with 120 TPH capacity hot mix plant batch type using crushed aggregates of specified grading, premixed with bituminous binder VG-40, @ 5.4 per cent of mix and filler, transporting the hot mix to work site, laying with mechanical paver finisher to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MORTH specification clause No. 507 complete in all respects	Cum	70.00	12,566.40	8,79,648
6	Dense Graded Bituminous macadam Grading - ii for traffic >20 MSA: Providing and laying Dense Graded Bituminous Macadam with 120 TPH capacity HMP batch type using crushed aggregates of specified grading, premixed with bituminous binder VG-40, @ 4.5 per cent by weight of total mix and filler, transporting the hot mix to work site, laying with mechanical paver finisher to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRTH specification clause No. 505 complete in all respects.	Cum	105.00	10,829.50	11,37,098

7	Wet Mix Macadam (Plant Mix Method): Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver/grader in sub-base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.	Cum	420.00	2,814.90	11,82,258
8	Granular Sub-base - Grading III: Construction of Granular Sub-Base by Mix in Place Method by providing well graded Gravel, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with smooth wheel roller to achieve the desired density, complete as per Technical Specification.	Cum	420.00	1,569.70	6,59,274
	Dismantling of Structures: Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead.				
9	Prestressed / Reinforced cement concrete grade M-20 & above	Cum	79.00	2,634.50	2,08,126
10	Dismantling of flexible Pavements Dismantling of Flexible pavements and disposal of dismantled materials and stacking serviceable and unserviceable materials separately.				
10.1	Bituminous course	Cum	105.00	354.20	37,191
10.2	Granular courses	Cum	770.00	58.30	44,891
11	Portable Barricade in Construction zone				
	Installation of a steel portable barricade with horizontal rail 300 mm wide, 2.5 m in length fitted on a 'A' frame made with 45 x 45 x 5 mm angle iron section, 1.5 m in height, horizontal rail painted (2 coats) with yellow and white stripes, 150 mm in width at an angle of 45 degree, 'A' frame painted with 2 coats of yellow paint, complete as per IRC:SP:55:2014.	m	716.00	1,622.28	11,61,552

12	Boring of 150 mm dia. (confirmatory bore holes), in all types of soil at selected Pier locations (Locations to be decided by the Engineer) 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 rate 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 with in three to six months of possession of site by Contractor.	m	70.00	2,210.81	1,54,757
13	Providing and fixing in position 20 mm thick premoulded joint filler in expansion joint for fixed ends of simply supported spans not exceeding 10 m to cater for a horizontal movement upto 20 mm, covered with sealant complete as per drawing and technical specifications.	m	628.00	254.10	1,59,575
14	Clearing and grubbing land , embankment/cutting area, existing slope and clearing of garbage from the existing slope, drain before starting the earthwork including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth upto 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.	Sqm	4,608.00	3.74	17,234
15	Kerb Stones				
	Supplying and fixing M15 grade precast cement concrete Kerb stones for Roadway, Sidewalls and gutters fixed with CM 1:3 fixed and finished in line as per direction of Engineer in charge. (The cost of PCC shall be paid extra)				
	600 x 300 x 150 mm size	m	59.00	509.30	30,049
16	Precast Cement Concrete interlocking Blocks				
	Manufacturing, supplying and laying factory made CC block pavers for road surface of level crossings to RDSO Drg. No. M.00003, manufactured using 20mm size graded hard stone aggregates of approved quality over a well compacted sand bedding 50 thick with all contractor's cement, labour, tools/plant and curing with all lead & lift as per specifications and as directed by Engineer in-charge. 120mm thick blocks of M-40 grade for heavy traffic.	Sqm	59.00	1,593.87	94,038
17	Painting lines, Dashes, arrows etc on Roads in Two Coats on New work				

	Painting speed breakers with paint of approved quality & colour over the Bituminous/ Concrete surface near approaches to level crossing. With Hot melt thermoplastic road marking paint	Sqm	18.00	120.84	2,175
18	Reinforced Cement Concrete Crash Barrier (New Jersey)				
	Provision of an Reinforced cement concrete new jersey crash barrier at the medians constructed with reinforcement cement concrete with TMT FE 550 reinforcement conforming MoRTH Specification and as per details given IRC:119 (Fig-6) including dowel bars 25 mm dia, 450 mm long at expansion joints filled with pre-moulded asphalt filler board, as per approved drawing and at locations directed by the Engineer, all as specified				
	M 30 grade concrete	m	90.00	2,970.00	2,67,300
	Note: i) Excavation and backfilling are incidental to work and not to be measured separately. ii) If PCC is required below crash barrier then it should be measured & paid separately				
	Total of Schedule-"D"				1,03,88,199
SCHEDULE-E: ITEMS UNDER SCHEDULE OF RATE PUBLISHED BY GOVERNMENT DEPARTMENTS					
1	Items not covered in any of the above schedules A to D to be executed under Schedule of Rates 2018-19 published by Government Department . KP WD/ NHR/ CPWD/ BWSSB/ BSCOM Note:(i) If the same item is available in all the Schedule of rates given above then the priority of schedule of rates is as follows: 1. KPWD, 2. NHR, 3. CPWD, 4. BWSSB, 5. BSCOM . (ii) If SR 2018-19 is not available then the previous SR rate may be adopted	LS	84,74,577.00		
	Total of Schedule-"E"				84,74,577
	Total (A+B+C+D+E)-BOQ Items				
	Total of Schedule-"F"				
	Design Charge at 1.8% of schedule A to E	LS	1	71,00,876	71,00,876
	Grand total (A+B+C+D+E+F)-BOQ Items				40,15,93,962

Schedule - F

Lumpsum cost for Detailed Design & Engineering of all Civil, Structural and other allied Works as per the scope of work / Employers Requirements.

