

ಬೆಂಗಳೂರು ಸಂಯೋಜಿತ ರೈಲು ಮೂಲಸೌಲಭ್ಯ
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BENGALURU INTEGRATED RAIL INFRASTRUCTURE DEVELOPMENT ENTERPRISE LIMITED (Bi-RIDE)

Bi-RIDE

Corridor 4/PACKAGE – 2

“NAME OF WORK: “Design & Construction of Formation In Embankments /Cuttings/Blanketing, MIB’s, ROB’s, RUB’s, ERS/Retaining Wall, Drains, Boundary Wall, Fencing Works In At-Grade Section of Length 12.632 Km (Ch: -0+635 Km To Ch: 13.694 Km) and Other Related Infrastructural Works From Heelalige To Bellandur Including Validation of Design & Stability Check Wherever Applicable For Works Executed By Previous Contractor (Excluding Station Buildings), of Corridor - 4 of Bengaluru Suburban Transport Project (BSTP)”.

BID DOCUMENT

SECTION 8A EMPLOYERS’ REQUIREMENT 2 GENERAL INFORMATION AND SCOPE OF WORK

SECTION - VIIIA

EMPLOYER'S REQUIREMENT - VOL 2 GENERAL INFORMATION AND SCOPE OF WORK

**EMPLOYER'S REQUIREMENTS
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SECTION VIII - VOL-2 **EMPLOYER'S REQUIREMENTS**

Name of Work:

Corridor4/PACKAGE – 2

“Design & Construction of Formation In Embankments /Cuttings/Blanketing, MIB's, ROB's, RUB's, ERS/Retaining Wall, Drains, Boundary Wall, Fencing Works In At-Grade Section of Length 12.632 Km (Ch: -0+635 Km To Ch: 13.694 Km) and Other Related Infrastructural Works From Heelalige To Bellandur Including Validation of Design & Stability Check Wherever Applicable For Works Executed By Previous Contractor (Excluding Station Buildings), of Corridor - 4 of Bengaluru Suburban Transport Project (BSTP)”.

EMPLOYERS REQUIREMENT - SCOPE OF WORK

1. INTRODUCTION

These Employer's Requirements are divided into four sections as follows:

- (a) General: these apply throughout the Contract.
- (b) Functional: these include the specific core requirements for the design and performance of the Works.
- (c) Design: these apply in respect of requirements relating to the design of the Permanent Works.
- (d) Construction: these apply in respect of other requirements relating to the construction of the Works.

2. DEFINITIONS AND INTERPRETATIONS

In addition to the words and expressions defined in the General Conditions of Contract (GCC), further following words and expressions shall have the meaning assigned to them except where the context otherwise requires:

"As-Built Drawings": means those drawings produced by the Contractor and endorsed by him as true records of construction of the Permanent Works and which have been agreed with the Engineer.

"Combined Services Drawings" (CSD): means drawings showing the locations, layouts and sizes of all services including those of other contractors coordinated so as to eliminate all clashes.

"Construction Phase": has the meaning identified in Clause 4 of the Employer's Requirements - General.

"Good for Construction Drawings" (GFC): means those drawings referred to in Clause 2(B) of the Employer's Requirements - Design in respect of which a Notice has been issued.

"Construction Specification": means those parts of the Standard Outline Specification which relate to construction.

"Definitive Design Submission": means the submission of documents which comprise the whole or parts of the proposed Definitive Design and for which the Contractor seeks a Notice.

"Design Manual": means the manual to be prepared and submitted by The Contractor as part of the Definitive Design and as described in the Employer's Requirements Design.

"Design Package": has the meaning identified in Clause 2(5) of the Employer's Requirements - Design.

"Design Phase": has the meaning identified in Clause 4 of the Employer's Requirements - General.

"Design Criteria": means those parts of the Standard Outline Specification which relate to design.

"Final Design": has the meaning identified in Clause 3(5) of Employer's Requirements -Design.

"Notice": means a Notice of No Objection.

"Particular Specification": means the combined specifications prepared by the Contractor in CSI format which combines the Employers Design Criteria, the Employer's Outline Construction Specifications and those parts of the Contractor's Technical Proposals which specify standards for design and construction which are developed during the Design Phase.

"Preliminary Design": means the submission of documents which comprise the initial stage of the design phase. **"Railway Envelope"**: means the zone or zones within the Works containing the track work and equipment necessary for the operation of the Railway.

"Services, Electrical, Mechanical Drawings"(SEM): means those drawings produced by the contractor executing the service works showing the locations, sizes and details for openings in structural elements for mechanical and electrical facilities and other related contracts.

"Standard Outline Specification": means the Design Criteria and the Outline Construction Specifications that specify standards issued by the Employer for development by the Contractor for design and construction.

"Specification": has the meaning identified in Clause 5 of the Employer's Requirements -General. **"Structure Gauge"**: means the profile related to the designed normal coordinated axis of the track into which no part of any structures or fixed equipment may penetrate.

"Working Drawings": comprise the GFC Drawings and such other drawings and documents, such as bar bending schedules and manufacturing drawings, as are necessary to amplify the GFC Drawings for construction purposes and endorsed as required by the Engineer.

3. **RELEVANT DOCUMENTS**

The Design Criteria shall be read in conjunction with the General Conditions of Contract (GCC), the Particular Conditions of Contract (PCC), the Employer's Requirements, the Drawings and any other document forming part of the Contract.

In the event of a conflict between the Employer's Requirements and any Design Criteria, the Design criteria shall prevail.

In the event of a conflict between any Design Criteria and any other standards or specifications quoted, the requirement of the Design Criteria shall prevail.

Notwithstanding the precedence specified above the Contractor shall always immediately seek advice from the Engineer in the event of conflicts in Specifications among various standards.

The order of precedence is:

- i. Design Criteria
- ii. Employer's Requirements
- iii. Indian and other International Standards referenced herein.
- iv. Indian and other International Standards

4. **PHASES (DESIGN AND CONSTRUCTION)**

- (1) The Contractor shall execute the Works in two phases, the Design Phase, and the Construction Phase.
- (2) The Design Phase shall commence upon the date of issue of Letter of Acceptance. This phase shall include the preparation and submission of:
 - (a) The Preliminary Design

- (b) The Definitive Design; and
- (c) The GFC Drawings.

The Design Phase will be complete upon the issue of a Notice in respect of the comprehensive and complete GFC Drawings Submission for the whole of the Permanent Works.

- (3) The requirements for the Preliminary Design, Definitive Design and GFC Drawings are stated in Employer's Requirements-Design.
- (4) The Construction Phase for the whole or a part of the Permanent Works shall commence immediately upon the issue of a Notice by the Engineer/Employer in respect of the relevant GFC Drawings Submission. Such Notice may be issued by the Engineer in respect of a GFC Drawing Submission covering a major and distinctive part of the Permanent Works. However, construction shall not be commenced until the original negatives of the appropriate Working Drawings have been endorsed:

- (a) by the Contractor as "Good for Construction"; and
- (b) by the Engineer that he has no objections to the drawing with the approval of Authority/Employer.

The Construction Phase shall include the completion and submission of the Final Design and the preparation and submission of the As Built Drawings and other records as specified.

- (5) Notwithstanding Clause 4 (4) above, for those elements identified under Clause 2 of the Employer's Requirements - Design, the Construction Phase may commence immediately upon the issue of the Notice in respect of the Definitive Design Submission in respect of each such element subject to availability of the site in accordance with agreed programme.

5. SPECIFICATIONS

In accordance with the provisions of these Employer's Requirements, the Contract Specification contained in the Contract shall be developed during the design stage and submitted as part of the Definitive Design Submission. When the Specification has received a Notice of No Objection from the Engineer it shall become the Particular Specifications and shall take precedence over the other Specifications for construction purposes.

6. SPECIFICATIONS IN METRIC AND IMPERIAL UNITS

- (1) The Contract shall utilize the SI system of units. Codes and Standards in imperial units shall not be used unless the Engineer has given his consent.
- (2) Conversion between metric units and imperial units shall be in accordance with the relevant Indian Standards.

7. WORKS PROGRAMME

- (1) The Key Dates are defined in **Contract Key Dates of PCC**.
- (2) The Contractor shall prepare and submit its Works Programme and three-month rolling programmes and the detailed requirements to these Employer's Requirements.
- (3) In compiling its Works Programme and in all subsequent updating and reporting, the Contractor shall make provision for the time required for coordinating and completing the design, testing, commissioning and integrated testing of the Works, including, inter alia, design co-ordination periods during which the Contractor shall co-ordinate its design with those of Designated Contractors, the review procedures, determining and complying with the requirements of all Government Departments and all others whose consent, permissions, authority or license is required prior to the execution of any work.
- (4) The Works Programme shall take full account of the Design Submission Programme.

8. MONITORING OF PROGRESS

- (1) The contractor shall submit to the site Engineer three copies of a Monthly-Progress Report (MPR), as described in Employer's requirements describing the progress and current status of the Works. The MPR shall address the matters set out in the Works Programme.

- (2) The MPR shall be submitted by the end of each calendar month. It shall account for all works actually performed from twenty sixth day of the last month and up to twenty fifth day of the current month.
- (3) The MPR shall be divided into two sections. The first section shall cover progress and current status relating to design and the second section shall cover progress and current status relating to construction.
- (4) A monthly meeting to monitor & review the progress of the project shall be convened by the Engineer and chaired by the Employer's nominated official(s). Contractor's site Representative & Designer Representative of Contractor and site agent of all interfacing contractors shall also attend the meeting. The Employer's representative may also be present in the meeting.
- (5) The Employer/Engineer/both may also conduct progress review meetings on alternate day/periodical/weekly /bi-weekly/monthly intervals depending upon the requirements or urgency of works. In these review meetings Contractor's Supplier/Sub-Contractor/Designer etc. also may be called as per the requirements.

9. QUALITY ASSURANCE

The Contractor shall establish and maintain a Quality Assurance System in accordance with **Appendix-3 / Annexure - 1 of Section VIII, Employer Requirements** for design and construction procedures and the interfaces between them. This Quality Assurance system shall be applied without prejudice to, or without in any way limiting, any Quality Assurance Systems that the Contractor already maintains.

10.DIGITAL DELIVERY OF THE PROJECT AND SOFTWARE SUPPORT

(A) DIGITAL DELIVERY

Bi-RIDE envisages digitization of BIM (Building Information Model). The Designer and Contractor should be familiar with operations of a digital project platform enabling a fully integrated solution for employer & contractors.

The Contractor will be required to work on a digital delivery for built assets based on international standards and methodologies including:

- i. PAS 1192-2/2013 - "Specification for information management for the capital/delivery phase of construction projects using building information modeling"
- ii. PAS 1192-3 2014 - "Specification for information management for the operational phase of assets using building information modeling"
- iii. AIA Document E203TM-2013, Building Information Modeling and Digital Data Exhibit
- iv. CIC BIM Protocol 2013
- v. BIM Forum LOD Specification 2013
- vi. Software packages that may be considered to specify and integrate the system solution that will support the Digital Project Office may include Oracle, SAP, Microsoft Dynamics, CMiC, RiB AG, Autodesk, Bentley, Trimble, Synchro etc.

(B) SOFTWARE SUPPORT

- (1) The Contractor shall provide full support to the Employer and the Engineer for all computer programs provided by the Contractor under the Contract.
- (2) The Contractor shall submit a software support plan at least 90 days before commencement of software installation. This plan shall require the Contractor to provide all changes, bug fixes, updates, modifications, amendments, and new versions of the program as required by the Engineer.
- (3) The Contractor shall provide all tools, equipment, manuals and training necessary for the Employer and the Engineer to maintain and re-configure all the software provided under the Contract.
- (4) The Contractor shall submit all new versions to the Employer for review at least 2 weeks prior to their installation. New Versions of any program shall not result in any non-conformance with the Specification or degrade the operation of the System. The Contractor shall:

- i. Ensure that all new versions are fully tested and validated on the simulation and development system prior to installation.
 - ii. Ensure that all new versions are fully tested and commissioned once installed on the Site.
 - iii. Deliver to the Employer/Engineer any new version, together with the updated Operation and Maintenance Manuals.
- (5) The Employer / Engineer shall not be obliged to use any new version and -that: shall not relieve the Contractor of any of its obligations. Any effect upon the performance or operation of the computer-controlled system that may be caused by a new version shall be brought to the Employer's and Engineer's attention including updating the files to suit new version.
- (6) Within 14 days of the installation of any software into the Permanent Works by the Contractor, the Contractor shall submit to the Employer/Engineer for retention by the Employer/Engineer two backup copies (2 copies of the software one for Engineer and one for Employer) of the software, which shall include, without limitation:
 - i. All licenses in favour of Employer for their use.
 - ii. All source and executable code.
 - iii. All design documentation relating to the software; and
 - iv. Any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.
- (7) When a fault is discovered within delivered software or documentation, the Contractor shall take necessary steps to rectify errors or faults at the earliest.
- (8) The Contractor shall provide written details as to the nature of the proposed correction to the Engineer.
- (9) The Contractor shall notify the Employer promptly of any fixes or patches that are available to correct or patch faults.
- (10) The Contractor shall detail any effect such fixes or patches are expected to have, upon the applications.
- (11) The Contractor shall provide training for the Employer's staff to enable the Employer to make proper use of any software and its new versions.

11. CO-ORDINATION WITH DESIGNATED AND OTHER CONTRACTORS' GENERAL

- (1) The Contractor is responsible for detailed co-ordination of his design and construction activities with those of the Designated Contractors, Civil Contractors, Utility Agencies, Statutory Authorities, Private Service Providers, Developers, Consultants, and other Contractors whether or not specifically mentioned in the contract, that may be working on or adjacent to the site for the purpose of the Project. For the purpose of this Specification, all of the above parties shall be referred to as Interfacing Contractors. The Contractor shall note that there are other contractors, consultants, etc. which the Employer will engage from time to time with whom the Contractor shall have to similarly co-ordinate & cooperate. Such co-ordination responsibilities of the Contractor shall include the following:
 - (a) To provide all information reasonably required by the Interfacing Contractors in a timely and professional manner to allow them to proceed with their design or construction activities, and specifically to meet their contractual obligations.
 - (b) To ensure that the Contractor's requirements are provided to all other Interfacing contractors before the cut-off dates to be identified in the Interface Management Plan (IMP).
 - (c) To obtain from the Interfacing Contractors information reasonably required to enable the

Contractor to meet the design submission dates as identified in **Annexure-3 of Section VIII Employers' Requirement.**

- (d) Where the execution of the work of the Interfacing Contractors depends upon the site management or information to be given by the Contractor, the Contractor shall provide to such Interfacing Contractors the services or correct, and accurate information required to enable them to meet their own programme or construct their work.
 - (e) To co-ordinate access and delivery routes, and to ensure that all provisions for access and delivery of Plans are coordinated with and reflected in the Interfacing Contractor's Delivery Route Drawings. The Interfacing Contractors shall ensure that all Plans are delivered at the time agreed to allow openings left in the structure for such delivery to be sealed in accordance with the Contractor's programme.
 - (f) To co-ordinate with the Interfacing Contractors on attendance.
 - (g) To attend regular co-ordination meetings convened by the Engineer with the Interfacing Contractors. The Contractor shall conduct separate meetings with the Interfacing Contractors as necessary to clarify particular aspects of the interfacing requirements of the Works. The party who convenes the meeting shall prepare minutes of meeting recording all matters discussed and agreed at the meeting.
- (2) To ensure that copies of all correspondence, drawings, meeting, minutes, programmes, etc. relating to the Contractor's co-ordination with the Interfacing Contractors are issued to all concerned parties and four (4) copies issued to the Employer / Engineer not later than two (2) calendar days from the date of such correspondence and meetings. The Contractor, shall in carrying out his co-ordination responsibilities, raise in good time and provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the interfacing Contractors as to the extent of services or information required to pass between them. If such disagreement cannot be resolved by the Contractor despite having taken all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.
 - (3) Where an Interfacing Contract is yet to be awarded the Contractor shall proceed with the coordination activities with the Engineer until such time when the Interfacing Contractor is available. The Contractor shall provide the Interfacing Contractor with all information necessary to enable the Interfacing Contractor to follow-on and proceed with their coordination.
 - (4) The Contractor shall note that the information exchange is an iterative process requiring the exchange and update of information at the earliest opportunity and shall be carried out on a regular and progressive basis so that the process is completed for each design stage by the cut- off dates.
 - (5) The Contractor shall co-ordinate with the Engineer on all matters relating to works that may affect the Operation & Maintenance of the already operational Section corridor of the Employer in general. Such work shall be subject to the rules and regulations imposed by the Employer.

12.0 DEDICATED CO-ORDINATION TEAM

- (1) The Contractor shall establish a dedicated co-ordination team, led by a Chief Co-Ordinator in Bangalore reporting to the Contractor's Site Agent (Team Leader). The primary function of the team is to provide a vital link between the Contractor's design and construction teams and the Interfacing Contractors.
- (2) The Chief Co-Ordinator shall assess the progress of the co-ordination with Interfacing Contractors by establishing lines of communications as indicated in the co-ordination model shown in Figure 1 and promote regular exchange and updating of information so as to maintain the Contractor's programme.

- (3) The complexity of the Project and the importance of ensuring that work is executed within time limitations require detailed programming and monitoring of progress so that early programme adjustments can be made in order to minimise the effects of potential delays.
- (4) The Chief Co-ordinator in conjunction with the Interfacing Contractors shall identify necessary provisions in the Works for plant, equipment and facilities of the Interfacing Contractors. These provisions shall be allowed by the Contractor in his design of the Works.
- (5) During the course of the contract, information will be obtained in a number of ways. These may include direct inspection, regular site meetings, the obtaining of progress reports and the use of turn round document to obtain design and programme data. Turn round document shall be issued to the Interfacing Contractors to be returned giving the current positions on their programme.

13.0 DESIGN & CONSTRUCTION INTERFACE

- (1) The dates shown in Employer's Requirements **Annexure- 3 of Section VIII-Employers' Requirement.** are critical to the timely completion of the project. The Contractor shall commence design interface with the Interfacing Contractors as soon as he has been notified by the Engineer that such Interfacing Contract has been awarded. In the case of utility agencies and other statutory boards, interface shall commence as soon as it is practicable. Where no design interface date has been established because the Interfacing Contractors have not been identified or for whatever reason, the Contractor shall liaise with such Interfacing Contractor/s as soon as they have been awarded.
- (2) The Contractor shall immediately upon award of the Contract gather all necessary information and develop his design to a level where meaningful interaction can take place as soon as the Interfacing Contracts are available. The Contractor shall submit together with each of his Design Submissions a joint statement from the Contractor and the relevant Interfacing Contractor confirming that design co-ordination has been completed and that they have jointly reviewed the appropriate document to ensure that a consistent design is being presented.
- (3) The design interface is an iterative process requiring regular exchange and update of interfacing information. The Contractor shall ensure that the information he requires from the Interfacing Contractors is made known at the outset of each design interface and vice versa so that the information can be provided in time for the Contractor and the Interfacing Contractors to complete their design to meet their various design submission stages.

CONSTRUCTION INTERFACE

- (1) Construction interface will be necessary throughout the duration of the Works commencing from the time the Contractor mobilizes to the Site to the completion of the Works. Construction interface will overlap design interface, involving cast-in and buried items such as pipes for electrical and mechanical services, supports, brackets, plinths, ducts, conduits, service buildings if arising, openings, cableways, trenches etc. that are to be incorporated at the early stage of the construction up to provision of attendance during the testing and commissioning stage.
- (2) The Contractor shall ensure that there is no interference with the Works of the Interfacing Contractors and shall maintain close co-ordination with them to ensure that his work progresses in a smooth and orderly manner. The Contractor shall carry out and complete the Works, or any part thereof, in such order as may be agreed by the Engineer or in such revised order as may be requested by the Engineer from time to time. The Contractor shall, unless otherwise provided, be liable for and shall indemnify the Employer against all costs, charges, expenses, and the like resulting from failure of the Contractor to co-ordinate the Works as specified.
- (3) For effective document/record control consisting of Design reports and GFCDs to make the design interface more efficient.