The payment of Hundred percent (100%) for Detailed Design & Engineering of all Civil, Structural, and other allied Works as per the scope of work / Employers Requirements shall be governed by the stage payment schedule as detailed below:

S. No.	Description of Stage	Payable Unit	Percentage Breakup of "P"
P1.1	Provision of the Employer/Engineer IT requirements of (online Project Management Information System, Document Management System, Enterprise work program platform, BIM & all other design related software's for which contractor has carried out the design works.) Notes: 1. 30% of the apportioned payment under this Milestone (i.e. 30% of 7%) shall be released after the providing 2 Nos of Laptops, necessary hardware, IT centre and software licenses are provided by the Contractor. This should be accomplished not later than 1 month from Commencement Date. 2. 50% of the apportioned payment under this Milestone (i.e. 50% of 7%) shall be equally spread over 11 months or till completion of works. The remaining 20% payment shall be released on completion of all work through the Defects Notification Period.	Lump Sum	8.00%
P1.1	Engineer approval of Design Plan	Lump Sum	3.00%
P1.2	Engineer's approval of design team	Lump Sum	2.00%
P1.3	Design Submission Programme, Design Statement and Design Deliverables	Lump Sum	1%
P1.4	Design Checking Plan	Lump Sum	1%

S. No.	Description of Stage	Payable Unit	Percentage Breakup of "P"
P1.5	Submission of Preliminary Structural Design, GAD, CAD Manual and DBR	Lump Sum	10.00%
P1.6	Submission of Final Structural Design, GFC Drawings and BIM To be paid on pro-rata basis depending upon progress as certified by the Engineer.	Lump Sum	50.00%
P1.7	Submission of utility identification and proposed diversion report and submission of the report and approval.	Lump Sum	5.00%
P1.8	Submission of all As Built Drawings, BIM and O&M Manuals Including interface of civil and structural.	Lump Sum	18.00%
P1.9	Training of Employer's Personnel, in compliance with the Employer's requirements	Lump Sum	1.00%
P1.10	Submission of Insurance Premium Receipts and Insurance Policies as per the Contract Requirement – Professional Liability insurance	Lump Sum	1.00%
	Total		100%

Note:**Schedule of Payments for design & engineering works (Schedule F)**

1.	The Schedule of Payments for schedule F will not be modified. The percentages stipulated in Schedule of Payments (F) of Pricing Document shall be sub-divided upon award of the Contract with the approval of the Engineer / Employer, and his decision in this regard shall be final and binding. The payment shall be governed based on the actual works executed. Payments against the works will be made on the basis of quantities executed, measured and certified by the Engineer.
2.	The quantity schedule after being approved by the Engineer will be used for making all interim payments. The Contractor should note that while interim payment will be governed by the quantity schedule, total cost of the 'Lump Sum' component would remain unchanged for the specified work.
3.	The quantity schedule after being approved by the Engineer will be used for making all interim payments. The Contractor should note that while interim payment will be governed by the quantity schedule, total cost of the 'Lump Sum' component would remain unchanged for the specified work.
4.	Payment will be made on the submission of the IPC with quantity schedule versus progress achieved for review and certification and recommendation of the Engineer for various items.
5.	Further bifurcation/redistribution/minute distribution of price centres, if need be, within the overall % age or amongst sub works will be the right of Engineer/Employer. The decision of Engineer/Employer is final in this regard and the same is binding on the contractor.

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.

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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 ₹. _____ [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, 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.
- 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,
"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, 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. His 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 ₹. *[....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 its 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 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.
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

For each Installment of Advance, individual JV 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

For each Installment of Advance, individual JV 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 ₹. _____ (*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 ₹. _____ (*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 ₹.. _____ (*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:

--00--00--00--

Annexure IX-B**Arbitration & Conciliation Procedure****1. No Legal action till Dispute Settlement Procedure is exhausted.**

Any and all Disputes shall be settled in accordance with the provisions of Dispute Resolution Clause. No action at law concerning or arising out of any Dispute shall be commenced unless and until all applicable Dispute Resolution Procedures shall have been finally exhausted in relation to that Dispute or any Dispute out of which that Dispute shall have arisen with which it may be or may have been connected.

2. Notice of Dispute

For the purpose of this Sub-Clause, a Dispute shall be deemed to arise when one party serves on the other party a notice in writing (hereinafter called a "Notice of Dispute") stating the nature of the Dispute provided that no such notice shall be served later than 30 days after the date of completion of Contract.

3. Two Stages for Dispute Resolution

Disputes shall be settled through two stages:

- a) Conciliation procedures as established by "The Arbitration and Conciliation Act-1996" & amended by the Arbitration & Conciliation (Amendment) Act, 2015 and any statutory modification or re-enactment thereof and in accordance with this clause. In the event this procedure fails to resolve the Dispute then;
- b) Arbitration procedures undertaken as provided by "The Arbitration and Conciliation Act-1996" & amended by the Arbitration & Conciliation (Amendment) Act, 2015 and any statutory modification or re-enactment thereof and in accordance with this clause.