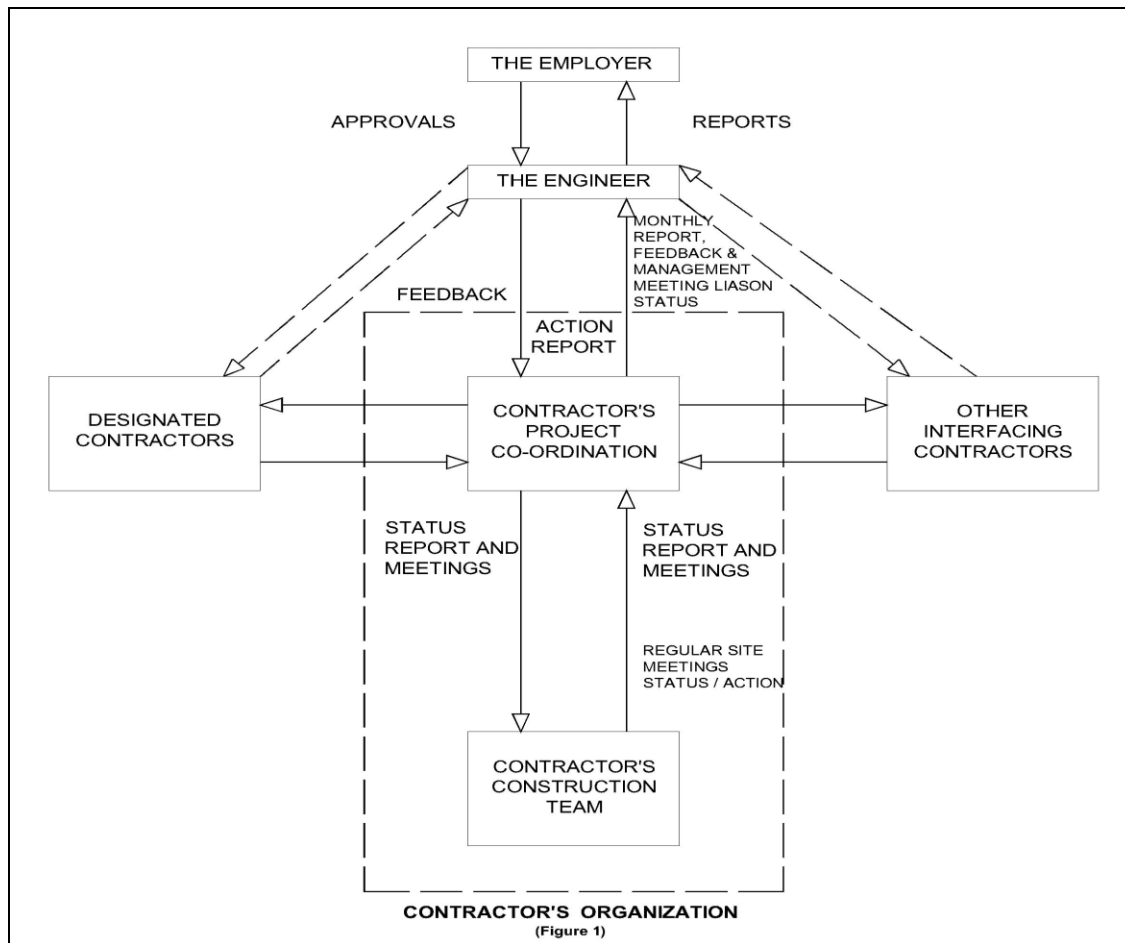


Figure 1 Co-ordination model

14. CONTRACTOR'S PROJECT ORGANISATION

- (1) The Contractor shall have a competent team of Managers, Engineers, Technical staff etc so as to complete the work satisfactory as per various requirements of the contract.
- (2) A control room with round the clock radio communication or telephone switch board links with all safety offices, works sites, site offices, batching plants, casting yards, workshops, fabrication yard, off site offices, Engineers site office, Resident Engineer's office, testing labs etc shall be maintained and manned round the clock. Residences of all senior project team members shall also be linked with the control room. Vehicles for emergency use should be on stand-by at the control room around the clock.
- (3) The designations of the various project organizations team members shall be got approved by the Engineer before adoption so as to avoid any duplication of the designations with those of the Employer or the Engineer.

15. TECHNOLOGY TRANSFER

- (1) The Contractor shall ensure that all local contractors and sub-contractors engaged in the works are

given training, guidance, and the necessary opportunity for transfer of technology in various areas of construction such as instrumentation, safety, SHE, quality assurance, fabrication, piling etc.

16. MAINTENANCE REPORT

- (1) The Maintenance Report shall be submitted as part of the Definitive Design and shall include full details of the long-term inspection and maintenance operations for each major component of Project
- (2) For each area an inspection checklist shall be supplied giving inspection frequency, items to be inspected, criteria for acceptance, criteria for remedial works and details of the remedial works, including proposed materials and method statements. The recommended regular maintenance regime of each area shall also be given including cleaning methods and frequency for different Surfaces; removal of leakage borne salts from concrete surfaces; cleaning of drainage channels, sumps and pipes; repainting of metallic items.
- (3) A long-term monitoring regime shall also be included covering items such as
 - i. Viaduct/Bridge
 - ii. Differential movement at viaduct / Bridge/station junctions or other areas identified in the design.
 - iii. Loss of prestress in the girders with passage of time.
- (4) All instruments necessary to carry out the inspections and monitoring that are identified in their port shall be provided by the Contractor within the lump sum tender price.

SECTION-B

EMPLOYER'S REQUIREMENTS – FUNCTIONAL

OBJECTIVE

The objective of the contract is construction, completion, testing and commissioning of the permanent works by the Contractor (including without limitation, construction, and removal of the Temporary Works) and the rectification of defects appearing in Permanent Works in the manner and to the standards and within the time stipulated by the Contract. In full recognition of this objective, and with full acceptance of the obligations, liabilities and risks which may be involved, the Contractor shall undertake the execution of the Work.

1. GENERAL

1. The design and performance of the Permanent Works shall comply with the specific core requirements contained in these Employer's Requirements-Functional.
2. The design of the Permanent Works shall be developed in accordance with these Employer's Requirements - Functional, the Contractor's Technical Proposals and the other requirements of the Contract.
3. The Permanent Works shall be designed and constructed to the highest standards available using proven up-to-date good Engineering practices. The Specification shall in any case not specify standards which, in the Engineer's opinion, are less than or inferior to those described in the Design Basis Report (Design Criteria) and Technical/Construction Specifications contained in the Tender Documents. Construction shall be carried out employing the procedures established by the Contractor in his Quality, Safety Health and Environmental management plans.
4. The Contractor shall be responsible for obtaining all necessary approvals from the relevant Public/Government/Local/Statutory or any agencies in the construction of the works.

2. CO-ORDINATION/CO-OPERATION WITH OTHER CONTRACTORS & AGENCIES (EXTERNAL/INTERNAL)

- i. In addition, the Contractor shall be required to carry out various miscellaneous works as per interfacing requirements. The contractor shall carry out necessary co-ordination with various system contractors pertaining to traction power supply, E&M, signalling, telecommunication etc. for keeping provisions pertaining to cut outs, shafts, concealed conduits, other conduits, fixtures, inserts clearances etc. all complete.
- ii. Earthing & bonding and lightning protection measures wherever required.
- iii. The track supporting structure will support ballast less track (long welded rail) which will be laid later by a separate contractor. Arrangements required for provision of such ballast less track will have to be incorporated in the deck, in consultation with the Engineer. Where the ballast less track concrete is to be laid on the top of the deck slab, as directed by the Engineer, contractor will make suitable arrangements for proper keying up / providing shear connectors further concrete layers /or casting track plinths / slab which will form part of track work to be done by a separate contractor.
- iv. The contractor shall cooperate with the other contractors appointed by the employer so that the work proceeds smoothly to the specifications of the Engineer. The contractor shall plan & execute the works with proper intimation to the other contractors.
- v. NOC & Approval of schemes of diversion of utilities from the concerned regulatory / statutory /Local authority is the responsibility of the contractor.
- vi. The contractor shall attend regular coordination meetings convened by the employer / engineer for interface and adhere to the decisions taken in the meeting.

- vii. Access will be provided to the staff of the other Contractor appointed by the Employer for carrying out their works and bringing materials and equipment at the site. However, the security of materials and Equipment's brought at the site will be the responsibility of the respective Contractors.
- viii. The contractor shall, in carrying out his coordination responsibility, raise in good time and provide sufficient information for the Employer to decide on any disagreement with other contractors. If the contractor despite having taken all reasonable efforts cannot resolve such disagreement, then the decision of the Engineer shall be final and binding on the contractor.

3. TRAFFIC MANAGEMENT

The Contractor shall make the detailed traffic diversion plans in consultation with Bangalore Traffic Police. The work is to be executed with proper liaison with Bangalore Traffic Police. Necessary assistance will be given by Bi-RIDE. The scheme should be such that preferably two lanes limiting to minimum of one lane of traffic in each direction of the road should be available for the smooth flow of traffic. The Contractor should inspect the site. The Contractor shall also strengthen the road where the diversions are planned by widening, repairing to the road surface etc.

4. STRUCTURES

The construction of structures will have to be planned in such a manner that they do not obstruct or interfere with the existing roads / Railways and other utilities. Where work is required to be carried out at locations adjacent to such roads / Railways, utilities, structures, monuments etc. suitable safety and protection arrangements will have to be ensured for which nothing extra will be payable. It should be ensured that no damage is caused to any such elements and engineer/employer shall be indemnified against such damage at no extra cost.

Any other item of work as may be required to be carried out for completing the construction of elevated structure of specified length including all necessary interfaces works with station and system Contractors in all respects in accordance with the provisions of the Contract and/or to ensure the structural stability and safety during and after construction are included in the scope.

DESIGN CRITERIA (VIADUCT/BRIDGE)

Design shall be carried out as per design basis report. Indicative parameters for designing of viaduct/Bridge are given below:

A. SPACING OF TRACKS.

Since the I-Girders / U-Girders are preferred in superstructure, the spacing of the tracks shall be considered in conformity with SOD.

If independent girders carry each track, then the Structure gauge on each track will determine the spacing of tracks when there is a structure between tracks. Ex: parapet wall, web of girder in case of trough type girder, etc. Since end evacuation is adopted in BSTP, Tenderers may note that side walkways are not a must in the viaduct/Bridge, and this may be taken note of while designing the girders for the viaducts/Bridges".

B. ADDITIONAL ELEMENTS

The Girder deck shall carry in addition to the two tracks,

- i) Rail plinths / Slab (since the track is ballast less track), Two numbers supporting the two rails of each track, totalling to four plinths ('L' shaped). **The rail plinths are also called 'derailment up stands'.**

- ii) Dowels / Shear connectors for rail plinth / Slab are covered in the scope of the work.
- iii) The parapet wall shall be designed to accommodate all system requirements including cable ducts / trays as specified and approved.

C. CLEARANCE BETWEEN CABLES

Since power cables and S&T cables will be close to each other, to prevent induction, etc a Minimum clearance shall be kept between them.

Note: B and C above will have to be additionally considered by the tenderer while fixing the Deck width of the girder. It may be noted that the tenderer cannot have any claim for minor changes which may be required to be made after award of contract. **The final parameters/dimensions shall be decided as an interfacing activity.**

Engineer's decision will be final and binding on the tenderer in this respect. Inserts/Fixtures/Supports/Hangers for system contractors shall be supplied and installed at no extra cost, by the contractor.

4.1 REFERENCE TO THE STANDARD CODES OF PRACTICE

All Standards, Technical Specifications and Codes of practice referred to shall be latest editions including all applicable official amendments and revisions. The Contractor shall make available at site all relevant Indian Standard Codes of practice and IRS & IRC Codes as applicable.

4.1.1 Wherever Indian Standards do not cover some particular aspect of design/ construction, relevant British/German Standards will be referred to. The Contractor shall make available at site such standard codes of practice.

4.1.2 In case of discrepancy among Standard codes of practice, Technical Specifications, and provisions in sub clauses of NIT, the order of precedence will be as below:

- i) Provision in ITT and Employers Requirements
- ii) Technical Specifications provided in the tender doc, (Order of priority IRS, IS, IRC codes)
- iii) MORTH Specification for road & Bridges
- iv) CPWD specifications
- v) Standard Codes of Practice

In case of discrepancy among Standard Codes of Practice, the order of precedence will be IRS, IS, IRC, BS, DIN, FIP, AASHTO, ASTM.

4.2 DIMENSIONS

4.2.1 As regards errors, omissions and discrepancies in Specifications and Drawings, relevant clause of Particular Conditions of Contract will apply.

4.2.2 The levels, measurements and other information concerning the existing site as shown on the conceptual / layout drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or strata turning out different from what is shown on the drawings.

4.3 ASSOCIATED WORKS

Works to be performed shall also include all general works preparatory to the construction and works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the

intent and meaning of the drawings adopted and technical specifications, to best Engineering standards and orders that may be issued by the Employer/Engineer from time to time, compliance by the agency with all Conditions of Contract, supply of all materials, apparatus, plants, equipment, tools, fuel, water, strutting, timbering, transport, offices, stores, workshop, staff, labour and the provision of proper and sufficient protective works, diversion, temporary fencing, lighting and watching required for the safety of the public and protection of works on adjoining land; first -aid equipment, sanitary accommodation for the staff and workmen, effecting and maintenance of all insurances, the payment of all wages, salaries, fees, royalties, duties or the other charges arising out of the erection of works and the regular clearance of rubbish, clearing up, leaving the site perfect and tidy on completion.

4.4 CONSTRUCTION OF CASTING & DUMPING YARDS.

No land for casting yard or offices/laboratories etc. will be provided by the employer. However, the employer will give the necessary assistance required for seeking permissions but without any responsibility for the same. Contractor should make his arrangements at his own cost which is deemed to be included in Lump sum price in **Schedule-A, B & C.**

Satisfactory HSE Compliance & tyre washing arrangements of each, and every vehicle shall be made by the contractor for the vehicles leaving the depot to avoid the spillage on the connecting roads.

4.5 TIME SCHEDULE & MONITORING OF PROGRESS

- (i) The agency shall submit with the tender "Time Schedule" for completion of various portions of works. This schedule is to be within the overall completion period of months. The detailed programme in the form of a quantified bar chart or CPM network shall include all activities starting design to completion.
- (ii) In compiling its Works Programme and in all subsequent updating and reporting, the contractor shall make provision for the time required for interfacing & co-coordinating and completing the design, testing, commissioning, and integrated testing of the Works, including, inter alia, design co-ordination periods during which the Contractor shall co-ordinate its design with those of Designated Contractors, the review procedures, determining and complying with the requirements of all Government Departments and all others whose consent, permissions, authority or license is required prior to the execution of any work.
- (iii) The Contractor shall submit to both the Employer & Engineer Four copies of a Monthly Progress Report (MPR), describing the progress and current status of the Works. The MPR shall address the matters set out in the Works Programme.
- (iv) The MPR shall be submitted by the end of each calendar month. It shall account for all works actually performed from twenty sixth day of the last month and up to twenty fifth day of the current month.
- (v) A monthly / biweekly meeting to monitor the progress of the project shall be convened by the Engineer, Contractor's site agent and site agent of all interfacing contractors shall attend the meeting. The Employer may also be present in the meeting.

4.6 UTILITIES

Utility identification at foundation locations will be done by the contractor and in case utility (ies) is encountered or obligatory requirement is to be met out; the contractor shall modify the span configuration at such location to save the utility (ies) or to meet obligatory requirements within the accepted price. No payment shall however be made for supporting the utilities during course of work. Any other utilities shifted by the contractor as directed by Engineer/Employer, will be paid separately under **Schedule-C.**

The utilities are to be diverted with proper liaison and approval of the utility owning agencies. The utilities which are not diverted but require supporting, proper supporting is to be done so that they are not damaged

along their routes / branches. Precautions to be taken while handling the utilities are mentioned as under.

- (i) Utilities must not be damaged at any cost. If due to some reason or the other, mishap occurs, it should be rectified immediately by the Contractor at his own cost under intimation of Engineer / Employer.
- (ii) Till rectification of the damaged trunk sewers, the Contractor shall arrange substitute arrangement for sewage pumping and its disposal as per directions of Engineer. Similar arrangement is to be done for other utilities.
- (iii) The manholes of Trunk/Sewers should not be covered under the foundation as these may create hindrances to the annual de-silting/cleaning of sewer lines.
- (iv) Sufficient distance of foundation from outer edge of Trunk / Sewers is kept in view of further maintenance/Safety of Trunk/Sewers.
- (v) The covers of manholes be saved from heavy machinery movement to avoid any accident/Slippage of malba / debris in manholes etc into the Trunk /Sewers which may cause blockage of lines. In case of damage of manhole cover & frame the same shall be replaced immediately by the Contractor at his own cost.
- (vi) Manholes of the trunk sewer should be kept freely accessible for cleaning and removal of blockages and malba / debris should not be dumped over these manholes.
- (vii) Branch sewer connections which are connected with the trunk sewers should also be taken care of. If the same are damaged, the same should be restored immediately on priority at his own cost.
- (viii) NOC & Approval of schemes of Diversion of Utilities from the concerned regulatory / statutory / Local Authority will be got done by contractor. However, necessary assistance will be provided by K-RIDE.

These are only indicative for one of the utilities only. Similarly, necessary precautions which are specified from time to time by the utility owning agencies shall also be followed. The Central verge/footpath furnishings which are to be dismantled be handed over to the concerned department in their stores at contractor's own cost.

4.7 INSPECTION

Engineer / Employer may appoint an independent agency to ensure the quality checking of design, supply, fabrication, erection, and construction of all the work under 'scope of work'. The contractor shall ensure complete co-operation with the agencies to perform their work satisfactorily. In addition, Engineer / Employer also reserves the right to undertake quality check and inspection directly by itself.

5. ALIGNMENT OF TRACKWAYS

- (1) The alignment shall be as shown in the tender drawings. The alignment has been developed by the Employer to meet operational and technical criteria. The Contractor is not required to evaluate the alignment for compliance with these criteria but shall review it with respect to his own design and construction proposals and shall satisfy himself that there is no conflict with existing structures which are to be preserved.
- (2) The Contractor is permitted to propose minor deviations in alignment to suit his construction proposals, but he must demonstrate that any such deviations shall comply with good design practice and the alignment requirement of the Design Criteria. Such deviations shall require prior approval of the Employer subject to following conditions: -

- i. There is no extra cost to the employer.
- ii. Changes proposed are essentially required to suit the contractor's specific design.
- iii. There is no change at the contract boundaries or if there is any, the same is agreed by the contractor of the adjoining section without any extra cost to the employer.

6. CLEARANCES

- (1) The Permanent Works shall not infringe the Structure Gauge. Extra clearances shall be provided on curved alignment as per the Schedule of Dimensions (SOD)/Design Basis Report (DBR).
- (2) The Permanent Works shall provide for the installation by the Designated Contractors of operating equipment for the Railway / BSTP and without infringement of the Structure Gauge.
- (3) Railway clearances:
Various clearances shall be provided as per the schedule of dimensions approved for the Engineer / Employer.
- (4) Construction limits:
 - (a) The limits of land for the Works will be given to successful tenderer. The Contractor shall design the Works to be contained totally within these limits, respecting the regulations concerning construction and property boundaries of the local authorities such as BMRCL, BDA, BBMP, SWR, BWSSB, BESCOM, DULT etc., In the event that the Contractor, having used its best endeavours, is unable to design the permanent works and utilities to be contained totally within these limits, then the Employer will obtain the necessary additional land or the Contractor may be required to redesign the structure as instructed by Engineer.
 - (b) The limits of land will be given to successful tenderer but for general guidance it is 4.5 m on either side of the center line in Viaduct/ Bridge portion and limits of the land for At-Grade portion as per the Tender drawing. However, the permission for barricading etc. will be given depending upon the preparedness of the contractor, issues concerning traffic department etc. as is the usual practice. It may undergo changes after final survey and the Contractor shall make any adjustments necessary to the design to acknowledge the changes to the limits as then defined. Site will be made available progressively depending upon the requirement.
 - (c) The approval for viaduct, major bridges, minor bridges, ROB's, RUB drawings from Railway to be obtained by the contractor. The necessary assistance will be provided by Engineer / Employer.

7. DESIGN LIFE

The design life of all Permanent Works shall be **100 Years**. Bridge bearings and movement joints shall have a minimum design life of 50 years. Paint systems for steelwork shall ensure a minimum life of 15 years.

8. DURABILITY AND MAINTENANCE

- (1) The Permanent Works shall be designed and constructed such that, if maintained reasonably and in accordance with the Contractor's statement of maintainability contained in the Contract, they shall endure in a serviceable condition throughout their minimum lives
- (2) The permanent Works shall be designed and constructed so as to minimize the cost of tenancy whilst not compromising the performance characteristics and ride quality of the Railway.
- (3) Restoration of roads, utilities and other services dislocated during construction is the responsibility of the contractor.
- (4) Survey, instrumentation, ground treatment, ground and building monitoring, risk analysis, settlement

prediction, preventive and corrective actions is the responsibility of the contractor.

- (5) Traffic management along the worksite including works connected with traffic management is the responsibility of the contractor.
- (6) Reinstatement of services (such as street lighting, signalling system, bus stand, footpath including kerb stone, boundary wall, horticulture work and any other work to bring the site to original position) within barricading area as per current standards with new materials (except electrical/signal post which may be reused if they are usable).
- (7) The contractor shall be responsible for obtaining relevant certificates or clearance from local civic authorities.
- (8) The contractor shall be responsible for obtaining approval by all relevant civic authorities having jurisdictional authority wherever required.

9. OPERATIONAL REQUIREMENTS

- (1) The Permanent Works shall be designed to permit the BSTP to operate satisfactorily at a maximum design speed as described in Design Basis Report.
- (2) The vertical and horizontal alignments for the main line track work shall comply with the conditions laid in para (3) and (4) of this document.
- (3) Particular attention shall be paid to locations where flooding could damage the Railway. In particular Construction of surface water drainage systems including plinths and ducts shall be avoided in the vicinity of traction substations to obviate any risk of flooding of electrical equipment areas.
- (4) During construction the contractor shall be responsible for providing and maintaining adequate flood protection to ensure protection of the works.