4. Conciliation

Within 60 days of receipt of Notice of Dispute, either party shall refer the matter in dispute to conciliation. Conciliation proceedings shall be initiated within 30 days of one party inviting the other in writing to Conciliation. Conciliation shall commence when the other party accepts in writing this invitation. If the invitation is not accepted, then Conciliation shall not take place. If the party initiating conciliation does not receive a reply within 30 days from the date on which he sends the invitation, he may elect to treat this as a rejection of the invitation to conciliate and inform the other party accordingly.

The Conciliation shall be undertaken by one Conciliator selected from a panel of Conciliators maintained by the Employer. The Conciliator shall assist the parties to reach an amicable settlement in an independent and impartial manner.

5. Conciliation procedure

The Employer shall maintain a panel of Conciliators, who shall be from serving or retired Engineers of Government Departments, or of Public Sector Undertakings. Out of this panel, a list of three Conciliators shall be sent to the Contractor who shall choose one of them to act as Conciliator and conduct conciliation proceedings in accordance with "The Arbitration and Conciliation Act, 1996" of India & amended by the Arbitration & Conciliation (Amendment) Act, 2015 and any statutory modification or re-enactment thereof. There will be no objection if conciliator so nominated is a serving employee of the Employer who would be Deputy HOD level officer and above. The Employer and the Contractor shall in good faith co-operate with the Conciliator and, in particular, shall endeavour to comply with requests by the Conciliator to submit written materials, provide evidence and attend meetings. Each party may, on his own initiative or at the invitation of the Conciliator, submit to the Conciliator suggestions for the settlement of the dispute. When it appears to the Conciliator that there exist elements of a settlement which may be acceptable to the

parties, he shall formulate the terms of possible settlement and submit them to the parties for their observations. After receiving the observations of the parties, the Conciliator may reformulate the terms of a possible settlement in the light of such observations.

If the parties reach agreement on a settlement of the dispute, then may draw up and sign a written settlement agreement. If requested by the parties, the Conciliator may draw up, or assist the parties in drawing up, the settlement agreement. When the parties sign the settlement agreement, it shall be final and binding on the parties and persons claiming under them respectively. The Conciliator shall authenticate the settlement agreement and furnish a copy thereof to each of the parties. As far as possible, the conciliation proceedings should be completed within 60 days of the receipts of notice by the Conciliator.

The parties shall not initiate, during the conciliator proceedings, any arbitral or judicial proceedings in respect of a dispute that is the subject matter of the conciliation proceedings.

6. **Termination of Conciliation proceedings**

The conciliation proceedings shall be terminated:

- a) By the signing of the settlement agreement by the parties on the date of agreement; or
- b) By written declaration of the conciliator, after consultation with the parties, to the effect that further efforts at conciliation are no longer justified, on the date of such declaration; or
- c) By a written declaration of the parties to the conciliator to the effect that the conciliation proceedings are terminated, on the date of declaration; or
- d) By a written declaration of a party to the other party and the conciliator, if appointed, to the effect that the conciliation proceedings are terminated, on the date of declaration.

Upon termination of the conciliation proceedings, the conciliator shall fix the costs of the conciliation and give written notice thereof to the parties. The costs shall be borne equally by the parties unless settlement agreement provides for a different apportionment. All other expenses incurred by a party shall be borne by that party.

7. **Arbitration**

If the efforts to resolve all or any of the disputes through conciliation fails, then such disputes or differences, whatsoever arising between the parties, arising out of or relating to construction/ manufacture, measuring operation or effect of the License Agreement or the breach thereof shall be referred to Arbitration in accordance with the following provisions:

- a) Only such dispute(s) or difference(s) in respect of which notice has been made but could not be settled through Conciliation, together with counter claims or set off, given by the employer, shall be referred to arbitration. Other matters shall not be included in the reference.
- b) The Arbitration proceedings shall be assumed to have commenced from the day, a written and valid demand for arbitration is received by Managing Director, Rail Infrastructure Development Company (Karnataka) Limited, Bangalore (MD/KRIDE).
- c) The disputes so referred to arbitration shall be settled in accordance with the Indian Arbitration & Conciliation Act, 1996 & amended by the Arbitration & Conciliation (Amendment) Act, 2015 and any statutory modification or re-enactment thereof.

Further, it is agreed between the parties as under:

8. **Number of Arbitrations: The Arbitral Tribunal shall consist of:**

- i) Sole Arbitrator in cases where the total value of all claims in question added together does not exceed ` 3.00 crores;
- ii) 3 (Three) Arbitrators in all other cases.

9. **Procedure for Appointment of Arbitrators: The Arbitrators shall be appointed as per following procedure:**