10. ENVIRONMENTAL CONSIDERATIONS

All provisions and conditions contained in the conditions of contract on safety, health & environment and Section-8C of the tender document shall be strictly complied with. Bidders should note that any stipulations specified by the funding agency in relation to environment, social, health and safety (ESHS) shall be complied in all respect. Such stipulations will be uploaded along with as addendum in due course of bid process.

11. URBAN PLANNING FUNCTIONAL REQUIREMENTS

1. Requests for temporary power supplies for the construction of the works must be submitted by the contractor to the concerned authorities. Alternatively separate power supplies may be arranged by the Contractor independent of concerned electricity distribution/ transmission authority subject to compliance with all necessary statutes.
2. In addition, a number of agencies are involved in the reinstatement works, permanent road accesses, temporary road accesses, refuse collection accesses, street lighting, traffic management and fire hydrant positions. The Contractor is responsible for obtaining the approvals for these other works.
3. The Contractor is responsible for obtaining the approval of applications from the above authorities for the design and construction of works. The Employer may provide assistance in order to obtain any permission on clearances.

12. TRAFFIC MANAGEMENT

The Contractor shall carry out the Works so as to minimize disruption to road and pedestrian traffic. The Contractor shall prepare his traffic management plan based on his proposed construction

methodology in co-ordination with Engineer and in conjunction with Bangalore Traffic Police. He shall comply strictly with the approved plan during construction of his works. The design shall provide for temporary road decking wherever necessary to provide minimum no. of traffic lanes as agreed with Bangalore Traffic Police.

13. MISCELLANEOUS

The Contractor shall note that the Commissioner for Railway Safety (CRS) will inspect the Works from time to time for the purpose of determining whether the Bangalore Suburban Rail Corridor Project complies in terms of operational and infrastructural safety in accordance with the Laws of India. The contractor shall note that CRS approval is mandatory for commissioning the system. Notwithstanding other provisions of the Contract, the Contractor shall ensure that the Works comply with the requirements of CRS in terms of construction to the drawings and shall assist the representatives of CRS in carrying out their inspection duties and also comply with their instructions regarding rectifying any defects and making good any deficiencies.

14. STANDARDS

- (1) Equipment, materials, and systems shall be designed, manufactured and tested in accordance with the latest issue of International and/or National codes and standards. The Contractor shall submit hard copies in original to the Employer/ Engineer of all codes and standards used for the work.
- (2) Reference to standards or to materials and equipment of a particular manufacturer shall be regarded as followed by the words "or equivalent". The Contractor may propose alternative standard materials, or equipment that shall be equal to or better than those specified. If the Contractor for any reason proposes alternatives to or deviations from the specified standards or desires to use materials or equipment not covered by the specified standards, the Contractor shall apply for the consent of the Engineer. The Contractor shall state the exact nature of the change, the reason for making the change and relevant specifications of the materials and equipment in the English language. The decision of the Engineer in the matter of quality will be final. No compensation or extra money shall be paid.

SECTION C**EMPLOYER'S REQUIREMENTS -DESIGN****1. INTRODUCTION**

- (1) The Employer's Requirements - Design, specifies the procedural requirements for the preparation of the design of the Permanent Works. These requirements are subdivided into those that are to occur during the Design Phase, those that are to occur during the Construction Phase, and those that are of general application.

- (2) Obligations prior to commencement of Works relating to Design and Construction.

Within 20 (twenty) days of the LOA, the Contractor shall:

- (a) appoint its representative, duly authorized to deal with the Authority in respect of all matters under or arising out of or relating to this Agreement.
- (b) appoint a Design Director who will head the Contractor's design unit and shall be responsible for surveys, investigations, collection of data, and preparation of preliminary and detailed designs.
- (c) undertake and perform all such acts, deeds and things as may be necessary or required before commencement of Works under and in accordance with this Agreement, Applicable Laws and Applicable Permits; and
- (d) make its own arrangements for quarrying and procurement of materials needed for the Railway Project under and in accordance with Applicable Laws and Applicable Permits.

- (3) DESIGN AND DRAWINGS

Design and Drawings shall be developed in conformity with the Specifications and Standards set forth in Schedules and Employers Requirement and scope of work. In the event, the Contractor requires any relaxation in design standards due to restricted Right of Access in any section, the alternative design criteria for such section shall be provided for review of the Authority's Engineer.

The Contractor shall appoint a proof check consulting agency (the "Proof Consultant") after proposing to the Authority a panel of 3 (three) names of qualified and experienced firms and Authority will select 1 Proof Consultant from panel. The Parties agree that no firm or person having any conflict of interest shall be engaged hereunder.

The Proof Consultant shall:

- a) Evolve a systems approach with the Design Director so as to minimise the time required for final designs and construction drawings; and
- b) Proof check the detailed calculations, drawings, and designs, which have been approved by the Design Director.

No review and/or observation of the Authority's Engineer and/or its failure to review and/or convey its observations on any Drawings shall relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Authority's Engineer or the Authority be liable for the same in any manner; and if errors, omissions, ambiguities, inconsistencies, inadequacies or other Defects are found in the Drawings, they shall, along with the affected Works, be corrected at the Contractor's cost.

The Contractor shall be responsible for delays in submitting the Drawings, caused by reason of delays in surveys and field investigations, and shall not be entitled to seek any relief in respect thereof from the Authority; and

the Contractor warrants that its designers, including any third parties engaged by it, shall have the

required experience and capability in accordance with Good Industry Practice and it shall indemnify the Authority against any damage, expense, liability, loss or claim, which the Authority might incur, sustain or be subject to arising from any breach of the Contractor's design responsibility and/or warranty as set out in this Clause.

Any cost or delay in construction arising from review by the Authority's Engineer shall be borne by the Contractor.

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.

(4) CONSTRUCTION OF THE BSTP PROJECT

The Contractor shall construct the Railway Project as specified in Schedules, and in conformity with the Specifications and Standards. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions, or alignment of the Works. For works involving existing yards, the non-interlocking programme for each year shall be drawn by the Authority's Engineer and provided to the Contractor. The Contractor and the Authority's Engineer, within a period of 30 days, will discuss the same and issue a jointly agreed programme. The execution of work during the non-interlocking period will be the responsibility of the Contractor. The work during non-interlocking period in yards will be executed directly under the supervision of Employer / Railways, however, the timely completion of non-Interlocked working will be the responsibility of the Contractor and the Contractor agrees and undertakes that the construction shall be completed on or before the Scheduled Completion Date, including any extension thereof, in which case the Scheduled Completion Date will be the extended date as per the time extension granted.

In addition to the express requirements herein, the Contractor shall, whenever the Engineer so requests, provide information and participate in discussions that relate to design matters.

The Contractor shall engage the Designer who shall undertake and prepare the design of the Permanent Works and Temporary Works. The Contractor shall establish an office for his core design team at the Site in Bangalore. The core design team shall function from this office and all meetings and discussions relating to design shall be held in this office.

The Contractor shall ensure that the Designer continues to be represented in Bangalore at all times by staff whose seniority and experience are to the satisfaction of the Engineer and whose representative is available on the Site as necessary or as required by the Engineer.

The Contractor shall submit his Quality Assurance Plan as required at **Appendix-3 / Annexure 1 of Section VIII - Employer Requirements** for the design required by the Contract.

2. REQUIREMENTS DURING DESIGN PHASE

- (1) The principal requirements of the Design Phase are the production of the Preliminary Design, the Definitive Design and Good for Construction Drawings (GFC).

(2) Preliminary Design

The Preliminary Design shall incorporate guidelines provided in tender documents and conceptual arrangements submitted. In addition, general construction methods and documentation needed to develop the Definitive Design shall be submitted.

- (3) Definitive Design shall accord with and incorporate the Contractor's Technical Proposals and shall be the

design developed to the stage at which all elements of the structures are fully defined and specified and in particular:

- (a) Calculation and analysis are complete;
 - (b) All main and all other significant elements are delineated;
 - (c) All tests and trials and all selection of materials and equipment are complete;
 - (d) Shall take full account of the effect on the Permanent Works of the proposed methods of construction and of the Temporary Works.
- (4) During the preparation of the Definitive Design, the Contractor shall complete all surveys investigations and testing necessary to complete the design of the Permanent Works.
- (5) The Contractor shall sub-divide the proposed Definitive Design into Design Packages to be submitted in advance of the Definitive Design Submission and to be identified in the Design submission Programme. The Design Packages are to relate to the significant and clearly identifiable parts of the proposed Definitive Design and shall address the design requirements as described herein. The Design Packages shall facilitate the review and understanding of the definitive Design as a whole and shall be produced and submitted in an orderly sequential and progressive manner.
- (6) Separate Definitive Design Submissions may be prepared for those major elements to be procured by sub-contract and which sub-contracts include design. Where such work is to be procured by the Contractor on the basis of outline design, design briefs and performance specifications, such documents may be submitted as Definitive Design Submissions.
- (7) Upon issue of the Notice in respect of the Definitive Design Submission, the Contractor shall complete the design in all respects and produce the GFC Drawings, the purpose of which is to illustrate all the Permanent Works and to be the drawings governing construction.
- (B) GFC Drawings shall fully detail for the construction of the elements covered by the Definitive Design and shall show in full the works to be constructed.

3. REQUIREMENTS DURING CONSTRUCTION PHASE

- (1) The principal requirements relating to design during the Construction Phase are the production of Working Drawings, the preparation of technical submissions as required under the Contract, the compilation of the Final Design and the production of the As-Built Drawings.
- (2) Working Drawings shall be prepared as required under the Contract. They shall be endorsed by the Contractor as being in accordance with the GFC Drawings.
- (3) The Contractor shall endorse the submissions required under the contract that "all effects of the design comprising the submission on the design of adjacent or other parts of the works have been fully taken into account in the design of these parts"
- (4) At least 3 months but not more than 6 months prior to the anticipated date of substantial completion of the Works, the Contractor shall submit the Final Design to the Engineer.

- 5) The Final Design is the design of the Permanent Works embodied in:
- (a) The latest revisions of the documents comprised in the Definitive Design, taking account of comments in the schedules appended to Notices of No Objection
 - (b) The latest revisions of the GFC Drawings.
 - (c) The calculations (see Clause 11 herein); and
 - (d) Such other documents as may be submitted by the Contractor at the request of the Engineer to illustrate and describe the Permanent Works and for which a Notice has been issued.
- (6) The Contractor shall maintain all records necessary for the preparation of the As-Built Drawings. Upon completion of the Works or at such time as agreed to or required by the Engineer, the Contractor shall prepare drawings which, subject to the Engineer's agreement, shall become the As-Built Drawings. All such drawings shall be endorsed by the Contractor as true records of the construction of the Permanent Works and of all temporary works that are to remain on the site. The Contractor shall also show the locations of utilities exposed and retained as directed.

4. DESIGN INTERFACES WITH DESIGNATED CONTRACTOR

The Contractor shall coordinate all design and installation works with the various Designated contractors and establish the Co-ordinated Installation Plan (CIP). The coordinated installation Plan (CIP) shall be developed by the contractor in a format acceptable to the Engineer. The Contractor shall co-ordinate with all interfacing designated contractors to produce a detailed programme of access dates, equipment delivery routes and occupation periods for each room and area inside the station envelope. The CIP shall be signed off by each Designated Contractor and Submitted to the Engineer not later than **3 (Three) months** before basic structure is completed as described in **Annexure-3 of Section VIII, Employers' Requirement**.

5. DESIGN SUBMISSIONS

5.1. PRELIMINARY DESIGN

SUBMISSION GENERAL

The preliminary design shall provide initial design documents for review and shall be sufficiently detailed to show the design of main elements and documents required for preparation of the definitive design. It shall also include:

- a) The quality assurance plan for design
- b) A review of the outline design criteria
- c) The submission of design manuals
- d) The submission of proposed software
- e) The preliminary equipment layouts and details
- f) The preliminary maintenance analysis
- g) The preliminary off-site testing recommendation
- h) The submission of specifications proposed for the work
- i) The identification of design codes and standards
- j) The CAD procedures
- k) Deleted
- l) Preliminary viaduct/Bridge sizing
- m) An alignment review
- n) The preliminary construction methodology
- o) The design submission programme (update)
- p) The utility diversion plan
- q) Proposed site surveys and other field surveys
- r) A review of permanent land requirement
- s) The preliminary ground treatment and building protection proposal.
- t) The preliminary reinstatement drawings.

5.2. DEFINITIVE DESIGN SUBMISSION**1. GENERAL**

The Definitive Design Submission shall be a coherent and complete set of documents properly consolidated and indexed and shall fully describe the proposed Definitive Design. In particular, and where appropriate, it shall define:

- (a) The dimensions of all major features, structural elements and members.
- (b) All materials.
- (c) Potential forces and movements due to all possible loadings and actions on the structures, and their accommodation.
- (d) All second order effects.
- (e) The layout and typical details of reinforcement in structural concrete members.
- (f) The locations and nature of all relevant joints and connections and details thereof.
- (g) Standard details.
- (h) Location, geometry and setting-out of all main elements and features.
- (i) Electrical and mechanical services and equipment and their interaction with the structures.
- (j) Provisions and proposals for construction interfacing with the Designated Contractors.
- (k) Utilities to be diverted/supported.
- (m) Traffic or other civic service affected.

2. DRAWINGS

The Definitive Design Submission shall include drawings that shall illustrate the proposed Definitive Design and in particular shall include, without limitation:

- (i) General arrangements.
- (ii) Layouts and details of structural elements.
- (iii) Associated fittings.
- (iv) Structural and surface drainage
- (vii) Existing and proposed utilities.
- (viii) Road works and works related to traffic management including decking.

3. CONTRACT SPECIFICATION

The Specification included in the tender documents together with the Outline Design Specification and Outline Construction Specifications shall be amplified so as to specify comprehensively the design and construction of the Permanent Works.

DESIGN MANUAL

The Design Manual shall incorporate all design requirements, standards, codes, loading cases, permissible movements and deflections, limit states, design-stresses and strains, material properties and all other documents or matters which are relevant to and govern the design. The Design Manual shall refer to all materials, codes and standards used, making clear their specific applications. The Design Manual shall be produced so that it can be used by those involved in the preparation or review of the design of the Permanent Works as a comprehensive reference text and efficient working document.

INTERFACE REPORT ON DESIGNATED CONTRACTS

This will include the following:

Details of the design and construction of the Works adjacent to other contracts. Details of provisions for the Designated Contractors, indicating arrangements for accesses, fixings, casting- in, openings, supports, decks, manholes, trenches, and the like; updated interface management plan relating to design

integration and co-ordination.

TESTING AND COMMISSIONING REPORT

Details of proposals for testing and commissioning procedures for all relevant elements and equipment contained in the Permanent Works.

MAINTENANCE REPORT

A report updating the Statement of Maintainability in the tender documents and Detailing maintenance routines necessary for the achievement of the required life of the various elements of the Works.

AESTHETICS

REPORT: BRIDGE

AESTHETICS:

Bridge structures are important landmarks and play a significant impact in the collective experience of the built environment. Hence there is a clear need for these structures to be, put in simple words, good looking & aesthetically pleasing.

1. The general arrangement shall have good proportions, of harmonic proportions between length and height, between span clearance and depth, between the supporting and the supported structures
2. The product, or the structure, must be shaped in a way to allow easy fabrication or construction. This means that the material used has an influence on the design. The final shape should also display special qualities of the material, for instance high strength should lead to slenderness or gracefulness.
3. All sharp edges shall generally and preferably rounded off with minimum 50 mm radius curves.
4. All surfaces beyond 1 m width shall be provided with aesthetically designed grooves, as approved by Authority/Employer. Grooves, wherever provided shall be on the vertical plane to avoid accumulation of dust.

The following bridge aesthetic aspects shall be considered in design:

5. Bridges shall have a minimum structural depth consistent with their spans and method of construction.
6. The design of bridges shall address the slenderness aspects of the structure and consider the effects of the parapets and all other elements of the structure in the determination of the apparent visual slenderness.
7. All structures shall present smooth, clean lines and continuous lines.
8. Bridge proportions shall represent spanning and supporting requirements and shall respond to the context of the individual bridge localities.
9. Length of spans shall be maximised where practical, within the context of the necessary bridge length and constructability.
10. Bridge structural elements such as piers, sill beams and abutments shall be aesthetically integrated.
11. The bridge deck, kerb and barriers shall extend beyond the deck units to prevent water staining of the units to improve aesthetics.
12. All the elements of superstructure and substructure shall be gracefully harmonized (angles, curbs, shapes, geometry, etc.) to ensure aesthetics.
13. Drip moulds / Drip Courses shall be provided monolithically with the structural concrete.

14. Form Finishes: All exposed surfaces shall be necessarily form finished to category Finish F4.

To meet with requirements for F4 finish, forms shall be manufactured in a skilful, workmanlike manner, accurately to dimensions. There should be no visible offsets, bulges, or misalignment of concrete. At construction joints, the forms shall be rightly set and securely anchored close to the joint. Abrupt and gradual irregularities shall not exceed 3mm. All joints or any infirmities in the surfaces shall be made good to be absolutely uniform, at no extra cost.

SPECIFICATION FOR FORMWORK

1.0 FORMWORK FOR EXPOSED CONCRETE SURFACES

The facing formwork shall be specifically approved by the Engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure:

- 1.1 Plain slab soffit, and sides of beams, girders, joists and ribs and side of walls, fins, parapets, pardis (Roofing Material), sun-breakers, etc shall be made with Steel plates not less than 4mm thick of specified sizes stiffened with a suitable structural framework and fabricated true to plane.
- 1.2 Bottoms of beams, girders and ribs, sides of columns shall be made with steel plates not less than 5mm thick of specified sizes stiffened with a suitable structural framework and fabricated true to plane.
- 1.3 For Precast segments, piers, pier heads, portals etc. suitable steel form work is to be used unless otherwise specified by Engineer.

2.0 FORMWORK FOR SLOPED SURFACES

- 2.1 Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration, inspection and finishing of the concrete, as approved by Engineer In-Charge.
- 2.2 The formwork shall be built in such a way so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 2 horizontals: 1 vertical shall be formed as required herein.
- 2.3 All construction joints shall be harmoniously treated, as per the directions of Engineer In-Charge, at no extra cost.

3.0 FORMWORK FOR CURVED SURFACES

- 3.1 The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form lumber shall be built up of laminated splices cut to make tight, smooth form surfaces.
- 3.2 After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature, as directed by the Engineer In-Charge

4.0 AESTHETIC FINISHES

Special approved aesthetic finishes like grooves, logos, engravings/projections in inset and out set as per the approved design shall be provided by fixing monolithic rubber forms or any other approved material fixed on the entire surface of the form work. The shore hardness of the rubber shall ensure strength, flexibility, and elasticity. The rubber shall be cold cured (preferably polyurethane based) and fixed to the formwork under controlled conditions in shade and air temperature.

The form liners should be shrinkage free, solvent free and should be impervious to abrasion by Concrete, resistant to concrete pressure and heat resistant as per latest NFPA guidelines. Formwork liner fixation should be factory made under close tolerances and stage inspections.

If proprietary system of formwork is used, detailed information as given below herein shall be furnished to Engineer for approval before use.

4.1. GENERAL

- a. The information which the manufacturer is required to supply shall be in such detail as to obviate unsafe erection and use of equipment due to the intention of the manufacturer not having been made clear or due to wrong assumptions on the part of the Contractor.
- b. The Contractor shall refer unusual problems of erection/assembly not in keeping with intended use of equipment, to the manufacturer of the equipment.

4.2. THE MANUFACTURERS OF PROPRIETARY SYSTEMS SHALL SUPPLY THE FOLLOWING INFORMATION.

- a. Description of basic functions of equipment.
- b. List of items of equipment available, giving range of sizes, spans, and such like, with manufacturer's identification number or other references.
- c. The basis on which safe working loads have been determined and whether the factor of safety given applies to collapse or yield.
- d. Whether the supplier's data are based on calculations or tests. This shall be clearly stated as there may be wide variations between results obtained by either method.
- e. Instructions for use and maintenance, including any points which require special attention during erection, especially where safety is concerned.
- f. Detailed dimensional information, as follows:
 - i. Overall dimensions, depths and widths of members.
 - ii. Line drawings including perspectives and photographs showing normal uses.
 - iii. Self-weight.
 - iv. Full dimensions of connections and any special positioning and supporting arrangements.
 - v. Sizes of members, including tube diameters and thicknesses of material.
 - vi. Any permanent camber built into the equipment.
 - vii. Sizes of holes and dimensions giving their positions.
 - viii. Manner of fixing including arrangements for sealing joints.
 - ix. Method of de-stripping, storing & shifting.
- g. Data relating to strength of equipment as follows:
 - i. Average failure loads as determined by tests.
 - ii. Recommended maximum working loads for various conditions of use.
 - iii. Working r e s i s t a n c e 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.

5.0 SUPPORTING DOCUMENTS

The Definitive Design Submission shall be accompanied by the following documents, which will be considered by the Engineer in his review of the Definitive Design Submission. Where relevant or required, these documents shall be accompanied by a design note stating clearly how information has been used in the design of the Permanent Works.