- i) In case of Sole Arbitrator: Within 60 days from the day when a written and valid demand for arbitration is received by MD/ KRIDE, the Employer will forward a panel of 03 names to the Contractor. The Contractor shall have to choose one Arbitrator from the panel of three, to be appointed as Sole Arbitrator within 30 days of dispatch of the request by the Employer. In case the Contractor fails to choose one Arbitrator within 30 days of dispatch of panel of arbitrators by KRIDE then MD/KRIDE shall appoint anyone Arbitrator from the panel of 03 Arbitrator as Sole Arbitrator.
- ii) In case of 03 Arbitrators:
 - a) Within 60 days from the day when a written and valid demand for Arbitration is received by MD/KRIDE, the Employer will forward a panel of 5 names to the Contractor. The Contractor will then give his consent for any name out of the panel to be appointed as one of the Arbitrators within 30 days of dispatch of the request by the Employer.
 - b) Employer will decide the second Arbitrator. MD/KRIDE shall appoint the two Arbitrators, including the name of one Arbitrator for whom consent was given by the Contractor, within 30 days from the receipt of the consent for one name of the Arbitrator from the Contractor. In case the Contractor fails to give his consent within 30 days of dispatch of the request of the Employer then MD/KRIDE shall nominate both the Arbitrators from the panel.
 - c) The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties out of the panel of 05 Arbitrators provided to Contractor or from the larger panel of Arbitrators to be provided to them by Employer at the request of two appointed Arbitrators (if so desired by them) and who shall act as Presiding Arbitrator. In case of failure of the two appointed Arbitrators to reach upon consensus within a period of 30 days from their appointment, then upon the request of either or both parties, the Presiding Arbitrator shall be appointed by the Managing Director/KRIDE, Bangalore.
 - d) If one or more of the Arbitrators appointed as above refuses to act as Arbitrator, withdraws from his office as Arbitrator, or vacates his / their office/ offices or is / are unable or unwilling to perform his functions as Arbitrator for any reason whatsoever or dies or in the opinion of the MD/KRIDE fails to act without undue delay, the MD/KRIDE shall appoint new Arbitrator/ Arbitrators to act in his/ their place except in case of new Presiding Arbitrator who shall be chosen following the same procedure as mentioned in para (ii) (c) above. Such re-constituted Tribunal may, at its discretion, proceed with the reference from the stage at which it was left by the previous Arbitrator(s).
 - e) The Employer at the time of offering the panel of Arbitrator (s) to be appointed as Arbitrator shall also supply the information with regard to the qualifications of the said Arbitrators nominated in the panel along with their professional experience, phone nos. and addresses to the Contractor.

Qualification and Experience of Arbitrators (to be appointed as per sub-clause above): The Arbitrators to be appointed shall have minimum qualification and experience as under:

Arbitrator shall be; a Working/ Retired Officer (not below E-7 grade in a PSU with which the Employer has no business relationship) of any discipline of Engineering or Accounts/ Finance Department, having experience in Contract Management;

Or

A Retired Officer (retired not below the SAG level in Railways) of any Engineering Services of Indian Railways or Indian Railway Accounts Service, having experience in Contract Management; or a Retired Officer who should have retired more than 3 years previously from the date of appointment as Arbitrator (retired not below E-8 grade in KRIDE or a PSU with which the Employer has a business relationship) of any Engineering discipline or Accounts/ Finance Department, having experience in Contract Management or Retired Judge of any High Court or Supreme Court of India or reputed Chartered Accountant & should be member of ICAI, New Delhi. No person other than the persons appointed as per above procedure and having above qualification and experience shall act as Arbitrator.

No new claim shall be added during proceedings by either party. However, a party may amend or supplement the original claim or defence thereof during the course of arbitration proceedings subject to acceptance by Tribunal having due regard to the delay in making it.

Neither party shall be limited in the proceedings before such arbitrator(s) to the evidence or arguments put before the Conciliator for the purpose of obtaining his decision. No decision given by the Conciliator in accordance with the foregoing provisions shall disqualify him from being called as a witness and giving evidence before the arbitrator(s) on any matter, whatsoever, relevant to dispute or difference referred to arbitrator/s. Neither party shall be limited in the proceedings before such arbitrators to the evidence.

It is agreed by both the Parties that in the cases where Arbitral Tribunal is consist of sole Arbitrator, their disputes shall be resolved by fast track procedure specified in sub-section (3) of 29B of the Arbitration and Conciliation (Amendment) Act, 2015 or as amended up to date.

If the Contractor (s) does/do not prefer his/their specific and final claims in writing, within a period of 90 days of receiving the intimation from the Employer/ Conciliator that the final demand is ready, he / they will be deemed to have waived his/their claim(s) and the Employer shall be discharged and released of all liabilities under the License Agreement in respect of these claims.

Arbitration proceedings shall be held at Bangalore, India and the language of the arbitration proceedings and that of all documents and communications between the parties shall be in English.

The Arbitral Tribunal should record day to day proceedings. The proceedings shall normally be conducted on the basis of documents and written statements. All Arbitration awards shall be in writing and shall state item wise, the sum and detailed reasons upon which it is based. A model time scheduled for conduct of Arbitration proceedings in a period of 180 days/365 days will be made available to Arbitral Tribunal for their guidance (180 days is for fast track Arbitration and 365 days for other Arbitrations). Both the parties should endeavor to adhere to time scheduled for early finalization of Award.

The Award of the sole Arbitrator or the award by majority of three Arbitrators as the case may be shall be binding on all parties. Any ruling on award shall be made by a majority of members of Tribunal. In the absence of such a majority, the views of the Presiding Arbitrator shall prevail.

A party may apply for correction of any computational errors, any typographical or clerical errors or any other error of similar nature occurring in the award of a tribunal and interpretation of specific point of award to tribunal within 60 days of the receipt of award party may apply to tribunal within 60 days of receipt of

award to make an additional award as to claims presented in the arbitral proceedings but omitted from the arbitral award.

10. **Interest on Arbitration Award**

Where the arbitral award is for the payment of money, interest @ 15% per annum (as per latest guidelines/amendments) shall be payable on whole or any part of the money for the period it is accrued, till the date on which the award is made.

11. **Cost of Conciliation/ Arbitration**

The fees and other charges of the Conciliator/ Arbitrators shall be as per the scales fixed by the Employer from time to time irrespective of the fact whether the Arbitrator(s) is / are appointed by the Employer or by the Court of law unless specifically directed by Hon'ble Court otherwise on the matter, and shall be shared equally by the Employer and the Contractor. However, the expenses incurred by each party in connection with the preparation, presentation will be borne by itself. The latest scale of fee & other charges shall be fixed by KRIDE.

12. **Jurisdiction of Courts**

Where recourse to a Court is to be made in respect of any matter, the Court at Bangalore shall have the exclusive jurisdiction to try all disputes between the parties.

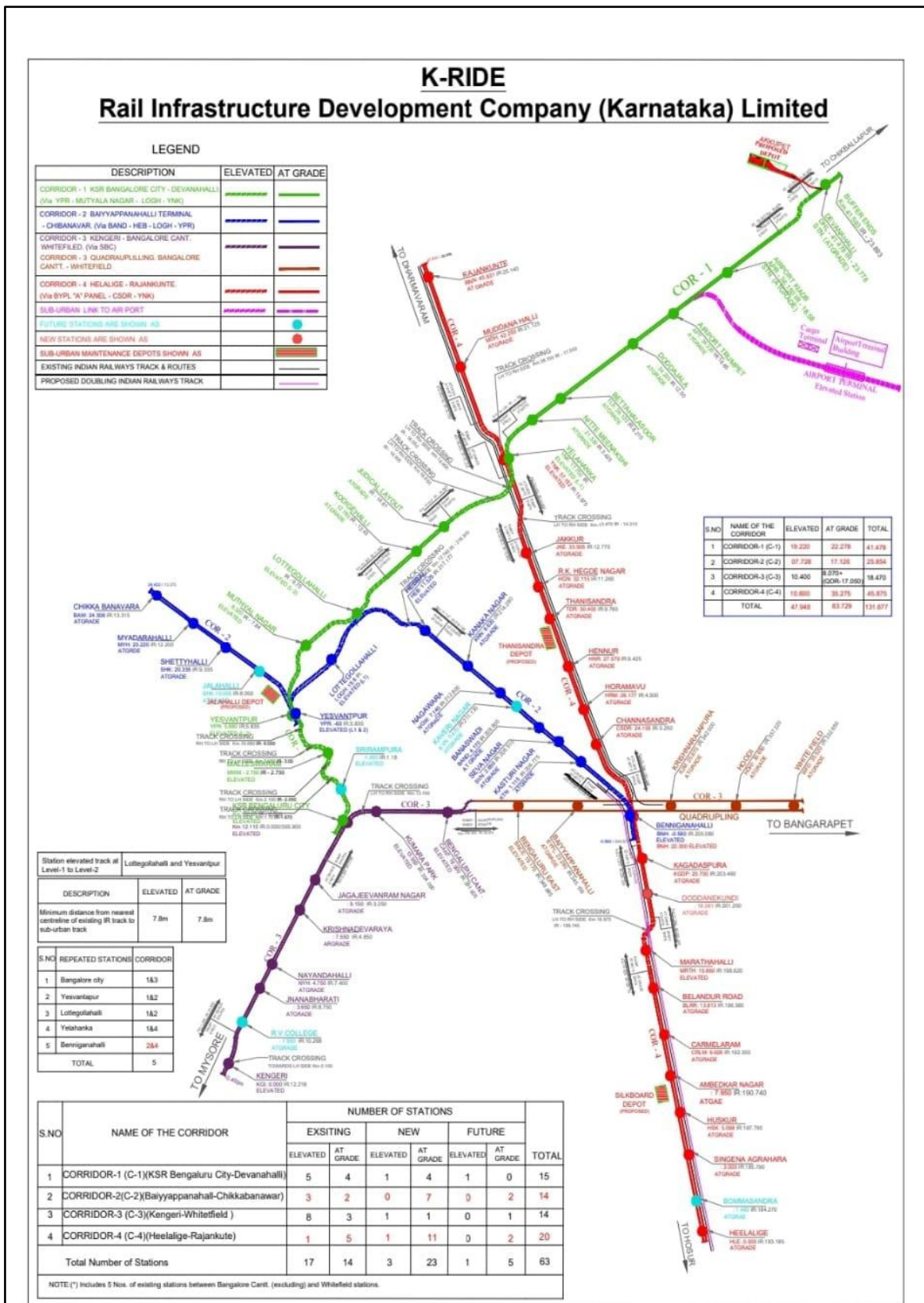
SECTION – 11

TENDER DRAWINGS AND SITE INVESTIGATION REPORTS

SECTION 11 – Tender Drawings & Site investigation Reports**TABLE OF CONTENTS**

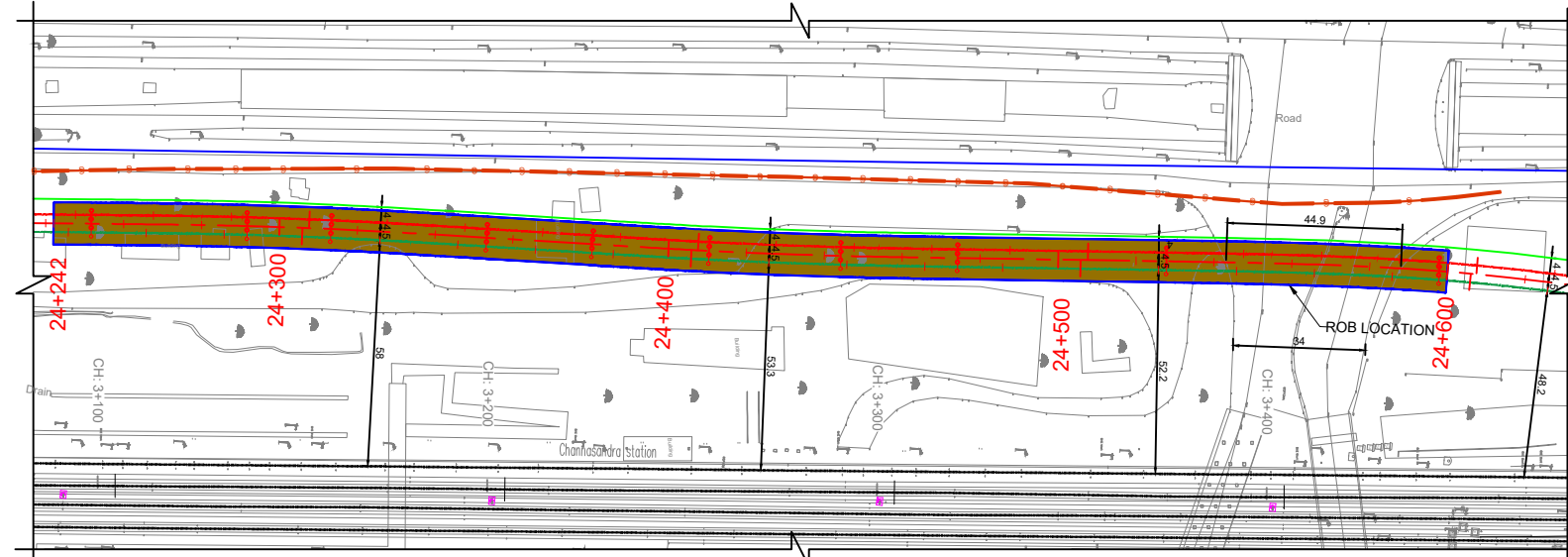
SL. NO	DESCRIPTION	PAGE NO
1	BSRP MAP	974
3	ALIGNMENT PLAN	ATTACHMENT-1
4	TENDER DRAWINGS	ATTACHMENT-2
5	SOIL INVESTIGATION REPORTS	ATTACHMENT-3
6	TYPICAL DRAWING OF BARRICADING BOARDS	ATTACHMENT-4