GEOTECHNICAL INTERPRETATIVE REPORT

A report including site investigation results and covering the geotechnical interpretation of site investigation work including that undertaken by the Contractor in sufficient detail to confirm and justify parameters used in the foundation and geotechnical designs. The report shall include the full logs and descriptions of confirmatory boreholes drilled by the Contractor.

SURVEY REPORT

A report on all survey work undertaken by the Contractor, including checks on mapping, survey stations, co-ordinates and setting-out. Updated topographical and survey drawings shall also be included.

UTILITIES REPORT

A report giving details of arrangements and working methods in respect of the existing utilities, including protection measures, diversions, reinstatements and programme allowances.

TEMPORARY WORKS DESIGN REPORT

A report which provides sufficient information on the design of the Temporary Works to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

CONSTRUCTION / INSTALLATION ANALYSIS REPORT

A report containing a stage-by-stage construction / installation sequence for all structures / equipment.

CONSTRUCTION METHOD STATEMENT

A report which provides sufficient information on the methods of construction, execution and launching systems proposed and Contractor's Equipment to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

PROJECT SCHEDULE REVIEW

- (i) The Contractor shall, prior to submitting the Definitive Design Submission, review the Project Schedule against the current version of the Design Submission Programme.
- (ii) In the event that the Contractor considers that there are any discrepancies or inconsistencies between the Design Submission Programme and the Project Schedule, the Contractor shall submit with the Definitive Design Submission its proposed revisions to the Project Schedule such that the discrepancies or inconsistencies are removed.
- (iii) The Contractor shall provide details of submissions of the proposed Working Drawings and their anticipated timing during the Construction Phase and shall identify information required from or actions to be undertaken by the Employer or others which are necessary to permit the completion of the design of the Permanent Works and the Working Drawings. Desired Dates for the receipt required by the Contractor of such information or for the completion of such actions shall be included with appropriate justification.

REPORT ON THE USE OF WORKS AREAS

A report updating the proposals from those contained in the Contractor's Technical Proposals for the use of Works Areas and their reinstatement and accesses facilities.

6.0 NOTICES ON DEFINITIVE DESIGN SUBMISSION

The Contractor may make Definitive Design Submissions and seek separate Notices in respect of:

- (a) The temporary works for construction of the viaduct/Bridge works (Wherever required).
- (b) All works related to the viaduct/Bridge sections.
- (c) Major elements as identified under Clause 2(6) herein.

The issue of such separate Notices under (a) and (b) above shall be conditional upon the Contractor having demonstrated, to the satisfaction of the Engineer, that the effect of each structure on other structures, utilities, etc., has been fully accommodated in the design.

6.1 Submission of Design Data

In the case of submissions subsequent to the Definitive Design, the Design Data shall be in accordance with Employer's Requirements and the Definitive Design.

The Contractor shall submit to the Engineer all Design Data, together with the relevant Design Certificates certified by the Contractor, on or before the respective dates for submission shown on the Design Submission Programme or, as the case may be, the Works Programme. In the event that a re-submission of Design Data is required, such re-submission shall be made as soon as practicable after the receipt of the relevant statement of objections. All submissions of Design Data shall include the copies as stipulated in the Employer's Requirements.

Following receipt of a submission of Design Data the Engineer shall, within 28 days, return one copy of the Design Data to the Contractor, together with either a Notice of No-Objection, or a statement of objections which shall identify the aspects of the Design Data which do not conform to the above requirements. If the Engineer returns any Design Data with a Notice of No Objection, the Contractor shall proceed with the Works in accordance with the Contract.

If the Engineer provides that revisions to a submission of Design Data/ are appropriate but that such revisions are of minor design significance, the Engineer may issue a Notice of No Objection subject to an appended schedule of comments identifying the relevant revisions. The Contractor shall revise such Design Data in accordance with such comments but shall not be obliged to re-submit such Design Data solely on account of such revisions.

If the Engineer returns any Design Data with a statement of objections the Contractor shall revise the Design Data to take account of the stated objections and re-submit such Design Data to the Engineer, together with new Design Certificates signed by the Designer and the Contractor.

The issue of a Notice of No Objection in relation to any submission of Design Data shall be entirely without prejudice to the review of subsequent submissions of Design Data or to any subsequent request for a Contractor's Variation, and shall not bind or fetter the Engineer in any manner whatsoever when deciding whether or not to raise objections in relation to any subsequent submission of Design Data or when dealing with a subsequent request for a Contractor's Variation.

Neither an objection raised to the Design Data nor revisions of minor design significance under this Clause will, under any circumstances, constitute an Employer's Variation.

7.0 DESIGN SUBMISSIONS - GFC DRAWINGS SUBMISSIONS

- (1) The GFC Drawings shall be derived directly from the Definitive Design and shall detail and illustrate in full the Permanent Works. The Construction' Reference Drawings shall form part of the Working Drawings to be used for construction purposes.
- (2) Prior to any GFC Drawings Submission, the Contractor shall prepare a full list of GFC Drawings in order to demonstrate, to the satisfaction of the Engineer, that such GFC Drawings will be sufficient in extent to cover the construction of the whole of the Permanent Works.
- (3) Unless otherwise required by the Engineer, the GFC Drawings need not include bar bending schedules, bar reference drawings, fabrication or shop drawings as well as other schedules or erection drawings which are to be provided by the Contractor during the Construction Phase.

8.0 DESIGN SUBMISSIONS – CONSTRUCTION PHASE

- (1) On the issue of a Notice in respect of the GFC Drawings the Contractor shall produce the proposed Working Drawings. These- shall either be identical to the GFC Drawings or shall be further drawings developed in accordance with the GFC Drawings such as site sketches, bar bending schedules, bar reference drawings, fabrication and shop drawings, construction erection sequences and the like. All such drawings shall comply with the requirements of the Contract.
- (2) Prior to submission of the proposed Working Drawings, the Contractor shall endorse the appropriate original paper drawings as "Good for Construction". If the Engineer so requires, the endorsed original shall be submitted to the Engineer who shall, if he has no objection to the contents of the submission, further endorse the original by stating that he has no objection to the proposed Working Drawings. On the endorsement by the Engineer, the original forthwith be returned to the Contractor as the Working Drawings.
- (3) Only the Working Drawings endorsed as in 7(2) above or those that the Engineer has expressly stated as not requiring his endorsement shall be issued to the Site. The construction of the Works shall be strictly in accordance with these Working Drawings.
- (4) The contractor shall finalize details of the proposed method of construction and submit such finalised details to the Engineer for review. The proposed method shall have no adverse effects on the partially completed Permanent Works and shall ensure the Works are statically and, if appropriate, aerodynamically stable.
- (5) The Contractor shall undertake and submit a stage-by-stage construction sequence and the effect of any Temporary Works and the Contractor's Equipment on the Permanent Works. This analysis shall be in sufficient detail to demonstrate that the Contractor's proposals are safe and have no adverse effects upon any parts of the Permanent Works.
- (6) As-Built Drawings, endorsed by the Contractor shall be submitted to the Engineer for agreement.

9.0 DESIGN SUBMISSIONS - REVIEW PROCEDURES

- (1) Submissions of Design Data shall be made and reviewed by the Engineer. The form and detail of the review shall be as determined by the Engineer and will not release or remove the contractor's responsibility for the design under the contract.
- (2) The issue of a Notice shall be without prejudice to the issue of any future Notices.
- (3) The Contractor shall, prior to the submission of the Design Data, obtain all required and/or statutory approvals that relate to that submission including, where appropriate, the approval of the Concerned Government Authorities and utility undertakings, and demonstrate that all required approvals have been obtained.
- (4) All submissions shall be accompanied by two original copies of a 'Design Certificate' as set out in Attachment - D1 hereto and signed by the Contractor and the Designer.

10.0 DESIGN SUBMISSION PROGRAMME

- (1) The Contractor shall prepare the Design Submission Programme which is to set out fully the Contractor's anticipated programme for the preparation, submission and review of the Design Packages, the Definitive Design Submission and the GFC Drawings Submissions and for the issue of Notices in relation thereto.
- (2) The Design Submission Programme shall:
 - (a) Be consistent with and its principal features integrated into the Works Programme and show all relevant Key Dates.
 - (b) Identify dates and subjects by which the Engineer's decisions should be made.
 - (c) Make adequate allowance for periods of time for review by the Engineer and other review bodies.

- (d) Make adequate allowance for the design and development of specialist works.
 - (e) Include a schedule identifying, describing, cross-referencing, and explaining the Design Packages into which the Contractor intends to divide the Definitive Design and GFC Drawings; and
 - (f) Indicate the Design Interface and Co-ordination periods for each Designated Contractor.
- (3) The Contractor shall submit the Design Submission Programme to the Engineer within thirty (30) days of the date of Notice to Proceed, and thereafter up-dated versions thereof at intervals of not more than one (1) month throughout the Design Phase.

11.0 PROGRAMME FOR SUBMISSIONS DURING CONSTRUCTION PHASE

In accordance with Clause 4 of the employer requirements – General, the contractor shall identify submissions required during the construction phase.

12.0 CALCULATIONS

- (1) Unless otherwise required by the Engineer, calculations relevant to the Definitive Design and GFC Drawings shall be submitted for review with the respective Design Packages or Submissions. The Engineer may require the submission of applicable software including in house software programmes / worksheets developed by the Contractor, computer input and programme logic for its review prior to the acceptance of the computer output.
- (2) The Contractor shall prepare and submit a comprehensive set of calculations for the Definitive Design in a form acceptable to the Engineer. Should the design of the Permanent Works be revised thereafter, and such revision renders the calculations as submitted obsolete or inaccurate, the Contractor shall prepare and submit the revised calculations.
- (3) Similarly, the Contractor shall submit such further calculations as have been prepared in connection with the GFC Drawings.
- (4) Calculations to be included as part of the submission herein shall comprise the up-to-date calculations in respect of the Definitive Design, the GFC Drawings and such further calculations which the Contractor has prepared during the production of Working Drawings.
- (5) The Contractor shall submit all calculations necessary to support proposals relating to the construction methods.

13.0 DOCUMENTS REQUIREMENTS

- (1) Drawings shall be prepared generally to A1 size, but to ISO A0 size where appropriate. **Appendix - 9 / Annexure - 1 of Section VIII, Employer Requirements** to these Employers Requirements defines the Drawings and CAD Standards required for drawing preparation and submittal.
- (2) The Contractor shall submit 7 copies of his design and/or drawings for review by the Engineer. After receipt of "No Objection" from the Engineer's Representative, the Contractor shall submit 7 copies of design and/or drawing for the use of the Engineer.
- (3) The submission of drawings may be by CAD Media files and **Appendix - 9 / Annexure -1, Section VIII, Employer Requirements** to these Employers Requirements specifies the drawing submission requirements for CAD Media files.

14.0 LIABILITY FOR REVIEW OF DOCUMENTS AND DRAWINGS

Except to the extent expressly provided in this Agreement:

- (a) no review, comment or approval by the Authority or the Authority's Engineer of any Document or Drawing submitted by the Contractor nor any observation or inspection of the construction of the Railway Project nor the failure to review, approve, comment, observe or inspect hereunder shall relieve or absolve the Contractor from its obligations, duties and liabilities under this Agreement, Applicable Laws, and Applicable Permits; and

- (b) the Authority shall not be liable to the Contractor by reason of any review, comment, approval, observation, or inspection referred to in Sub-clause (a) above.

ATTACHMENT D 1**DESIGN CERTIFICATE**

This design Certificate refers to design submission no which comprises of Definitive Design submission / GFC Drawings submission, working drawing submission scheduled in the attached transmittal, in respect of:

(Description of Permanent Works to which the submission refers)

DESIGNER'S STATEMENT:

We certify that:

- a) The outline designs, design briefs and performance specifications of those elements of the Permanent works as illustrated and described in the documents scheduled in the attached transmittal, complies with the design basis criteria and other contract provisions.
- b) An in-house check has been undertaken and completed to confirm the completeness, adequacy, and validity of the design of the Permanent Works as illustrated and described in the documents scheduled in the attached transmittal.
- c) All necessary and required approval relating to the design of the Permanent Works, as illustrated, and described in the documents listed in the attached transmittal, have been obtained.
- d) All effects of the design comprising the submission on the design of adjacent or other parts of the works have been fully taken into account in the design of those parts.

Signed by Designer's Authorized Representative Name :

Position :

Date :

CONTRACTOR'S CERTIFICATE:

The Certifies that all design has been performed utilizing the skill and care to be expected of a professionally qualified and competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us and the design proposed by the designer has been accepted by us.

Signed by Contractor's authorized representative.

Name :

Position :

Date :

Note 1

The Contractor shall insert one of the following, as applicable:

- (i) The Contractor's Technical Proposals
- (ii) The Contractor's Technical Proposals and Design Packages Nos for which a Notice of No Objection has been issued.
- (iii) Design Packages Nos for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.
- (iv) The Definitive Design.

SAMPLE DRAWING TEMPLATE(a) Design Quality Assurance' by designer & contractor:

DESIGN QUALITY ASSURANCE			
The responsibility of control, Check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the design consultants and the contractor.			
By Designer			By Contractor
Sig:	Sig:	Sig:	Sig:
<u>Date:</u>	<u>Date:</u>	<u>Date:</u>	<u>Date:</u>
<u>Name:</u>	<u>Name:</u>	<u>Name:</u>	<u>Name:</u>
<u>Designed By</u>	<u>Checked by</u>	<u>Approved by</u>	<u>Accepted by</u>

(b) Notice of 'No Objection' from Engineer's representatives:

Notice of 'No Objections' from Engineer's			
	Remarks	Date	Signature
Chief Design Expert	Reviewed		
Deputy Project Director	Reviewed & comments as marked on drawing		
Project Director	Reviewed & No objection issued with comments as marked on Drawing		

Section C

[Contractor to attach copies of necessary and required approvals]

SECTION D**EMPLOYER'S REQUIREMENTS -CONSTRUCTION****1. CONTRACTORS SUPERINTENDENCE**

- (1) The Contractor shall submit a Staff Organization Plan in accordance with the ITT/Employer's Requirement. This plan shall be updated and resubmitted whenever there are changes to the staff. The plan shall show the management structure and state clearly the duties, responsibilities, and authority of each staff member.
- (2) The site agent and his associates/supervisors shall have experience and qualification appropriate to the type and magnitude of the Works. Full details shall be submitted of the qualifications and experience of all proposed staff to the Engineer for his approval.

2. CHECKING OF THE CONTRACTOR'S TEMPORARY WORKS DESIGN

The Contractor shall, prior to commencing the construction of the Temporary Works, submit a certificate to the Engineer signed by him certifying that the Temporary Works have been properly and safely designed and checked and that the Contractor has checked the effect of the Temporary Works on the Permanent Works and has found this to be satisfactory. The contractor to obtain the approval for designs and drawings of temporary structures from Railways and CRS as applicable. The necessary assistance will be given by Engineer / Employer.

3. THE SITE

- (1) Works Areas are those areas identified in **Annexure-1 to these Employer's Requirements** and on the Drawings.

No land shall be made available by the employer for casting yard, site offices, and site laboratories. Contractor shall make his own arrangements at his own cost. In case the Railway land is arranged adjacent to near to Railway track for casting of Segmental Box, I-Girders / U-Girders & for initial erection and launching activity temporarily, the necessary land rent / lease charges shall be levied as per Railway guidelines /Bi-RIDE norms and the same will deducted from RA bills of the Contractor.

USE OF THE SITE

- (2) The Site or Contractor's Equipment shall not be used by the Contractor for any purpose other than for carrying out the Works in the scope of this contract, except that, with the consent in writing of the Engineer, the Site or Contractor's Equipment such as batching and mixing plants for concrete and bituminous materials may be used for the work in connection with other contracts under the Employer.
- (3) Rock crushing plant shall not be used on the Site.
- (4) The location and size of each stockpile of materials, including excavated materials, within the Site shall be as permitted by the Engineer. Stockpiles shall be maintained at all times in a stable condition.
- (5) Entry to and exit from the Site shall be controlled and shall be only available at the locations for which the Engineer has given his consent.

ACCESS TO THE SITE

- (6) The Contractor shall make its own arrangements, subject to the consent of the Engineer, for any further access required to the Site.
- (7) In addition, the Contractor shall ensure that access to every portion of the Site is continually available to the Employer and Engineer.
- (8) Following the handover of the Railway Envelope, (as defined in the Employer's Requirements- General), to the Employer, the Employer will control the Railway Envelope and will be responsible for all matters relating to security and safety therein. Access to the Railway Envelope by the Contractor shall be in accordance with any procedure's requirements and conditions.

ACCESS TO OUTSIDE THE SITE

- (9) The Contractor shall be responsible for ensuring that any access or egress through the Site boundaries are controlled such that no disturbance to residents or damage to public or private property occur as a result of the use of such access or egress by its employees and sub-contractors.

SURVEY OF THE SITE

- (10) A survey shall be carried out of the Site to establish its precise boundaries and the existing ground levels within it. This survey shall include a photographic survey sufficient to provide a full record of the state of the Site before commencing the work with particular attention paid to those areas where reinstatement will be carried out later on. The survey shall be carried out before the site clearance wherever possible and in any case prior to the commencement of work in any Works Area. The survey shall be carried out by the Contractor and agreed with the Engineer.

BARRICADES AND SIGN BOARDS

- (11) The Contractor shall erect barricades and gates around its areas of operations to prevent entry by unauthorized persons to his Works Areas and necessary identity cards /permits should be issued to workers and staff by the contractor. The Contractor shall submit proposal for barricades of the complete perimeter of all works areas to the Engineer. The safety barricading as per Drawing No. Bi-RIDE/ BSTP/ C4/TD/BD/04/01&02 with Contractor's material labour including foundation works are required adjacent to IR tracks along the alignment for ensuring the safety of running trains. The temporary barricades of 2m heights of line MS sheets 16 gauge as per Bi-RIDE drawing are required to be provided near to IR/BSTP boundary. Painting of the barricades shall be carried out to the design and colours as directed by the Engineer and the Contractor shall carry out re- painting of the entire barricades on an annual basis. No work shall be commenced in any Works Area until the Engineer has been satisfied that the barricades installed by the Contractor are sufficient to prevent, within reason, unauthorized entry.
- (12) Project signboards shall be erected within four (4) weeks, or such other period as the Engineer has given his consent, after the date of commencement of the Works. The types, sizes and locations of project signboards shall be agreed with the Engineer before manufacture and erection. Other advertising signs shall not be erected on the Site. The cost of these signboards is included in quoted price.
- (13) The consent of the Engineer shall be obtained before hoardings, fences, gates, or signs are removed. Hoardings, fences, gates, and signs which are to be left in positions after the completion of the Works shall be repaired and repainted as instructed by the Engineer.
- (14) Hoardings, barricades, gates, and signs shall be maintained in clean and good order by the Contractor until the completion of the Works, whether such hoardings, fences, gates, and signs have been installed by the Contractor or by others and transferred to the Contractor during the period of the Works. All the fencing, hoardings, gates, and signs etc. shall be mopped minimum once in a week and washed monthly.
- (15) All hoardings, barricades, gates, and signs installed by the Contractor shall be removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.
- (16) Hoarding/ barricades can be reused after removing from one place to other locations / sites provided they are in good condition and approved by Engineer.
- (17) Damage/worn-out barricades /hoarding shall be replaced by contractor within 24 hours. Engineer's decision regarding need for replacement shall be final and binding and if no action is taken by contractor, the Engineer may get it repaired through other agency and the cost of any repairs will be deducted by the Engineer from any payment due to the contractor.

CLEARANCE OF THE SITE

- (18) All Temporary Works which are not to remain on the Site after the completion of the Works shall be removed prior to completion of the Works or at other times instructed by the Engineer. The Site shall be cleared and

reinstated to the lines and levels and to the same condition as existed before the Works started except as otherwise stated in the Contract.

4. SURVEY

- (1) While doing the survey work, the fact that similar work will have to be done once again on the completed earth work in formation for fixing up the longitudinal levels of the installed P. Way should be kept in view.
- (2) The Contractor to fix alignment reference points at regular intervals all along the alignment. The contractor along with the Engineer should verify the details of these alignment pillars. If any mistakes are detected in these details, the same should be indicated to the Engineer before starting any work. These detected mistakes should be corrected by the Contractor in consultation with the Engineer. These corrections should be got approved from the Engineer.
- (3) The Contractor shall relate the construction of the Works to the Site Grid. To facilitate this, survey reference points have to be established by the contractor and benchmarks in the vicinity of the Site.
- (4) Before the Contractor commences the setting out of the Works, the Contractor shall satisfy itself that there are no conflicts and shall establish and provide all subsidiary setting out points, monuments, towers, and the like which may be necessary for the proper and accurate setting out and checking of the Works.
- (5) The Contractor shall carefully protect all the survey reference points, benchmarks, setting out points, monuments, towers and the like from any damages and shall maintain them and promptly repair or replace any points damaged from any causes whatsoever. The Contractor shall regularly recheck the position of all setting out points, benchmarks and the like to the satisfaction of the Engineer.
- (6) The survey reference points will become the responsibility of the Contractor. The Contractor shall, by annual or more frequent review, ensure that these survey points continue to remain consistent with the benchmarks.

5. SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS

The Contractor shall comply with in the conditions stipulated in the Conditions of contracts on Safety, Health & Environment (SHE) including ESMP plan attached with SHE manual.

5.1 TRAINING OF CONTRACTOR'S EMPLOYEES/STAFF/WORKERS: -

Contractor shall provide a training/workshop on Safety, Health & Environment (SHE) to all its workers/staff/employees/subcontractors of at least 2 weeks (96hrs.) at the time of induction. Before postings of any his workers/staff/employees/subcontractors, the contractor shall give a certificate that the said person had undergone the requisite SHE training. Non-compliance of the above will invoke penalties as per condition of contract on SHE, **Section-8C** of Tender document.

In case of any mishap/ accident-causing death/injury to public or damage to public/private property or damage to public/private vehicles or damage to Railway property, the employer, will impose a penalty to the contractor as deemed fit and appropriate in addition to the cost of damage caused due to the mishap/accident.

5.2 USE OF "TRACTOR TRANSMISSION TYPE" PICK AND CARRY HYDRA CRANE: -

"Tractor Transmission type" Pick and Carry Hydra crane - 1st Generation model is prohibited at BSTP works, Contractor shall mobilize "Truck Transmission type" pick and carry hydra crane - 2nd Generation model only.

6. OTHER SAFETY MEASURES

SITE SAFETY, HEALTH & ENVIRONMENT PLAN

- (1) The Contractor shall, within 60 days of the date of Notice to Proceed, prepare and submit to the Engineer for review his proposed Safety, Health and Environment plan which shall contain as a minimum those items set out in Conditions of Contract on Safety, Health & Environment Plan.

FIRE REGULATIONS AND SAFETY

- (2) The Contractor shall provide and maintain all necessary temporary fire protection and firefighting facilities on the Site during the construction of the Works and shall comply with all requirements of the Karnataka Fire Services Department. These facilities may include, without limitation, sprinkler systems and fire hose reels in temporary site buildings, raw water storage tanks and portable fire extinguishers suitable for the conditions on the Site and potential hazards.
- (3) The Contractor shall submit details of these facilities to the Engineer for review prior to commencement of work on the Site.
- (4) If, in the Engineer's opinion, the use of naked lights may cause a fire hazard, the Contractor shall take such additional precautions and provide such additional firefighting equipment (including breathing apparatus) as the Engineer considers necessary. The term "naked light" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.
- (5) Oxyacetylene burning equipment will not be permitted in any confined space; Burning equipment of the oxypropane type shall be used.

HAZARD AND RISK ASSESSMENTS

- (6) The Contractor shall, prior to the commencement of any operation carry out a detailed hazard and risk assessment. The results of such assessments shall be recorded, and the records kept for inspection by the Engineer.
- (7) The Contractor shall produce detailed method statements for all medium and high-risk operations and shall submit them to the Engineer for his consent prior to commencement of any task to which they relate.
- (8) The Contractor shall produce and implement a Permit to Work system for all high-risk operations. The Permit to Work system shall be submitted to the Engineer for consent before application.

EXPLOSIVES

- (9) Explosives shall not be used without prior written consent of the Engineer. Before consent to blasting is granted, the Contractor shall prepare a Specification as to the size of charge, the method of firing and any other restrictions that may be imposed from time to time.
- (10) Where the Engineer has consented to the use of explosives, the Contractor shall be responsible for obtaining the requisite licences and permits for complying with all statutory requirements for blasting.
- (11) The storage, transportation and use of explosives shall at all times be governed by the Explosives Acts and such other statutory regulations which may be applicable and as imposed by the Statutory Authority.

LAUNCHING GIRDER/ LAUNCHING CRANE

- (12) No Launching Girder or Launching Crane shall be used without written consent of the Engineer.
- (13) The Contractor shall prepare a detailed design, specification & method statement for the operation of Launching Girder and submit it to the Engineer for review and approval.

STANDBY EQUIPMENT

- (14) The Contractor shall provide adequate stand-by equipment to ensure the safety of personnel, the Works, and the public. These measures shall include as a minimum the following: -
 - (a) stand-by pumping and generating equipment for the control of water.
 - (b) stand-by equipment and spares for illumination of the Works; and
 - (c) stand-by generating equipment and equipment for the lighting for the works.

CO-OPERATION

- (15) The Contractor shall provide full co-operation and assistance in all safety surveillance carried out by the Engineer or the Employer. Any breaches of the Site Safety Plan or the statutory regulations or others

disregard for the safety of any persons may be the reason for the Engineer to exercise his authority to require the site agent's removal from the Site.

7. CARE OF THE WORKS

- (1) Any error in the execution of work leading to redesign work shall be duly compensated by the contractor as per the decision of Engineer. Any error attributable to the construction including failure to locate underground utilities shall attract penalties.
- (2) Unless otherwise permitted by the Engineer all works shall be carried out in dry conditions.
- (3) The works, including materials for using in the works, shall be protected from damage due to water. Water on the site and water entering the site shall be promptly by temporary drainage or pumping system or by other methods capable of keeping the works free of water. Silt and debris shall be removed by traps before the water is discharged and shall be disposed off at a location or locations to which the engineer has given his consent.
- (4) The discharge points of the temporary systems shall be as per the consent of the engineer. The contractor shall make all arrangements with and obtain the necessary approval from the relevant authorities for discharging water to drains, watercourses etc. The relevant work shall not be commenced until the approved arrangements for disposal of the water have been implemented.
- (5) The methods used for keeping the works free of water shall be such that settlement of, or damage to, new and existing structure does not occur. Measures shall be taken to prevent floatation of new and existing structures.

PROTECTION OF THE WORKS FROM WEATHER

- (6) Work shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.
- (7) Permanent Works, including materials for such Works, shall be protected from exposures of weather conditions that may adversely affect such Permanent Works or materials.
- (8) During construction of the Works storm restraint systems shall be provided where appropriate. These systems shall ensure the security of the partially completed and ongoing stages of construction and in all weather conditions. Such storm restraint systems shall be installed as soon as practicable and shall be compatible with the Right of Access or other access around or through-out the Site.
- (9) The contractor shall at all-time programme and order progress of the work and make all protective arrangements such that the works can be made safe in the event of storms.

PROTECTION OF THE FINISHED WORKS

- (10) The finished works shall be protected from any damage that could arise from any activities on the adjacent site/ works.

8. DAMAGE AND INTERFERENCE

- (1) Work shall be carried out in such a manner that there is no damage to or interference with:
 - (a) watercourses or drainage systems; (b) utilities; (c) structures (including foundations), roads, including street furniture, or other properties; (d) public or private vehicular or pedestrian access; (e) monuments, trees, graves, or burial grounds other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works. Heritage structures shall not be damaged or disfigured on any account. The Contractor shall inform the Engineer as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers need to be removed or diverted to enable the Works to be carried out. Such items shall not be removed or diverted until the consent of the Engineer to such removal or diversion has been obtained.
- (2) Items which are damaged or interfered with as a result of the Works and items which are removed to

unable work to be carried out shall be reinstated to the satisfaction of the Engineer and to at least the same condition as existed before the work started. Any claims by Utility Agencies due to damage of utilities by the Contractor shall be borne by the Contractor.

UTILITIES

- (3) Please refer Employer's Requirement –Functional

STRUCTURES, ROADS, AND OTHER PROPERTIES

- (4) The Contractor shall immediately inform the Engineer of any damage to structures, roads or other properties.

ALTERNATIVE ACCESS

- (5) Alternative access shall be provided to all premises if interference with the existing access, public or private, is necessary to enable the Works to be carried out. The arrangements for the alternative access shall be as agreed by the Engineer and the concerned agency. Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed immediately as it is no longer required, and the ground surfaces reinstated to the satisfaction of the Engineer. Proper signage and guidance shall be provided for the traffic / users regarding diversions.

REMOVAL OF GRAVES AND OTHER OBSTRUCTIONS

- (6) If any graves and other obstructions are required to be removed in order to execute the Works and such removal has not already been arranged for, the Contractor shall draw the Engineer's attention to them in good time to allow all necessary arrangements and authorizations for such removal, and it shall not itself remove them unless the Engineer has given consent.

PROTECTION OF THE ADJACENT STRUCTURES AND WORKS

- (7) The Contractor shall take all necessary precautions to protect the structures or works being carried out by others adjacent to and, for the time being, within the Site from the effects of vibrations, undermining and any other earth movements or the diversion of water flow arising from its work.

9. WORK ON ROADS

(1) TRAFFIC MANAGEMENT PLAN

The Contractor shall develop a detailed Traffic Management Plan for the work under the contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighbourhoods impacted by the construction activities. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract.

PRINCIPLES FOR TRAFFIC MANAGEMENT

The basis for the Plan shall take into consideration four principles:

- a. to minimize the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities.
- b. to ensure the safety of road users in the impacted area.
- c. to facilitate access to the construction site, and to maintain reasonable construction progress.
- d. to ensure traffic safety at each construction site.

INTEGRATED TRAFFIC MANAGEMENT PLAN

The Contractor shall prepare an integrated plan showing the arrangements to be made for accommodating road and pedestrian traffic, at individual construction sites and continuously along the alignment, to smooth traffic operations and for the safety of both construction workers and road users. The Plan shall consider different measures such as:

- i. Proper phasing and timing of traffic signals.
- ii. Modifications to intersection geometry.
- iii. Changes in lane usage.
- iv. Parking prohibitions.
- v. Relocation of bus stops.
- vi. Reducing width of footpaths & median
- vii. Right turn prohibition.
- viii. Work site access management.
- ix. Minimizing the duration of any road closure.
- x. Reversible lane operations.
- xi. Modification of roadway alignment affected by the construction, which shall be in conformance with the requirements and regulations defined by the relevant authorities; and may include widening of roads, Construction of temporarily new road etc.
- xii. other traffic engineering measures as may be applicable.

(2) MITIGATION OF TRAFFIC DISTURBANCES

The Contractor shall manage the vehicular and pedestrian Right of Access during the period of construction. The Contractor shall take account of the need to maintain essential traffic requirements, as these may influence the construction process.

The Contractor shall include local traffic diversion routes and assess traffic impacts caused by the construction in the affected areas. Signage layout shall be included to ensure that adequate motorist information will be provided for traffic diversions.

Where it becomes necessary to close a road or intersection, or supplementary lanes are required to satisfy the traffic demands, traffic diversion schemes to adjacent roadways shall be developed with quantitative justifications. The Contractor shall co-ordinate with all relevant authorities.

Other considerations include:

- i. The minimum lane widths for fast traffic and mixed traffic shall follow the regulations of the different authorities.
- ii. Any roads or intersections that have no alternative access shall not be fully closed for construction.
- iii. Emergency access to all properties shall be maintained at all times.
- iv. Access to business premises and property shall be maintained to the extent that normal activities are not seriously disrupted.
- v. Minimum footpath width shall be 1.5 m, unless otherwise indicated. The footpath shall be separated from vehicle traffic and not necessarily immediately adjacent to vehicle traffic.
- vi. Where existing footbridges and underpasses are demolished or closed, provisions shall be made for pedestrian crossing to minimise the conflicts between a traffic lane.
- vii. Construction traffic shall be separated from other traffic wherever possible.
- viii. Any traffic related facilities (bus stops, parking, etc.) which are affected by the construction works shall be maintained or relocated to appropriate locations.
- ix. Motorists, pedestrians, workmen, plant and equipment shall be protected from accident at all times.
- x. Roadway designs, traffic management schemes, and installation of traffic control devices shall be in conformance with the requirements and regulations defined by the relevant authorities. And
- xi. Where applicable, utility diversions shall be incorporated in the traffic management plan.

(3) APPROVAL FOR TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL

The Contractor shall make all arrangements with and obtain the necessary approval from the transport authorities and the Police Department for temporary traffic arrangements and control on public roads. In the

event that the Contractor, having used its best endeavours, fails to secure the necessary approval from the transport authorities and the Traffic Police Department for temporary traffic arrangements and control on public roads, then the Employer will use its best endeavours to assist the Contractor to secure such approval but without responsibility on the part of the Employer to do so.

(4) TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL

- i. Temporary traffic diversions and pedestrian routes shall be surfaced and shall be provided where work on roads or footpaths obstruct the existing vehicular or pedestrian access. The relevant work shall not be commenced until the approved temporary traffic arrangements and control have been implemented.
- ii. Temporary traffic arrangements and control for work on public roads and footpaths shall comply with the requirements of the Traffic Police. Copies of documents containing such requirements shall be kept on the Site at all times.
- iii. Temporary traffic signs, including road marking, posts, backing plates and faces, shall comply with the requirements the traffic police and should be in accordance with the requirements of Ministry of Surface Transport. All overhead traffic management signs that are fixed to bridges and gantries shall be illuminated at night. Pedestrian routes shall be illuminated at night to a lighting level of not less than 50 lux.
- iv. Adequate number of traffic guards, supervisors and in charge shall be deployed for smooth regulation of traffic.
- v. Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night. Lights and signs shall be kept clean and legible. Equipment which are damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced promptly.

(5) PARTICULARS OF TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL

The following particulars of the proposed temporary traffic arrangements and control on public roads shall be submitted to the Engineer for consent at least 28 days before the traffic arrangements and control are implemented:

- (a) details of traffic diversions and pedestrian routes.
- (b) details of lighting, signage, guarding and traffic control arrangements and equipment.
- (c) any conditions or restrictions imposed by Traffic Police or any other relevant authorities, including copies of applications, correspondence, and approval.

Where concrete barriers are used to separate flows of traffic, the barriers shall be in a continuous unbroken line. No gaps shall be left between any section of the barrier.

Site perimeter fencing and barriers along the roadway, shall have flashing amber lights positioned on the top of them every 50 meters apart and at every abrupt change in location. Directly below the flashing light shall be fixed, in the vertical position, a white fluorescent, with a waterproof cover.

(6) USE OF ROADS AND FOOTPATHS

Public roads and footpaths on the Site in which the work is not being carried out shall be maintained in a clean and passable condition.

1. Measures shall be taken to prevent the excavated materials, silt or debris from entering gullies on roads and footpaths, entry of water to the gullies shall not be obstructed.
2. Surfaced roads on the Site and leading to the Site shall not be used by tracked vehicles unless protection against damage is provided.

3. Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall be washed, when necessary, before leaving the Site to avoid the deposition of mud and debris on the roads.

(7) REINSTATEMENT OF PUBLIC ROADS AND FOOTPATHS

1. Temporary diversions, pedestrian access, and lighting, signing, guarding and traffic control equipment shall be removed immediately when they are no longer required. Roads, footpaths, and other items affected by temporary traffic arrangements and control shall be reinstated to the same condition as existed before the work started or as permitted by the Engineer immediately after the relevant work is complete or at other times permitted by the Engineer.
2. The contractor shall submit his design for the reinstatement to the relevant authorities and obtain their prior approval to carrying out the work. Reinstatement works shall include:
 - i. Parking bays
 - ii. Footpath and kerbs
 - iii. Road Signage
 - iv. Street Lighting
 - v. Landscaping
 - vi. Traffic Lights and Control Cable
 - vii. Road painting

10. SITE ESTABLISHMENT: SITE LABORATORIES

- (1) The Contractor shall provide, erect, and maintain in a clean, stable and secure condition a laboratory, equipped for the routine testing of concrete, soil and rock samples and for the storage and curing of concrete cubes or cylinders only. This laboratory shall be located at the Contractor's principal work site or at a location agreed to by the Engineer. Detailed requirements for this laboratory are set out in **Appendix 14 / Annexure 1 of Section VIII , Employers' Requirement.**

(2) CONTRACTOR'S SITE ACCOMMODATION

The Contractor shall provide and maintain its own site accommodation at locations consented to by the Engineer. Offices, sheds, stores, mess rooms, garages, workshops, latrines and other accommodation on the Site shall be maintained in a clean, stable and secure condition. Living accommodation shall not be provided on the Site. The Contractor shall comply with the requirements of **Appendix 13 / Annexure 1 of Section VIII, Employers' Requirement.**

(3) LATRINES AND WASH PLACES

The Contractor shall provide latrines and wash places for the use of its personnel and all persons who will be on the Site: The size and disposition of latrines and wash places shall accord with the numbers and dispositions of persons entitled to be on the Site, which may necessitate their location on structures and, where necessary there shall be separate facilities for males and females. The capacities and layout shall be subject to approval of the Engineer. The Contractor shall arrange regular disposal of effluent and sludge in a manner that shall be in accordance with local laws/ regulations & as per approved SHE norms.

- (4) The Contractor shall be responsible for maintaining all latrines and wash places on the Site in a clean and sanitary condition and for ensuring that they do not pose a nuisance or a health threat. The Contractor shall also take such steps and make such provisions as may be necessary or directed by the Engineer to ensure that vermin, mosquito breeding etc. are at all times controlled.

(5) SITE UTILITIES AND ACCESS

- (a) The Contractor shall be responsible for providing water, electricity, telephone, sewerage and

drainage facilities for contractor's site offices, structures and buildings and for all site laboratories in accordance with **Appendix 14 / Annexure 1 of Section VIII, Employers' Requirement** to these Employer's Requirements and all such services that are necessary for satisfactory performance of the Works. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant civil and utility authorities for the facilities.

(b) The contractor shall be responsible for provision of power supply for his works including for launching girder and the like. The Employer cannot guaranty provision of adequate, continuous power supply however assistance will be given in obtaining the necessary permissions for site generators and the like.

- (6) Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, acceptable, and stable condition. For lengths of roadway longer than 100 m and heavy commercial vehicle are to ply the Contractor shall provide paved surfacing of adequate thickness and quality to the satisfaction the Engineer.

SUBMISSION OF PARTICULARS

- (7) The following particulars shall be submitted to the Engineer for his consent not more than thirty (30) days after the date of commencement of the Works:
- (a) drawings showing the formation works and the layout within earmarked area for the Contractor's offices, project signboards, principal access and other major facilities required early in the Contract, together with all service utilities.
 - (b) drawings showing the details to be included on the project signboards and diversion boards.
- (8) Drawings showing location of stores, storage areas, concrete batching plants and other major facilities and their access roads/paths shall be submitted to the Engineer for his consent as early as possible but in any case, not less than twenty-eight (28) days prior to when such facilities are intended to be constructed on the Site.

11. SECURITY

- (1) The Contractor shall be responsible for the security of the site for the full time the site is in its possession, except for the specific case of the Railway Envelope after handover to the Railway Operator. It shall set up and operate a system whereby only those persons entitled to be on the Site can enter the Site. To this end, the Contractor shall with the consent of Engineer provide the specific points only at which entry through the security fence can be affected, and shall provide gates and barriers at such points of entry and whereby maintain a twenty-four (24) hours security guard, and such other security personnel and patrols elsewhere as may be necessary to maintain security.
- (2) The Contractor shall maintain all site boundary fences in first class condition and shall so arrange site boundary fences at all access/drainage points of work areas that its use of such access points etc., are not restricted by the system or method of achieving the required security measures. Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.
- (3) During the progress of the Works the Contractor shall maintain such additional security patrols over the areas of the Works as may be necessary to protect its own and its subcontractor's work and equipment.
- (4) In order to operate such a security system, it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Site, and which may need to be separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system, and the design of passes to suit the requirements of the foregoing and to suit the methods of work to be adopted by the Contractor. The Contractor shall at all times ensure that the Engineer has an up-to-date list of all persons entitled to be on the Site at any time. The contractor shall also introduce a system of issue passes to any outsider or person/vehicles belonging to agencies other than employer/Engineers who may have to visit the site in connection with work.

- (5) The Contractor shall liaise with the Designated Contractors and the contractors responsible for the adjacent and other interfacing contracts and ensure that coordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the Site and/or the adjacent sites.
- (6) Security and checking arrangements as felt necessary shall be provided with advice and help of Police.
- (7) Contractor's as well as his Subcontractor's employees and representative shall wear Identification Badges (cards), uniforms, helmets, safety shoes/gum boots & other safety/protection wear as directed by Engineer, and to be provided by the Contractor. Badges shall identify the Contractor/ Subcontractor and show the employee's name and number and shall be worn at all times while at site.
- (8) All vehicles used by the Contractor/ Subcontractor shall be clearly marked with the Contractor's / Sub Contractor's name or identification mark.
- (9) The Contractor shall co-ordinate and plan the security of both the works under this Contract and the works of other engaged in adjacent and interfacing contractor's and requiring access to the site. In order to operate such a security system, it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Site, system of separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system including the design of passes to suit the requirements of the foregoing and to suit the methods of works to be adopted by the Contractor. The Contractor shall at all times ensure that the Engineer has an up-to-date list of all persons entitled to be on the Site at any time. The Contractor shall also introduce a system for issue of passes to any outsider or persons/ vehicles belonging to agencies other than Employer/ Engineer who may have to visit the site in connection with work.