1 BSRP MAP

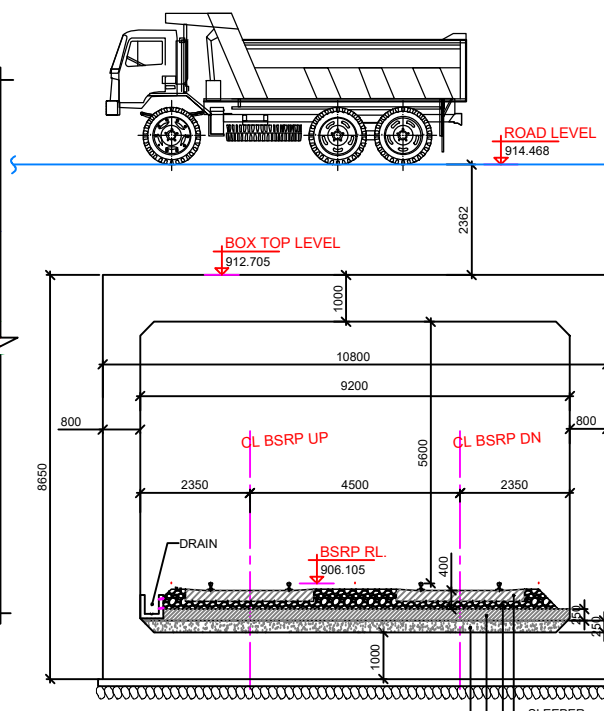


TO HEELALIGE

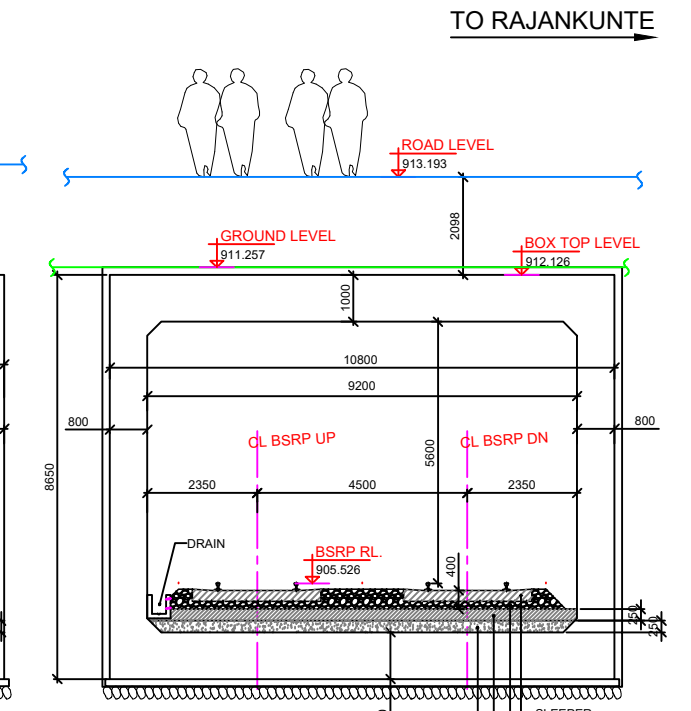
TO RAJANKUNTE



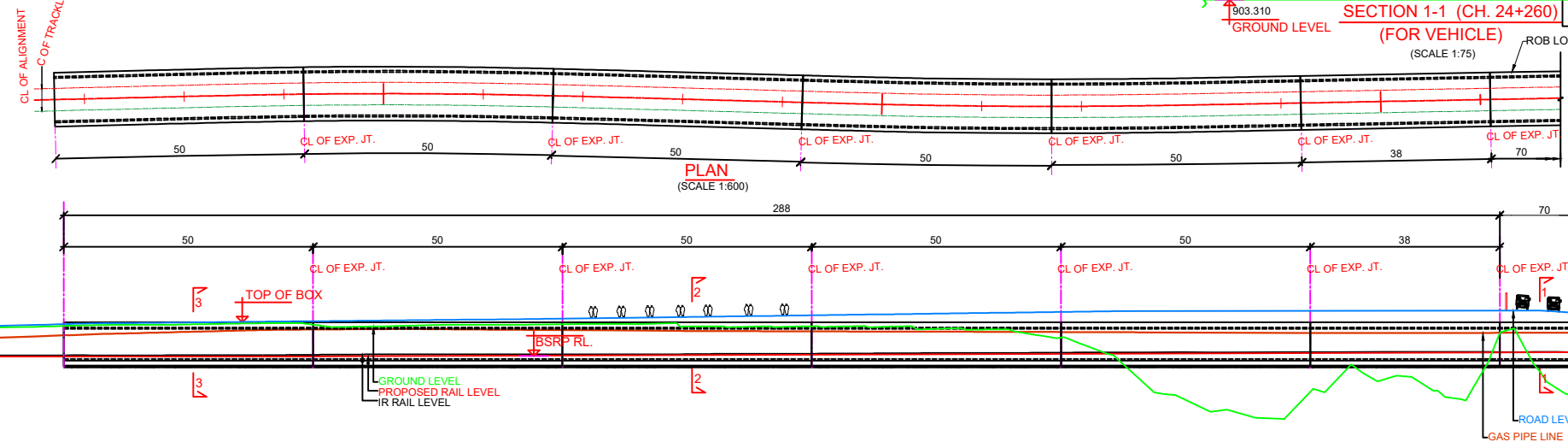
KEY PLAN
(SCALE 1:1)



SECTION 1-1 (CH. 24+260)
(FOR VEHICLE)
(SCALE 1:75)



SECTION 2-2 (CH. 24+360)
(FOR FOOTPATH)
(SCALE 1:75)



PLAN
(SCALE 1:600)

VERTICAL GEOMETRY	TRL= 40.000 m	R= 6000.000 m CL= 20.426 m	TRL= 40.000 m	Straight = 27.151 m	TRL= 30.000 m	R= 1397.750 m L= 33.803 m	TRL= 30.000 m	Straight = 53.608 m	TRL= 70.000 m
HORIZONTAL GEOMETRY									
DIFFERENCE BETWEEN IR TRACK RAIL LEVEL & BSRP TRACK RAIL LEVEL (CR-M)	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256
PROPOSED RAIL LEVEL	905.250	905.250	905.250	905.250	905.250	905.250	905.250	905.250	905.250
IR RAIL LEVEL	905.506	905.506	905.506	905.506	905.506	905.506	905.506	905.506	905.506
GROUND LEVEL	911.090	911.510	911.710	911.930	911.350	911.694	911.620	911.780	911.250
DESIGN CHAINAGE BSRP UP TRACK	24+220	24+240	24+260	24+280	24+300	24+320	24+340	24+360	24+380

ELEVATION
(SCALE 1:600)

NOTES :

1. ALL DIMENSIONS AND LEVELS ARE IN METER, UNLESS OTHERWISE SPECIFIED.
2. DIMENSIONS ARE NOT TO BE SCALED. ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.
3. ALL SUPERSTRUCTURE ARE PRECAST PRETENSIONED U-GIRDER UNLESS OTHERWISE MENTIONED.
4. CHAINAGES MENTIONED ARE AT THE CENTER LINE OF ALIGNMENT.

SPECIAL NOTE :
RAIL LEVELS ARE TAKEN FROM LATEST REVISION OF ALIGNMENT

LEGEND :

LEGEND FOR PLAN:	
PROPOSED BSRP TRACK	—
EXISTING IR TRACK	—
FUTURE IR WORK	—
EXISTING ROW AS PER ER	—
PROPOSED ROW AS PER ER	—
PROPOSED ROW AS PER IR	—
EXISTING SERVICE ROAD	—
PROPOSED ROAD	—
UP TRACK	—
DOWN TRACK	—

LEGEND :

LEGEND FOR PROFILE:	
PROPOSED BSRP RAIL LEVEL	—
EXISTING IR RAIL LEVEL	—
GROUND LEVEL	—
PROPOSED BSRP VERTICAL ALIGNMENT	—
CLOSE BOX PORTION	—
BOREHOLE (BH)	—