12. TESTING - GENERAL

- (1) The Contractor shall provide and perform all forms of testing procedures applicable to the Works and various components and the interfacing of the Works with the other Contract works and shall conduct all necessary factory, site, and acceptance tests.
- (2) All testing procedures shall be submitted at least thirty (30) days prior to conducting any Test. The Testing procedures shall show unambiguously the extent of testing covered by each submission, the method of testing, the Acceptance Criteria, the relevant drawing (or modification) status and the location.
- (3) The testing Procedures shall be submitted as required, by the contractor during the duration of the contract to reflect the changes in system design or the identification of additional testing requirements.
- (4) The Engineer shall have the facilities for monitoring all tests and have access to all testing records. Ample time shall be allowed within the testing programmes for necessary alterations to equipment, systems and designs to be undertaken, together with re-testing prior to final commissioning.
- (5) All costs associated with the Testing shall be borne by the Contractor, unless otherwise specified, including the services of any specialized personnel or independent assessors. The Contractor shall also bear any expenses incurred due to resetting caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.
- (6) Unless agreed in writing by the Engineer, the personnel engaged on testing shall be independent of those directly engaged in the design or installation of the same equipment.
- (7) All testing equipment shall carry an appropriate and valid calibration label.

BATCHES SAMPLES AND SPECIMENS

- (8) A batch of material is a specified quantity of the material that satisfies the specified conditions. If one of the specified conditions is that the material is delivered to the Site at the same time, then material delivered to the Site over a period of a few days may be considered as part of the same batch if in the opinion of the Engineer there is sufficient proof that the other specified conditions applying to the batch apply to all of the material delivered over the period.
- (9) A sample is a specified quantity of material that is taken from a batch for testing, and which consists of a specified amount, or a specified number of pieces or units, of the material.
- (10) A specimen is the portion of a sample that is to be tested.

SAMPLES FOR TESTING

- (11) Samples shall be of sufficient size and in accordance with relevant Standards to carry out all specified tests.
- (12) Samples taken on the Site shall be selected by, and taken in the presence of, the Engineer and shall be suitably marked for their identification. An identification marking system should be evolved at the start of works in consultation with the Engineer.
- (13) Samples shall be protected, handled, and stored in such a manner that they are not damaged or contaminated and such that the properties of the sample do not change.
- (14) Samples shall be delivered by the Contractor, under the supervision of the Engineer, to the specified place of testing. Samples on which non-destructive tests have been carried out shall be collected from the place of testing after testing and delivered to the Site or other locations instructed by the Engineer. '
- (15) Samples which have been tested may be incorporated in the Permanent Works provided that:
 - (a) the sample complies with the specified requirements.
 - (b) the sample is not damaged; and
 - (c) the sample is not required to be retained under any other provision of the Contract.
- (16) Additional samples shall be provided for testing if in the opinion of the engineer:
 - (a) material previously tested no longer complies with the specified requirements; or
 - (b) material has been handled or stored in such a manner that it may not comply with the specified requirements.

TESTING

The Contractor shall be responsible for all on-site and off-site testing and for all in-situ testing. All appropriate laboratory tests shall be carried out in the Contractor's laboratory, unless otherwise permitted or required by the Engineer. Where the laboratory is not appropriately equipped and/or staffed for some tests, or if agreed to by the Engineer, tests may be carried out in other laboratories. All materials required approval of Engineer after 3rd party test at approved or reputed laboratory at the discretion of engineer.

Authority & Engineer in charge may recommend any test pertain to work or material to any laboratory of repute if they are accredited for the relevant work to a standard acceptable to the Engineer. The cost of such tests shall be borne by contractor.

- (17) In-situ tests shall be done in the presence of the Engineer.
- (18) Equipment, apparatus and materials for in-situ tests and laboratory compliance tests carried out by the Contractor shall be provided by the Contractor. The equipment and apparatus shall be maintained by the Contractor and shall be calibrated before the testing starts and at regular intervals as permitted by

the Engineer. The equipment, apparatus, and materials for in situ tests shall be removed by the Contractor as soon as practicable after the testing incomplete.

- (19) The Contractor shall be entitled in all cases to attend the testing carried out in the Employer's or other laboratories, to inspect the calibration certificates of the testing machines and to undertake the testing on counterpart samples. Testing of such samples shall be undertaken in laboratories complying with Clause 12 above and particulars of the laboratory proposed shall be submitted to the Engineer for consent prior to the testing.
- (20) Attendance on tests, including that by the Engineer, Contractor, and Designer, shall be as laid down in the Quality Assurance procedures.

COMPLIANCE OF BATCH

- (21) The results of tests on samples or specimens shall be considered to represent the whole batch from which the sample was taken.
- (22) A batch shall be considered as complying with the specified requirements for a material if the <2 results of specific tests for of the specified properties comply with the specified requirements for the properties.
- (23) If additional tests are permitted or required by the Engineer but separate compliance criteria for the additional tests are not stated in the Contract, the Engineer shall determine if the batch complies with the specified requirements for the material on the basis of the results of all tests, including the additional tests, for every property.

RECORDS OF TESTS

- (24) Records of in-situ tests and laboratory compliance tests carried out by the Contractor shall be kept by the Contractor on the Site and a report shall be submitted to the Engineer within seven (7) days, or such other time stated in the Contract or in the Quality Assurance Programme, after completion of each test. In addition to any other requirements, the report shall contain the following details:
 - (a) material or part of the works checked
 - (b) location of the batch from which samples were taken or location of the part of the works.
 - (c) place of testing.
 - (d) date and time of tests.
 - (e) weather conditions in the case of in-situ tests.
 - (f) technical personnel supervising or carrying out the tests.
 - (g) size and description of samples and specimens.
 - (h) method of sampling.
 - (i) properties tested.
 - (j) method of testing.
 - (k) readings and measurements taken during the tests;
 - (l) test results, including any calculations and graphs;
 - (m) specified acceptance criteria; and
 - (n) other details stated in the Contract.
- (25) Reports of tests shall be signed by the site agent or his assistant, or by another representative authorized by the Contractor.
- (26) If requested, records of tests carried out by the Employer's staff or by the Engineer shall be given to the Contractor.

13. RECORDS

DRAWINGS PRODUCED BY THE CONTRACTOR

- (1) Drawings produced by the Contractor including drawings of site layouts, Temporary Works, etc. for submission to the Engineer shall generally be to ISO A1 size. They shall display a title block with the information as detailed in

Appendix - 9 / Annexure - 1 Section VIII, of Employers' Requirement to these Employer's Requirements. The number of copies to be submitted to the Employer / Engineer shall be as stated in the Contract, or as required by the Employer / Engineer.

PROGRESS PHOTOGRAPHS

- (2) The Contractor shall provide monthly progress photographs which have been properly recorded to show the progress of the works to the Employer / Engineer. The photographs, of not less than 72 in number, shall be taken on locations agreed with the Employer / Engineer to record the exact progress of the Works. Two sets of photographs shall be provided on Memory Device with two sets of colour prints of 175 mm x 125 mm size.
- (3) The Contractor shall mount each set of each month's progress photographs in a separate album of a type to which the Engineer has given his consent and shall provide for each photograph two typed self-adhesive labels, one of which shall be mounted immediately below the photograph and one on the back of the photograph. Each label shall record the location, a brief description of the progress recorded and the date on which the photograph was taken.
- (4) All photographs shall be taken by a skilled photographer whose name and experience shall be submitted to the Engineer for consent and approval received. Processing shall be carried out by a competent processing firm to the satisfaction of the Engineer.
- (5) The Contractor shall ensure that no photography is permitted on the Site without the agreement of the Engineer. Contractor should be aware of the legal regulations and conditions with regard to Photography in 'RESTRICTED AREA' in Bangalore.

RECORDS OF WAGE RATES

- (6) The Contractor shall keep monthly records of the average, high and low wage rates for each trade/tradesman employed on the Site and records shall be made available to the Engineer during inspection.

14. MATERIALS

- (1) Materials and goods for inclusion in the Permanent Works shall be new unless the Engineer has consented otherwise. Preference shall be given to local materials where available. Approved Manufacturers/Suppliers of few important items have been given in **Section VIII B, Technical specifications**. These materials shall be procured only from these manufacturers/Suppliers. Under special circumstances provision of sub para 4 below may be invoked.
- (2) Certificates of tests by manufacturers which are to be submitted to the Engineer shall be current and shall relate to the batch of material delivered to the Site. Certified true copies of certificates may be submitted if the original certificates could not be obtained from the manufacturer.
- (3) Parts of materials which are to be assembled on the Site shall be marked to identify the different parts.
- (4) Materials which are specified by means of trade or proprietary names may be substituted by materials from a different manufacturer which has received the consent of the Engineer provided that the materials are of the same or better quality and comply with the specified requirements.
- (5) Samples of materials submitted to the Engineer for information or consent shall be kept on the Site and shall not be returned to the Contractor or used in the Permanent Works unless permitted by the Engineer. The samples shall be used as a mean of comparison which the Engineer shall use to determine the quality of the materials subsequently delivered. Materials delivered to the Site for use in the Permanent Works shall be of the same or better quality as the samples which have received consent.

PROVISION AND DISPOSAL OF EARTHWORKS MATERIALS

- (6) The Contractor shall be responsible for the provision of all classes of earthworks material required for the Works, whether sourced from the excavations within the Contract or obtained from any other

sources, which are located outside the Site, for which the Engineer has given the consent.

- (7) For fill or dumping sites, the Contractor shall prepare a land plan with details of surface drainage requirements, final formation levels, spreading and compaction of the fill during dumping acceptable to the Engineer. The Contractor shall also provide security for such sites.
- (8) All excavated material, excluding waste material, bentonite/polymer fluid and bentonite/polymer contaminated material shall be disposed of at the appointed site only. This material shall be placed and compacted in accordance with the Construction Specification for Earth Works or as otherwise directed by the Engineer's Representative. The disposal of waste material shall be the full responsibility of the Contractor, and these materials shall be disposed of by the Contractor at an approved location & complying to SHE norms. No dumping sites will be provided by the Employer.
- (9) Rock deposited as fill material at the dumpsites shall be capable of compaction with single pieces no larger than 300mm.

15. PROVISIONS FOR DESIGNATED CONTRACTORS

- (1) The contractor shall make all reasonable provision to accommodate the fastenings and fixings of the designated contractors. Such provisions will be notified by the designated contractors during design interface stage. The contractor shall take a lead in developing the interface management Plan (IMP) with respect to the other contracts having interfacing with the works under the scope of present contract. The IMP will be prepared in conjunction with the other designated contractor to cover all aspects of the implementation of the interface works required. The IMP will define the interface works necessary to complete all the works under this contract.

16. RESTORATION OF AREAS DISTURBED BY CONSTRUCTION.

Unless otherwise directed by the engineer, any area disturbed by the construction activity, either inside or outside the project Right of Access, shall be reinstated as follows:

All areas affected by the construction work shall be reinstated to their original condition, with new materials, including but not necessarily limited to, sidewalks, parking lots, access roads, and adjacent roads, properties, and landscaping. Grass cover shall be provided for any bare earth surface areas, along with proper provisions for surface drainage.

17. CONTRACTORS LABOUR CAMPS

- (1) The employer will not provide living accommodation for use of the contractor or any of his staff or labour employed on the works. Living accommodation shall not be established on any land provided to the contractor by the employer for the works.

- (2) Provisions of Labour Camps.

The contractor, shall, at his own expense make adequate arrangements for the housing, supply of drinking water and provisions for bathrooms, latrines, and urinals, with adequate water supply for his staff as well as for workman employed on the works directly or through subcontractors at the locations authorized by engineers. No labour camp shall be allowed at work site or any unauthorized place.

The contractor at his own cost shall maintain all camp site in a clean and sanitary conditions, the contractor shall obey all health and sanitary rules and regulations and carry out at his cost all health and sanitary measures, that may from time to time be prescribed by the local/medical authorities and permit inspection of all health and sanitary arrangements at all times by the employer, the employer and the staff of the local municipality or the other authority concerned. Should the contractor failed to provide adequate health and sanitary arrangement these shall be provided by the Employer and the cost will be recovered from the contractor.

The contractor shall, at his own cost, provide first-aid and medical facilities at the labour camp and at work sites on the advice of the medical authority consistent with the strength of the contractor's staff and workman, employed directly or through subcontractors.

The contractor shall at his own cost, provide the following minimum requirements for meeting the fire hazards.

- i. Portable fire extinguishers
- ii. Manual fire alarms
- iii. Water supply for use by the fire service.

The contractor at his own cost shall provide necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers. He should also ensure that electrical installations done by trained electricians. These installations shall be maintained, and daily maintenance record must be made available for inspection by the engineer.

(3) CAMP DISCIPLINE

The contractor shall take requisite precautions, use his best endeavours to prevent any riotous or unlawful behaviour by or amongst his workmen, others, employed directly or through sub- contractors. These precautions shall be for the preservation of the peace and protection of the inhabitants and the security of the property in the neighbourhood of the Works. In the event of the Employer requiring the maintaining of a Special Police Force at or in the vicinity of the site, during the tenure of the work, the expenses thereof shall be borne by the contractor and if paid by the Employer, shall be recoverable from the contractor.

The sale of alcoholic drinks or other intoxicating drugs or beverages upon the work, in any labour camp, or in any of the buildings, encampments or tenements, own or occupied by, or with the control of, the contractor or any of his personnel employed on the work directly or through sub-contractors shall be forbidden, and the contractor shall exercise his influence and authority to secure strict compliance with this condition. The contractor shall also ensure that no labour or employees are permitted to work at the site in an intoxicated state or under the influence of drugs.

The contractor shall remove from his camp such labour and their families, as refuse protective inoculation and vaccination when called upon to do so by the Engineer on the advice of his Medical Authority. Should Cholera, Plague or any other infectious disease break out, the Contractor shall at his own cost burn the huts, bedding, cloths and other belongings of or used by the infected parties. The contractor shall promptly erect new heads on healthy sides as required by the Employer. Within the time specified by the Employer, failing which the work may be done by the Employer and the cost recovered from the Contractor.

(4) LABOUR ACCOMODATION

The contractor shall provide living accommodation that is equal to or exceeds the minimum criteria established in the following sub-sections, needed to house his staff as well as workers employed directly or through sub-contractor. The buildings shall be constructed so as to have a minimum life of not less than the length of contract.

- (a) The roof shall be watertight and laid with suitable non-flammable materials. permissible for residential use under local regulation and for which the consent of the Engineer has been obtained.
- (b) Each hut shall have suitable ventilation. All doors, windows, and ventilators shall be provided with security leaves and fasteners. Back-to-back units may be avoided.
- (c) The minimum height of each unit shall be 2.1m and shall have separate cooking place.
- (d) Suitable number of common toilets / bathrooms shall be provided.

(5) WATER SUPPLY

The contractor shall provide an adequate supply of water for the use of labours in the camp. The provisions shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where

pipled water supply is available, supply shall be at stand post and where the supply is from wells or river, tanks that may be of metal or masonry shall be provided. The contractor shall also at his expense make arrangements for the provision and laying of water pipelines from the existing mains wherever available and shall pay for all the fees and charges thereof.

(6) DRAINAGE

The contractor shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy. Surface water shall be drained away from the paths and roads and shall not be allowed to accumulate into ditches or ponds where mosquitoes can breed.

(7) SANITATION

The contractor shall make arrangements for conservancy and sanitation in the labour camps according to the rules and regulations of the Local Public Health and Medical Authorities.

The contractor shall provide a sewerage system that is adequate for the number of the residents in the camp, and which meets the requirements of the Municipal Authorities.

SECTION E

GENERAL PLANNING CRITERIA

PURPOSE AND SCOPE

The purpose of this Appendix is to include other criteria and requirements not included elsewhere that are necessary for the full development and Detailed Design of Viaduct/Bridge.

OUTLINE DESIGN CRITERIA FOR VIADUCT/BRIDGE PORTION

1. GENERAL

- 1.1 This Outline Design Criteria and the Appendices hereto provide minimum standards which are to govern the design of the Permanent Works.
- 1.2 The Outline Design Criteria shall be read in conjunction with the other contract documents including the Outline Construction Specifications.
- 1.3 The Design of the Permanent Works shall comply with codes of practice and standards current at the time of submission of Tender Documents, Regulations made and requirements issued by the Indian Government and by relevant utility companies shall be followed and specified.
- 1.4 Alternative or additional codes, standards and specifications proposed by the Contractor shall be internationally recognized codes and shall be equivalent to or better than, Indian Standards subject to being, in the opinion of the Engineer, suitable for incorporation into the Specifications.

2. CODES AND STANDARDS

Design and loading requirements for the structures shall be not less than the following Indian Standards and Codes of Practice, together with all applicable amendments.

Where other standards and codes of practice are referred to in the text of other Appendices then the designer is expected to apply those Standards and Codes of Practice unless the designer can show that an economic case exists for use of an Indian Standard. However, preferences of codes will be as follows: -

- i. IRS
- ii. IS
- iii. IRC
- iv. AASHTO

INDIAN RAILWAY STANDARDS (IRS)

- IRS - Bridge Rules for loading (Min. of Railway) IRS- Code of practice for Steel bridges.
- IRS - Code of practice for plain, reinforcement and pre-stressed concrete for general Bridge construction, latest revision.
- IRS - Code of practice for the design of substructures and foundation of bridges.

INDIAN ROADS CONGRESS (IRC) STANDARDS (WITH LATEST REVISIONS, ADDENDUM & CORRECTIONS)

- IRC 5: 1985 Standard Specifications and Code of Practice for Road Bridges, Section I
 – General Features of Design
- IRC 6: 2000 Standard Specifications and Code of Practice for Road Bridges, Section II
 – Loads and Stresses

IRC 10:	1961	Recommended Practice for Borrow pits for Road Embankments Constructed by Manual Operation
IRC 19:	1977	Standard Specifications and code of Practice for Water Bound Macadam
IRC 21:	2000	Standard Specifications and code of Practice for Cement Concrete (PCC& RCC)
IRC 22:	2008	Standard Specifications and Code of Practice for Road Bridges, Section VI – Composite Construction for Road Bridges
IRC 24:	2010	Standard Specifications and Code of practice for Road Bridges, Section V – Steel Road Bridges
IRC 36:	2010	Recommended Practice for the Construction of Earth Embankments for Road Works
IRC 37:	1984	Guidelines for the Design of Flexible Pavement
IRC 45:	1972	Recommendations for Estimating the Resistance of Soil below the maximum Scour Level in the Design of Well Foundations of Bridges
IRC 48:	1972	Tentative Specifications for Bituminous surface Dressing using Pre-coated Aggregates
IRC 75:	1979	Guidelines for the Design of High Embankments
IRC 78:	2014	Standard Specifications and Code of Practice for Road Bridges, Section VII (Parts 1 and 2), foundations and Substructure.
IRC 83:	1999	Standard Specifications and code of practice for Road Bridges, Section IX
IRC 83:	2002	Standard Specifications & Code of Practice for Road Bridges, Part-III Pot, Pot-Cum-PTFE, Pin and Metallic Guide Bearings
IRC 87:	2011	Guidelines for the Design and Erection of False Work for Road Bridges
IRC 112:	2011	Code of Practice for Concrete Road Bridges
1RC: SP 11	1958	Handbook of quality Control for Construction of Roads and Runways.
1RC: SP 65	2018	Guidelines for the Design and Construction of Segmental Bridges.
1RC: SP 71	2006	Guidelines for the Design and Construction of Precast Pre tensioned Girders.

IS: CODES: NATIONAL BUILDING CODE

SP 7:	2015	Bureau of Indian Standards
1S 73:	1992	Paving Bitumen
1S 215:	1995	Road Tar
1S 217:	1988	Cutback Bitumen
1S 226:	1975	Structural steel (standard quality)
1S 269:	2013	Spec s for Ordinary and low heat Portland Cement
1S 278:	1978	Galvanised steel barbed wire for fencing
1S 280:	1978	Mild Steel wire for general engineering purposes
1S 281:	2009	Mild Steel siding door bolts for use with Padlocks
1S 383:	1970	Coarse and fine aggregates
1S 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
1S 455:	1989	Portland slag cement
1S 456:	2000	Code of practice for plain and reinforced concrete
1S 457:	1957	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures
1S 460:	1985	Test sieves

IS 515:	1959	Natural and manufactured aggregates for use in mass concrete
IS 516:	1959	Method of test for strength of concrete
IS 650:	1991	Standard sand for testing cement
IS 800:	2007	Code of practice for general construction in steel structures
IS 814:	1991	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
IS 815:	1974	Classification coding of covered electrodes for metal arc welding of structural steel
IS 823:	1964	Code of procedure for manual metal arc welding of mild steel
IS 875:	1987	Code of practice for design loads (other than earthquake) for buildings and structures (Parts I, II, IV & V)
IS 875:	2015	Code of practice for design loads (other than earthquake) for buildings and structures (Parts III)
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:	1998	Steel tubes for structural purposes
IS 1239:	1990	Mild steel tubes, tubular and other wrought steel fittings
	(Part 1) 2004	Mild steel tubes
	(Part 2) 1992	Mild steel tubular and other wrought steel pipe fittings
IS 1322:	1993	Bitumen felts for water proofing and damp-proofing
IS 1343:	2012	Code of practice for Pre-stressed Concrete
IS 1364	1992	Hexagon Head bolts, screws & nuts of product grades A & B (Part I)
IS 1489:	1991	Portland Pozzolana Cement
IS 1732:	1989	Dimensions for round and square steel bars for structural and general engineering purposes
IS 1785:	1983	Plain hard-drawn steel wire for pre-stressed concrete
	(Part 1)	Cold-drawn stress – relieved wire
	(Part 2)	As drawn wire

IS 1786:	2008	High strength deformed steel bars and wire for concrete reinforcement
IS 1791:	1985	Batch type concrete mixers
IS 1834:	1984	Hot applied sealing compound for joint in concrete
IS 1838:	1983	Pre-formed fillers for expansion joint in concrete pavements and structures (non-extruding and resilient type)
	(Part 1)	Bitumen impregnated fiber
IS 1888:	1982	Method of load tests on soils
IS 1892:	1979	Code of practice for sub surface investigations for foundations
IS 1893: Part I	2001	Criteria for earthquake resistant design of structures
IS 1893: Part II	2014	Criteria for earthquake resistant design of structures
IS 1893: Part III	2014	Criteria for earthquake resistant design of structures
IS 1893: Part IV	2005	Criteria for earthquake resistant design of structures
IS 1904:	1986	Design and construction of foundations in soils General Requirements
IS 1905:	1987	Code of practice for Structural use of unreinforced Masonry
IS 1977:	1976	Low Tensile Structural steel
IS 2062:	2006	Steel for general structural purposes
IS 2090:	1983	High tensile steel bards used in pre-stressed concrete
IS 2116:	1980	Sand for masonry mortars (first revision)
IS 2119:	1980	Code of practice for construction of brick-cum-concrete composite
IS 2386:	1963	Methods of test for aggregate for concrete
	(Part 1)	Particle size and shape
	(Part 2)	Estimation of deleterious materials and organic impurities
	(Part 3)	Specific gravity, density, voids, absorption, and bulking
	(Part 4)	Mechanical properties

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	(Part 5)	Soundness
	(Part 6)	Measuring mortar properties of fine aggregates
	(Part 7)	Alkali aggregate reactivity
	(Part 8)	Petrography examination
IS 2430:	1986	Methods of sampling of aggregate for Concrete
IS 2502	1963	Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
IS 2751:	1979	Recommended practices for welding of mild steel plain and deformed bars used for reinforced construction
IS 2911:	2010	Code of practice for design and construction of pile foundations
	(Part 1)	Concrete piles 3
	Section 1	Driven cast-in-situ concrete piles
	Section 2	Bored cast-in-situ concrete piles
	Section 3	Driven precast concrete piles
	Section 4	Bored precast concrete piles
	(Part 3)	Under-reamed piles
	(Part 4)	Load test on piles
	(2013)	
IS 2950:	1981	Code of practice for design and construction of raft foundations.
IS 3812:	2003	Fly ash for use as pozzolana and admixture
IS 3955:	1967	Code of practice for design and construction of well foundations
IS 4000:	1992	High Strength Bolts in Steel Structures- Code of Practice (First Revision)
IS 4082:	1996	Recommendations on stacking and storage of construction materials at Site
IS 4138:	1977	Safety code for working in compressed air
IS 4326:	1993	Earthquake resistant design and construction of buildings – code of Practice
IS 4656:	1968	Form vibrators for concrete
IS 4736:	1986	Hot-dip zinc coating on mild steel tubes
IS 4826:	1979	Hot-dipped galvanized coatings – round steel wires
IS 4925:	1968	Concrete batching and mixing plant

IS 4926:	1976	Ready mixed concrete
IS 4923:	1997	Hollow steel sections for structural use -specification
IS 4968:	1976	Method for sub surface sounding 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 pre-stressed concrete
IS 6006:	1983	Specification for uncoated stress relieved strands for pre-stressed concrete
IS 6403:	1981	Code of practice for determination of bearing capacity of shallow foundations
IS 6603:	1972	Stainless steel bars and flats
IS 6911:	1992	Stainless steel plate, sheet and strip
IS 7205:	1974	Safety codes for erection of structural steel work
IS 7293:	1974	Safety code for working with construction machinery
IS 7320:	1974	Concrete slump test apparatus
IS 7861:	1975	Code of practice for extreme weather concreting
	(Part 1)	For Hot Weather
	(Part 2) 1981	For Cold Weather
IS 7969:	1975	Safety code for handling and storage of building materials
IS 8009	1976	Calculation of settlement of shallow foundations

IS 8041:	1990	Rapid - hardening Portland cement
IS 8112:	1989	43 grade ordinary Portland cement
IS 8142:	1994	Method of test for determining setting time of concrete by penetration resistance
IS 8500:	1991	Structural steel-micro alloyed (medium and high strength qualities)
IS 9013:	1978	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens
IS 9103:	1979	Admixtures of concrete
IS 9284:	1979	Method of test for abrasion resistance of concrete
IS 9417:	1989	Recommendations for welding cold worked bars for reinforced concrete Construction
IS 9595:	1996	Recommendations for metal arc welding of carbon and carbon manganese steels
IS 10262:	1982	Recommended guidelines for concrete mix design
IS 10379:	1982	Code of practice for field control of moisture and compaction of soils for embankment and sub-grade
IS 11384:	1985	Code Of Practice for Composite Construction in Structural Steel and Concrete
IS 12070:	1987	Code of Practice for Design and Construction of Shallow Foundations on Rocks
IS 12269:	2013	53 grade ordinary Portland cement
IS 12894:	2002	Fly ash line bricks
IS 13920:	2016	Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces
IS 14268:	1995	Uncoated Stress Relieved Low relaxation Seven-ply Strands for Prestressed Concrete
IS 14593:	1998	Design And Construction of Bored Cast-In-Situ Piles Founded on Rocks-Guidelines.
		IS 15658 : Precast Blocks

FOREIGN STANDARDS**FOREIGN STANDARDS**

ASTM	D-297	Methods for Rubber Product Chemical Analysis ASTM D-395 Compression set of vulcanized rubber
ASTM	D-412	Tension testing of vulcanized rubber ASTM D-429 Adhesion of vulcanized rubber metal
ASTM	D-573	Accelerated ageing of vulcanized rubber by the oven method
ASTM	D-624	Tear resistance of vulcanized rubber
ASTM	D-797	Young's Modulus in flexure of elastomer at normal and subnormal temperature
ASTM	D-1149	Accelerated Ozone cracking of vulcanized rubber
ASTM	D-1559	Test for resistance to plastic flow of bituminous mixtures using Marshall Apparatus
ASTM	D-2166	Test methods for Unconfined Compressive Strength of Cohesive Soils
ASTM	0-2172	Extraction, quantitative, of bitumen from bituminous paving mixtures
ASTM	0-2240	Indentation hardness of rubber and plastic by means of a Durometer
ASTM	0-2434	Test methods for permeability of Granular Soils
ASTM	0-30B0	Method for direct shear test of soils under consolidated drained condition
ASTM	E-11	Specification for wire cloth sieve for testing purpose

AASHTO OM 57-80	Materials for embankments and sub-grade
AASHTO OM 147-67	Materials for aggregate and soil (1980) base and surface courses
AASHTO M 282-80	Joints sealants, not poured, elastomeric type,
(ASTM: D 3406)	for Portland cement cure rate pavements
AASHTO LRFD	Bridge Design Specification

Note: - The above list is not exhaustive and shall be augmented during detailed design and construction of the viaduct/Bridge.

OTHER PUBLICATIONS

Indian Standard Handbook on Steel sections Part I
Indian Railways Manual on Design and Construction of well and pile foundations.

UIC/772 - R The International Union of Railways Publication. IEC International Electromechanical Commission

UIC/772 -2R The Code for usage of Rubber Bearings for Rail Bridges

The provision of UIC-774-3 in relation to rail-structure interaction is well known and is being used in many rail-based structures.

ACI CODE -318-19: Building code requirements for structural concrete.

FIP -Recommendations for the acceptance of post-tensioning systems.

The design relating to fire safety and escape shall be in accordance with the requirements of NBC/NFPA 130 Standard for Fixed Guide way Systems.

3. BSTP ALIGNMENT

3.1 CRITERIA

- 3.1.1 Any modification to the Railway alignment design shall comply with the requirements of the project and as approved by Engineer / Employer.

4. BSTP DESIGN REQUIREMENTS

4.1 GENERAL

- 4.1.1 The Railway Envelope is defined as the extent of works to be constructed to allow installation and operation of the Railway equipment.

4.1.2 TRACK SUPPORTING STRUCTURE

The contractor shall be responsible for the first stage primary concrete for track supporting structure. Others will undertake the design of the secondary concrete, track slabs and track work under contracts with the Engineer / Employer. A fundamental obligation of the contractor is to co-ordinate and co-operate with the Track work contractor so that the design of all components of the Railway are compatible.

4.1.3 SECOND POUR CONCRETE

The Contractor will carry out the second pour concrete for the track work. In this regard, the contractor shall provide starter bars in the primary concrete pour to facilitate anchorage of the second pour concrete. The contractor shall co-ordinate with the contractor as to the size and location of the starter bars.

4.1.4 The Contractor shall provide drainage pipes, channels and catch basins to be in the first pour concrete.

4.1.5 The design of all Railways operating equipment, including signals and signalling cables, the traction power electrification equipment, electrical cables, electrical and mechanical equipment, telecommunication links, etc. that are required for the Railway will be undertaken by other contractors working with the Employer. Similar co-ordination and co-operation obligations as expressed in Clause 4.1.2 above apply.

4.1.6 The Contractor shall include in the civil works blind holes, plinths, trenches etc. as required by the other DDC. The extent and detail of such provisions are to be determined by the Contractor making due enquiries, as design co-ordination, from DDCs engaged to provide Railway-operating equipment

4.1.7 The Contractor shall include in the design, terminals as required from the continuous electrical path through the structures to external connections. The terminals shall be suitable for the connection of 35 mm² copper cable. At each connection, four such terminals shall be provided at the track level, two on each side of the viaduct/Bridge, one of which shall be kept as spare and suitably protected. Similar terminals, spare terminals and connections shall be provided over any joint of the structure.

4.1.8 General requirements for earthing and bonding the structures are to be determined in liaison with the system wide Contractor.

4.1.9 Cross bonding of the running rails, stray current return cabling etc. will be carried out by the system wide Contractor.

4.1.10 The Contractor shall take account in his design of the fact that the Contract will be integrated with others in the Project in respect of the control of stray currents and may therefore carry stray currents corrosion control measure arising from any foreseeable operating condition of the Project.

4.3 RAILWAY CROSS SECTIONS AND STRUCTURE GAUGES

4.3.1 The Kinematic Envelope for the rolling stock of the Railway, and Structure Gauges for straight and curved track as provided by Bi-RIDE is to be followed.

4.3.2 the Contractor shall ensure that the proposed size of structure is adequate to contain the equipment, required under Clause 4.1 above, outside the Structure Gauge.

4.3.3 Structures shall not infringe the clearances specified. See also Clause 4.3.2 above.

5. STRUCTURAL DESIGN CRITERIA

5.1 DESIGN LIFE Clauses 6 to 9 below define the design life and serviceability requirements for the various elements of the structures.

5.2 The design life of a structure is that period for which it is designed to fulfil its intended function when inspected and maintained in accordance with agreed procedures. The assumption of a design life for a structure or component does not necessarily mean that the structure will no longer be fit for its purpose at the end of that period. Neither will it necessarily continue to be serviceable for that length of time without adequate and regular inspection and routine maintenance.

5.3 All Design Life criteria shall be confirmed during detailed design by the Employer's Representative.

5.4 CIVIL ENGINEERING STRUCTURES

All components of Permanent Works including viaduct/Bridge structures shall be designed for a design life of 100 years.

5.5 BRIDGE BEARINGS AND MOVEMENT JOINTS

Bridge bearings and movement joints shall have a minimum design life of 50 years apart from inner components that can be replaced without complete removal and without interruption to traffic.

6. SERVICEABILITY

- 6.1 Paint systems for steelwork shall ensure a minimum life of 15 years before full maintenance painting is required.
- 6.2 The corrosion protection of non-structural steel items shall be appropriate to the accessibility of the item for inspection and maintenance.
- 6.3 Serviceability of electrical and mechanical equipment included in this Contract shall be 5 to 25 years, depending on the various items.

7. STRUCTURAL SYSTEM

Span arrangement shall be made by the Contractor. Span arrangement may have to be adjusted based on existing utilities and other street furniture. Certain restrictions for location of piers are given below: -

The structural system shall comprise of pre-stressed segmental super structure/U-Girder Superstructure, sub structure (pier & pier cap) and foundations (pile, based on above provisions. However, the Contractor has to provide alternatives for cost effective design and in such case, load combination is to be suggested by Design and construction contractor for approval of Authority.

Load Combinations for Simply Supported Spans Superstructure Constructed by Precast Segmental Construction/U-Girder Superstructure (As per DBR/SOD)

7.1 BSTP LIVE LOADS (AS PER DBR)

7.2 GENERAL

The Railway loading applied to structures on the Project shall generally be in accordance with IRS Bridge Rules except as detailed below (Refer DBR)

Dead loads shall be used that are in accordance with IRS Bridge Rules and IS 456 (for buildings) and IS 875 part 1 for unit weights of materials and self-weight of all structural elements shall be worked out as per DBR. Axle Loads and spacing are as per DBR.

7.3 NOMINAL LOADS (AS PER DBR)

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

7.3.2 Dead loads

7.3.3 Super imposed Dead Load

SIDL -OC s Signalling (MISc)- 4 kN/m

5.4.3 Viaduct SIDL (Variable):

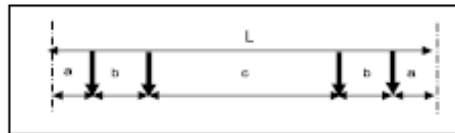
S.no	Structural Component	Double Track (MT/m)	Single Track (MT/m)
1	Rails + Pads	0.30	0.15
2	Cables	0.07	0.04
3	Cable trough cell	0.74	0.35
4	Cable trays	0.01	0.01
5	Hand-rail	0.08	0.08
6	Plinth (slab track)	3.44	1.72
7	Lightweight deck drainage concrete	0.24	0.12
8	OHE mast signaling etc.	0.40	0.20
9	miscellaneous (OCS, signaling, fasteners)	0.40	0.20
	Total (MT/m)	6.05	3.05

Solar Panel

On the parapets of viaducts/Bridge, solar panels are planned to be fixed. The designer shall consider in their design and all fixtures required to mount the panels. The loading of 50 Kg / m shall be considered on both the parapets while designing.

7.3.4 Live Loads Dynamic effects

- Each component of the structure will be designed / checked for all possible combinations of these loads and forces. They will resist the effect of the worst combination:



Axle loads = 17 MT

Maximum number of successive cars in a train = 6 (extendable to 9) Wheel Configuration

$a = (\text{balance})$

$b = 2300 \text{ mm to } 2500 \text{ mm}$ (Wheel base in a bogie)

$c = 11700 \text{ mm to } 12700 \text{ mm}$ (Distance between Axle-2 and Axle-3

in the car)

Total Length of one car $L = 2a + 2b + c = 21740 \text{ mm}$.

Equivalent UDL (EUDL) as provided in Annexure -1 of K-Ride DBR for various simply supported span for flexure and Shear force will be used for design and analysis of superstructure and substructure except for frame type structure like Minor bridges and Minor RUB (LC Boxes) where Moving load analysis will be carried out. The said EUDL for various spans has been enclosed in Annexure I of this DBR.

Braking and Traction (Longitudinal Forces):

Braking load will be taken as 18% of the un-factored vertical Axle loads

Traction load will be taken as 20% of the un-factored vertical Axle loads

Tractive force of one track and braking force of another track will be considered in the same direction to produce worst condition of loading

As per IRS: Seismic Code Cl. 7.1, when considering seismic forces, only 50% of gross tractive effort / braking force will be considered.

7.3.5 Long welded rail forces Racking forces.

Longitudinal temperature force due to continuation of long welded rails on bridges is computed as per provisions of UIC 774-3R, 2002 EDITION. This works out to a maximum of For Short Piers where pier height is lesser than 6 times the longitudinal pier dimension ($H/d < 6$) – LWR force = 2.4 t/m for two tracks and For Slender Piers where pier height is more than 10 times the longitudinal pier dimension ($H/d > 10$) – LWR force = 1.2 t/m for two tracks and In transverse direction = $650 / R$ KN/m/track.

The longitudinal force due to the case of one of one rail fracture will also be considered in the design of the structures with increase in allowable stresses by 33.3%.

7.3.6 Forces due to curvature or eccentricity of track

7.3.7 Temperature effects

7.3.8. Frictional resistance of expansion bearings Longitudinal forces

7.3.9. Forces on parapets Wind pressure effect

7.3.10. Forces and effect due to earthquake Erection forces and effects Buoyancy Differential settlement.

7.4 LOADING COMBINATIONS

The various combinations of loads and forces to which components of the structures can be subjected are given in Bridge Rules/IRS CBC & DBR. Each component of the structure shall be designed checked for all applicable combinations of these loads and forces. They shall resist the effect of the worst combination. The allowable unit stress in a member subjected to a particular combination loading shall not exceed the percentage indicated below against the respective combination.

The loading combinations indicated are not exhaustive. The Contractor shall analyse the effects of any other combination as deemed appropriate.

7.5 DESIGN LOADS (AS PER DBR)

When a structure carries two tracks, both tracks shall be considered to be occupied simultaneously. Traction forces shall act on one track and braking forces acting on the other, with both acting in the same direction to produce the worst loading condition.

Longitudinal forces acting on the track shall be considered to be dispersed through the track before being transmitted to the substructure. This shall be calculated based on IRS Bridge Rules and IS Codes

Provision shall be made for effect of horizontal and longitudinal forces in the rail, especially in the girders with ballast less deck.

Additional permissible stresses while considering this contingency will be proposed by the CONTRACTOR for review by the Employer's Representative. Forces shall be calculated for continuous welded rail with a concrete structure interaction resulting from temperature differential of rail and concrete. Rail structure interaction analysis on representative stretches based on UIC 774 3-R shall be adopted to work out the LWR forces.

Longitudinal forces shall consider the effects on stability and safety arising from a broken rail in ballast less track.

Centrifugal load based on relevant IRS codes/ IRS Bridge Rules shall be worked out for the given track geometry.

Train Derailment Load: Check for derailment loads shall be made as per IRS Bridge Rules.

7.6 WIND LOADING (AS PER DBR)

The viaduct/Bridge structure shall be designed for wind loading as per IRS Bridge Rules.

However, a bridge shall not be considered to be carrying any live load when the wind pressure at deck level exceeds 150 kg/m². Wind load shall be taken as 400-kg/meter length of train in transverse direction and 90-kg/meter length in longitudinal direction. These are computed for length of train as seen in elevation normal to longitudinal axis. The transverse load will be applied to train as concentrated at axle locations at a height of 3.2 m or at C.G. of projected area of the vehicle as accepted by the Employer's Representative above top of lowest rail and normal to track. The horizontal force component transmitted to rails and superstructure by an axle will be treated as a concentrated load at rail having direct wheel flange to railhead contact.

7.7 TEMPERATURE LOADING (AS PER DBR)

Overall temperature and differential temperature effects shall be determined as per provisions of DBR.

7.8 SEISMIC LOADING (AS PER DBR)

Seismic effects shall be considered on all structures, except culverts as per DBR. It is also required to check the structures for seismic forces as per IS: 1893- 2001 and Latest RDSO guidelines for seismic design of bridges.

Seismic Load (EQ) "Seismic Code for Earthquake Resistant Design of Railway Bridges" shall be followed. The code also covers load combination and ductile detailing. Bangalore District area is in Seismic Zone II and all the designs shall be carried out for one zone classification above.

7.9 ERECTION FORCES AND EFFECTS (AS PER DBR)

The weight of all permanent and temporary materials together with all other forces and effects which can operate on any part of structure during erection shall be taken into account. Allowance shall be made in the design for stresses caused in any member during erection. For extra allowance in permissible stresses when erection forces are also considered, relevant codal provisions should be followed.

7.10 SHRINKAGE AND CREEP

Provision shall be made for the effects of shrinkage and creep of the concrete in the structure.

- The shrinkage strains shall be evaluated as per clause 6.2.4 of IS:456 for Plain and Reinforced Concrete Structures and clause 6.2.4 of IS :1343 for prestressed concrete structures and for structure supporting rail loading the effects of creep as per clause 5.2.3 of IRS-CBC shall be considered.
- The creep strains shall be evaluated as per clause 6.2.5 of IS:456 for Plain and Reinforced Concrete Structures and clause 6.2.5 of IS :1343 for prestressed concrete structures and for structure supporting rail loading the effects of shrinkage as per clause 5.2.4 of IRS-CBC shall be considered.

7.11 DIFFERENTIAL SETTLEMENT: AS PER DBR

- 7.12** In addition, for derailment loads "Sacramento derailment criteria" is intended to be used. This criterion corresponds to the application of 40% of one coach weight applied horizontally as a 3m long uniform impact load on the Box girder top flange. This derailment load corresponds to an ULS load. For SLS combination (Group V), a 1/1.75 co-efficient shall be applied to the derailment load.