GENERAL ARRANGEMENT DRAWING

SOUTH WESTERN RAILWAY



RAIL INFRASTRUCTURE DEVELOPMENT
COMPANY (KARNATAKA) LIMITED

GENERAL CONSULTANTS : AECOM EGIS WSP AECOM-EGIS-WSP

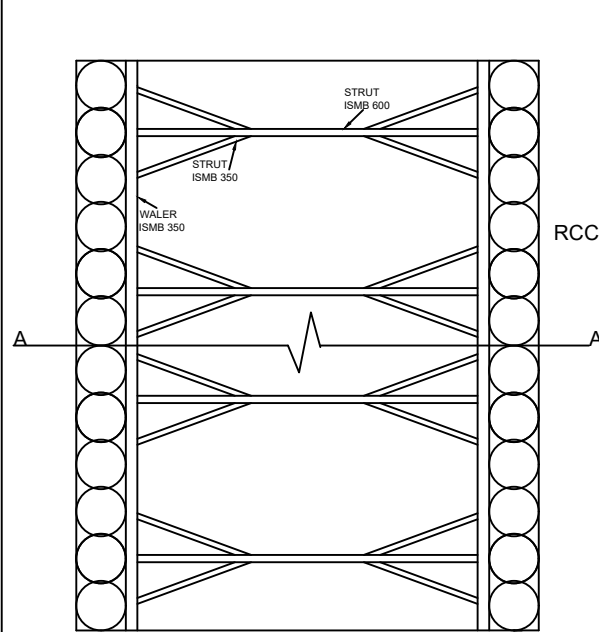
BENGALURU DIVISION

BAIYAPPANAHALLI - HEELALIGE SECTION OF BSRP C-4

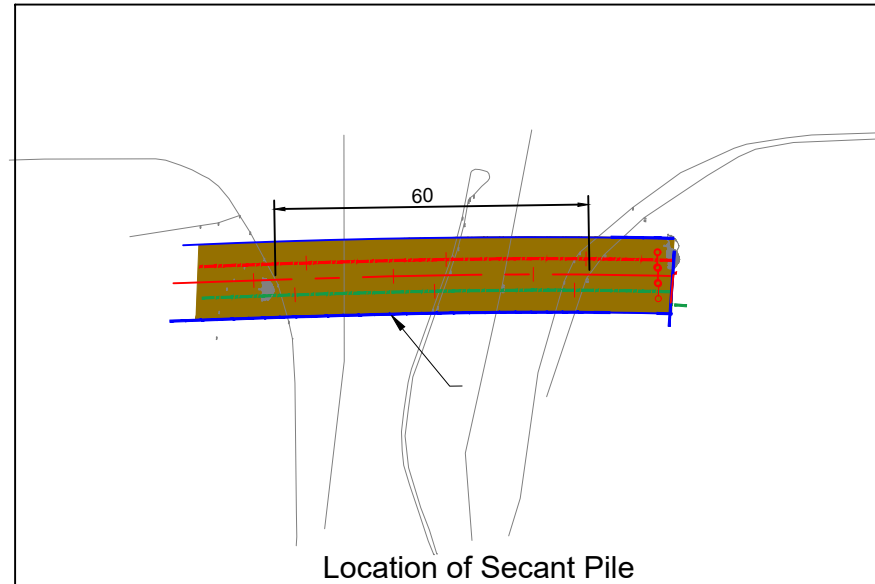
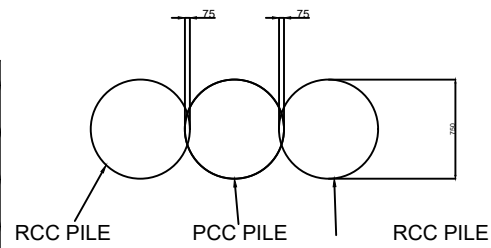
GENERAL ARRANGEMENT : PROPOSED SINGLE
CELL CLOSED RCC BOX AT CHANNASANDRA
STATION LOCATION

K RIDE DRG.NO:

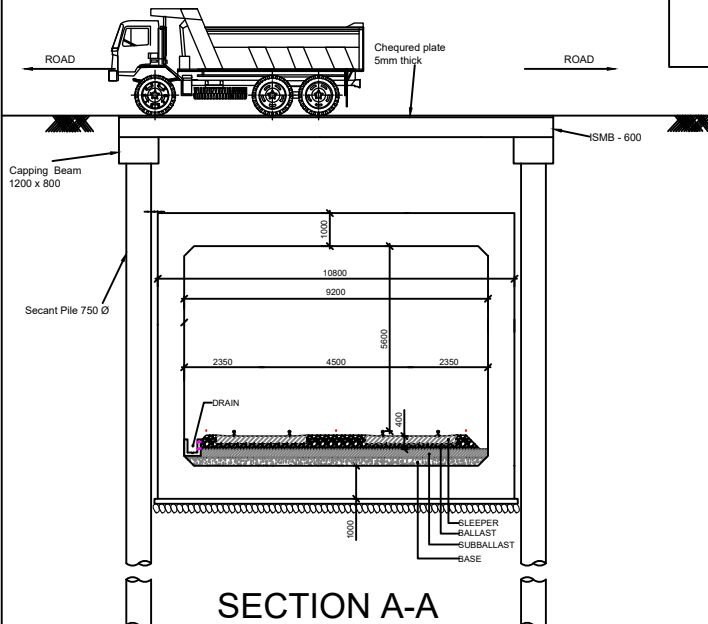
SCALE - 1 : 100





PLAN



Location of Secant Pile



SECTION A-A

GENERAL ARRANGEMENT DRAWING	
SOUTH WESTERN RAILWAY	
	RAIL INFRASTRUCTURE DEVELOPMENT COMPANY (KARNATAKA) LIMITED
GENERAL CONSULTANTS :	 AECOM-EGIS-WSP
BENGALURU DIVISION	
BAIYAPPANAHALLI - HEELALIGE SECTION OF BSRP C-4	
GENERAL ARRANGEMENT : PROPOSED SINGLE CELL CLOSED RCC BOX AT CHANNASANDRA STATION LOCATION TENTATIVE DRAWING FOR SECANT PILE	