7.13 NOISE ABATEMENT

Allowable Range of Noise Levels:

Generally, the allowable range of noise levels for different land uses is:

i.	Residential	50 - 70 dbA
ii.	Business & Commercial	75 dbA
iii.	Hospitals	60 dbA
iv.	Rural	45 - 50 dbA

Provision of Noise Barriers:

Structures shall be designed to reduce noise to locally acceptable levels by provision of low vibration track forms, resilient base plates and also design of parapet walls and treatment of their track side surfaces. They can be supplemented by providing sound elimination material on sides of the viaduct/Bridge superstructures. But in many locations, existing noise level itself may be much higher at 1.0 to 1.2 meters above walkway level. Noise barriers may be required in some lengths of viaducts and bridges passing through sensitive residential or hospital zones. The choice of type and their disposition along the parapet railing is also closely related to aesthetics of the structure.

8. BSTP REQUIREMENTS**8.1 EMERGENCY EVACUATION**

Provision for emergency evacuation shall be provided along the Railway / BSTP for the full length of the structure. Routes assigned for emergency evacuation shall be designed for footway loading in accordance with the requirements.

8.2 PARAPET

8.2.1 Parapet shall be provided on both sides of all viaducts/Bridges for the full length of the structure. For providing signal mast, CBTC radio tower. They shall be designed to act as the support structure to the Railway cabling and junction boxes as appropriate and will be cast inbuilt with box segments.

8.2.2 Parapets shall be designed to resist the wind load and other relevant loads based on the codal provision & DBR.

8.2.3 Parapets shall be provided for all transition structures to protect the guide way from intrusion by trespassers, vandals, and road vehicles.

8.2.4 Parapets shall be designed to function as Noise Containment Barriers.

8.2.5 Parapets shall be designed to cater the forces of Signal masts, OHE masts and related structures. Bidder to suitably assume OHE locations as per track geometry and traction requirement. Generally, on an average, there will be one OHE on each side in a 25 m span (approximately).

8.3 VERTICAL PROFILE**8.3.1 Profile grade:**

The superstructure shall be so designed that, when subject to dead load only, the rail level would be above the theoretical vertical profile of the system by an amount equal to permissible LL deflection for the structure.

Provision for super-elevation shall be made preferably as part of the track structure over the deck. The dead load is to be considered at such locations.

8.3.2 Camber:

The superstructure deck, including the soffit of any overhead structure above the deck, shall be cambered so as to compensate for the combined effect of:

- i. Vertical Curvature, if any;
- ii. Dead load deflection; and

- iii. Permissible live load plus-impact deflection as accepted by the Employer's Representative.

8.4 SPAN/DEPTH RATIOS:

Span-to-depth ratio should as far as possible be restricted to:

- i. Reinforced concrete member - 10
- ii. Pre-stressed concrete member - 14
- iii. Composite members - 16,
- iv. Desirable 12

In Box girders these ratios shall be further subject to stipulations made with regard to internal dimensions required for inspection and future pre-stressing.

8.5 MINIMUM THICKNESS OF MEMBERS

DESIRABLE MINIMUM THICKNESS OF ANY RC MEMBER

- | | | |
|--|---|---------------------------------|
| i. Deck | - | 200 mm |
| ii. Web of T-beam | - | 250 mm |
| iii. Web of pre-stressed girders | - | 150 + d |
| iv. If there are 2 cables at any level | - | 150+3d, d - diameter cable duct |

BOX GIRDERS: MINIMUM MEMBER THICKNESS:

- | | | |
|-------------------|---|--------|
| i. Deck slab | - | 200 mm |
| ii. Bottom flange | - | 300 mm |
| iii. Web | - | 250 mm |

or as required by IRS Concrete Bridge Code whichever is greater.

In an aggressive environment, an additional thickness of 10 to 20 mm shall be used.

8.6 SPAN ARRANGEMENT

8.6.1 The Tenderer shall provide, by suitable choice of span lengths, a sufficiently stiff deck and supporting sub-structure to resist loading as defined in various Clauses stated above. Static and dynamic rail live load responses, at essential movement joint locations, shall be in compliance with the Employer's Requirements.

8.7 Rail Structural interaction analysis due to continuous welded rail with direct fixation or structure shall be performed in accordance with proven international practice.

8.8 Approach slabs of sufficient sizes shall be provided between abutments and at-grade sections.

An approach slab shall be provided in rear of all abutments of elevated structures and bridges. This should not be less than 6 m in length nor be less than the length computed from the formula:

$$L = 1.5 h \tan (45^\circ - \phi/2)$$

Where h = Depth from bottom of slab to bottom of abutment (top of footing)

ϕ = Angle of internal friction of backfill soil in degrees

Slab shall be designed assuming that it does not receive any support from the backfill for a distance of not less than 4.0 m or less than $h \tan (45^\circ - \phi/12)$ from back of abutment or as required by IRS Concrete Bridge Code whichever is greater.

9 DESIGN CONSIDERATIONS

9.1 VIBRATION AND DEFLECTION LIMITATIONS (AS PER DBR)

The Vibration and Deflection Limitations as per DBR. The overall deflection for elevated structure will be limited taking into consideration the effect of vibration in addition to other considerations. Suitable provisions shall be provided at the ends of beams and jacking pads on pier caps shall be provided to allow for replacement of bearings and for any repairs during service.

Provision should be made for adequate fixtures of the superstructure to the substructure, if any loading or loading combination increased by 100% of live load plus impact is likely to cause uplift of any support.

9.2 DESIGN PROCEDURES

Reinforced and pre-stressed concrete members of elevated structures shall be designed in conformity with the provisions of DBR, IRS and IRC Codes.

9.3 SUBSTRUCTURE AND FOUNDATIONS

Substructure and Foundations: As per DBR.

9.4 METHOD OF CONSTRUCTION

Stresses in partially completed structures shall be analysed for appropriate critical conditions at various stages of the construction. Any restriction on the construction operations resulting from the design assumptions shall be clearly specified on the contract drawings and specifications. Conversely, advantage may be taken by the designer of specified construction procedures or sequences to affect a more favourable distribution of loads or stresses.

9.5 MOVEMENT/EXPANSION JOINTS

Movement/expansion joints and other necessary measures to control shrinkage and thermal effects shall be incorporated in the structural design so that the performance of architectural finishes or of any services are not adversely affected during normal working conditions.

Movement/expansion joints shall be designed to be easily maintained and replaceable.

9.6 DESIGN SURFACE CRACK WIDTH

Design Surface Crack Width: As per DBR.

9.7 TEMPERATURE EFFECTS

Temperature effects: As per DBR.

9.8 SWAY OF VIADUCT/BRIDGE COLUMN

Longitudinal sway at the top of viaduct/Bridge columns due to live loads shall be restricted to a maximum of 5mm.

9.9 STRUCTURAL MEMBERS WITH BEARING

Consideration shall be given for the easy maintenance and replacement of viaduct/Bridge bearings. The minimum clearance between structural members separated by bearings shall be as follows:

Precast Viaduct/Bridge Beam/Cross Head :	150mm
In-Situ Viaduct/Bridge Beam/Column:	250mm

These are absolute minimum values and the requirement for easy maintenance and replacement of bearings shall prevail.

9.10 THERMAL RAIL FORCES

Provision shall be made for horizontal transverse and longitudinal forces due to temperature variation in rail. The forces shall be applied in a horizontal plane at the top of low rail as follows:

- (1) Transverse Force. The transverse force (T) per linear meter of structure per rail shall be determined by the following formula:

$$T = 650 \text{ kN}$$

R Where R = radius of rail curvature in meters

- (2) Longitudinal Force. A longitudinal force shall be applied in accordance with Indian Standards.
- (3) Provision of UIC 774 3-R shall be used for working out LWR forces.

9.11 ACCESS TO VOIDS

Continuous access between the deck voids shall be provided wherever possible. An easily removable, watertight manhole access to deck voids shall be provided in every span.

9.12 PRE-STRESSED CONCRETE

Non-shrink grout shall be used for grouting of post-tensioned tendon ducts.

Pre-stressing anchorages shall be detailed such that they are easily accessible for inspection and maintenance. The detailing shall also prevent the accumulation of water and dirt around the anchorage.

All assumptions made in the determination of the design pre-stress loads, e.g. curvature, friction, cross section and mechanical properties of strand and concrete shall be clearly stated on the drawings.

9.13 BEARINGS

9.13.1 The details in DBR may be referred.

9.13.2 In the selection of the bearing layout in viaducts/Bridges, consideration shall be given to their performance in relation to the supporting structures, economy as well as maintenance and replacement of the bearings.

9.13.3 Due care must be taken to ensure that no pair of bearings act against one another in service conditions to the detriment of the structure and to the bearings themselves.

9.13.4 Design Life

Whenever the expected design life of the bearings is significantly less than that of the structure, provision shall be made for the removal and replacement of the whole or parts of the bearings.

9.13.5 Types of Bearings

Type of Bearing adopted shall be justified by detailed design calculations and codal provisions as per DBR.

9.13.6 Bearing Design

Unless otherwise specified, bearings shall be designed in accordance with the requirements of DBR (IRS or IRC Codes or any other equivalent Code).

Bearings for viaducts/Bridges shall be designed as per DBR to allow for the following movements:

- i. Thermal expansion and contraction
- ii. Shrinkage of concrete
- iii. Creep in concrete
- iv. Elastic shortening under pre-stress
- v. Displacements of structure under load:

Differential settlement between viaduct/Bridges piers shall re-considered.

Rotation and sway of columns and crossheads under the worst load combination including the effects of temporary loads during construction shall be considered.

Schedule listing the performance requirements for each type of bearings for viaduct/Bridges

shall be incorporated in the drawings. The schedule shall indicate the following:

- i. Dead load to be supported (SLS and ULS)
- ii. Maximum and minimum vertical live load to be supported (SLS and ULS)
- iii. Horizontal forces to be resisted (SLS and ULS)
- iv. Rotation capacity required.
- v. Translation capacity required (both reversible and irreversible). In the case of in-situ viaducts/Bridges, the amount of pre-setting required for the bearings should be clearly indicated.

Calculations for movements of bearings shall take into account the variability of materials and conditions that the structure is expected to encounter during its design life.

In the above ULS and SLS mean Ultimate Limit State and Serviceability Limit State respectively.

Design of the bearings, derailment loads requirements specified in DBR shall be taken into consideration. The corresponding viaduct/Bridges rotation under derailment loads shall be controlled to minimize damage to the viaduct/Bridges elements.

In the design of the bearings to resist lateral loads, friction between the bearing and mortar shall be ignored.

Mortar bedding composing of sand and either cement, polyester resin or epoxy resin shall have a crushing strength of at least twice the average contact stress. In the choice of bedding due consideration shall be given to the future removal and replacement of the bearing without damage to bedding or to the structural elements bonded to it.

Shear studs or bolts shall be provided to secure the bearing top and bottom plates to the structure. The shear studs or bolts shall be designed in accordance with international practice.

The fixing method to be adopted shall be such that it is convenient and possible to replace the bearings at some future date.

The designer shall ensure that the bearings can be produced to satisfy the design requirements; and that the space allowed for in the overall design is sufficient to accommodate the bearings and enable them to be inspected, maintained and replaced when required.

Highway Clearances

The vertical and horizontal highway clearances required for the structures shall generally be in accordance with the requirements described below.

9.14 VERTICAL CLEARANCES

The minimum clearance between the elevated structures and highways, Railways, utility lines and other structures and property should be greater by a minimum of 250 mm on those prescribed by the agencies involved. The minimum vertical clearance below the bottom of the structure for any highway road passing below will be 5.5 meters as prevailing presently. In case of minor roads/streets a lower clearance may be adopted with specific approval of the agency owning and/or maintaining the road/street.

9.14.1 HORIZONTAL CLEARANCES

The clear span over the roads passing below the viaduct/bridge shall be determined after evaluation of present and future needs.

Protection shall be necessary for piers against accidental impact from road vehicles on a case by case basis. IRC/UIC codes shall be applied.

9.14.2 VIADUCT/BRIDGES DECK FURNITURE, DRAINAGE AND WATERPROOFING

Viaduct/Bridges deck furniture, drainage and waterproofing system shall be designed for all effects and requirements of the Railway.

Cast-in drains shall be used, provided with rodding eyes at every bend. Runoff on viaduct/Bridges structures and bridges shall be collected through surface drains that shall lead to down drains at the support columns. The down drains shall be connected to a drainage system which shall consist of collection header pipe and manholes which shall discharge to the nearest suitable drainage system. Silt removal shall be provided where necessary.

9.15 SYSTEM WIDE REQUIREMENTS

9.15.1 System wide requirements must be considered in the development of the structural design. Such consideration shall include:

1. The incorporation of a stray current corrosion control system
2. The incorporation of an adequate water drainage system
3. The necessary design of reinforcement in plinth and deck so as to avoid interference with and attenuation of the signalling circuits
4. Special care taken with the location of gullies in points and crossing areas.
5. Provision for future pre-stressing of cable/strands as per IRS code shall be made for all pre-stressed concrete members (External pre-stressing) as indicated in the conceptual drawings.

9.15.2 System wide details are liable to changes as the requirements of various contracts become known and their designs are developed. The Contractor shall be responsible for incorporating all System wide requirements as they become available.

9.15.3 All details provided to meet System wide requirements shall be subject to the acceptance by the Employer's Representative.

9.15.4 Rail Structural Interaction analysis (RSI) and LWR forces: RSI analysis shall be carried out for the alignment of BSTP project so as to determine the effects of thermal interaction between the elevated viaduct/Bridges (Box girder/U-Girder) and continuously welded rail (CWR/LWR). The analysis should incorporate the behaviour of various elements of the structure i.e., rail fasteners, stiffness of rail, the deck, the substructure, and foundations. As per DBR of K-RIDE, clause 5.16, page 23, RSI shall be carried out duly following the BS report no. 119 of RDSO "Guidelines for carrying out rail structure interaction studies on metro system (version 2)". The contractor shall do the necessary design in the connection, which shall be proof checked by GC and approved by Bi- RIDE with minimum. If required, a second opinion can be obtained from a reputed academic institution like IISc or IIT.

But a minimum load of 1.6t/m as used in other Metro, without dynamic augment must be used for designs. The LWR forces should be minimum 1.6t/m and if any additional LWR forces arrived during detailed design & analysis, the same shall be adopted as per the directions of the Engineer / Employer.

10. FOUNDATIONS AND GEOTECHNICAL WORKS

GEOTECHNICAL DATA

10.1 "Geotechnical works" shall mean foundations, earthworks, deep excavations, slopes, embankments, and earth retaining structures. It shall also include dewatering and any ground related activities in soil and rock.

10.2 The Contractor shall be responsible for determining for his design purposes the Geology and the Geotechnical parameters of the sub-surface strata along the route.

The Geo-Technical Investigation details/reports relevant to this contract as available with Bi-RIDE are enclosed with tender. Further GT investigation details/reports as available with Bi-RIDE will be supplied during execution of work. **The results can be of use for broad reference and**

information and tentative only. The geo-technical investigations are to be carried out by the Contractor on which the design should be based. GT Investigation shall be carried out at each pier and bridge locations as directed by Engineer.

The Contractor shall carry out the installation of test piles and testing as per relevant codes. If necessary, modification to design of piles after testing shall be done.

- 103 The design of pile foundation as per DBR (IS 2911). A safety factor of not less than 2.5 should be adopted as test load for a single pile and safety factor of not less than 2.0 shall be adopted when considering pile and pile group capacities. A safety factor of at least 1.75 for a single pile and at least 1.5 for group piles shall be adopted when the negative skin friction (which results from downward movement of adjacent soil relative to the pile caused by dewatering and/or the placement of fill) is considered. The Engineer's decision is final.
- 104 In his design the Contractor shall take adequate measures to minimize the amount of local differential settlement of road surfaces around underground works.
- 105 Minimum No. of piles in a pile group is generally four (4) / Six (6). However, in special spans it should be minimum 8 no's and for balanced cantilever it should be minimum 12 nos.
- 106 The type of foundation shall depend on soil and site condition, and, where the Bi-RIDE alignment is close to the Railway line, the foundation design of the adjacent structure.
- 107 EARTH WORKS FOR FORMATION, MINOR BRIDGES, MAJOR BRIDGES, ROB & RUB

Earth Works For Formation: The details given in DBR shall be referred. As per Comprehensive guidelines and specifications for Railway formation, specification no. RDSO/2020/GE: IRS-0004 (Including ACS No-01 dated 16.12.2021) and latest guidelines. IRS Codes shall be followed for minor Bridges, Major Bridges, ROB's & RUBs.

The Standard Drawings of box culverts (25 T Axle loading) of RDSO for minor bridges may be referred and the tentative spans are given in the minor bridges list. The standard drawings of RDSO for major bridges & ROB may be referred. The standard RUB Drawings (Segmental Construction) as per IRS Codes may be referred, if available otherwise the same shall be designed as per IRS Codes/DBR. IRS Codes shall be followed in-principle, and the design criteria is based on IRS Codes viz. IRS-Bridge Rules, IRS Concrete Bridge Code & IRS Bridge Substructure & Foundation Code

SCHEDULES

SITE OF THE PROJECT

1 THE SITE

1. Site is from Heelalige to Bellandur section i.e. BSRP Chainage Km -0+635 to 13.694.
2. Access and RUC shall be arranged progressively, as per **Section VIII, Employer Requirement Vol-2, Annexure 2.**
3. The tentative alignment plans, tentative L-sections, and cross sections of the BSTP are specified in Tender Drawings, **Section - XI**

ANNEXURE- I
SCHEDULE OF SITE**1. SITE**

The Site of the BSTP comprises the section commencing from km -0+635 to 13.694 i.e., the – Heelalige to Bellandur section. The land and other structures comprising the Site are described below:

2. ROUTE LENGTH

The route length of Corridor-4 Package 2 of BSTP Project comprises the section as described below (Dead end of yard to dead end of yard):

Sl. No	Name of location from	Name of location to	Start Chainage (km)	End Chainage (km)	Length (km)	Remarks
1	HEELALIGE	BELLANDUR	-0+635	13.694	12.632	AT-GRADE

3. ALIGNMENT PLAN:

The alignment plan is attached.

4. DETAILS OF EXISTING STRUCTURES AND PROPOSED STRUCTURES (FOR BSTP).

- 4.1 Road Over Bridge (ROB):** (Scope cover execution of two-lane bridge only including dismantling of existing bridge/Ramp wherever required)

Sl No	Existing		Proposed			
	Chainage (km)	Bridge No.	Type of Structure	Span (Nos. × length) (m)	RUB/ ROB	Barrel Length (m)
1	0.664	ROB 476A	RCC Box	11 X 7 (Clear Vent)	ROB	15

Note: Shall comply with RDSO specifications & SOD

4.2 Minor Bridges:

The Site includes the following Minor Bridges: Bidders are requested to refer the tender drawing enclosed.

4.2(a) Barrel Length

Sl. No.	Existing		Proposed (Tentative)		Barrel Length (m) (Balance work to be executed)
	Chainage (km)	Bridge No.	Type of Structure	Size in (m)	
1.	-0.054	476	RCC Box	1.8X1.35	33.2
2.	0.928	477	RCC Box	2.16X1.35	16.3
3.	1.344	478	RCC Box	1.2X1.35	16.4
4.	1.355	479	RCC Box	1.9X1.65	17.5
5.	2.477	480	RCC Box	1.8 X 1.35	6.95
6.	2.691	481	RCC Box	2.16 X 1.35	7.1
7.	3.617	483	RCC Box	1.2X1.35	16.4
8.	3.738	484	RCC Box	6.0X3.71	16.4
9.	3.887	485	RCC Box	1.2X1.35	4.65
10.	3.920	486	RCC Box	1.90 X 1.65	5.1
11.	4.137	487	RCC Box	1.2X1.35	16.4
12.	4.537	488	RCC Box	3.36X3.71	16.4
13.	5.412	490	RCC Box	1.2X1.35	8.8
14.	5.790	491	RCC Box	1.2X1.35	19.5
15.	5.955	492	RCC Box	3.66X2.1	16.3
16.	6.092	493	RCC Box	4.57X2.05	16.4
17.	6.387	494	RCC Box	1.9X1.35	16.6
18.	6.768	495	RCC Box	6.00 X 3.71	3.15
19.	7.092	496	RCC Box	1.2X1.35	7.65
20.	7.293	497	RCC Box	1.2X1.35	16.3
21.	8.267	498	RCC Box	3.66X3.6	16.3
22.	8.408	499	RCC Box	1.2X1.35	16.3

23.	9.072	500	RCC Box	1.2X1.35	16.6
24.	10.008	502	RCC Box	1.2X1.35	16.3
25.	11.245	504	RCC Box	1.2X1.35	12.4
26.	11.888	505	RCC Box	2.1X1.35	16.3
27.	12.663	506	RCC Box	2.0X3.65	16.3
28.	13.245	507	RCC Box	3.66X3.53	23.7
29.	13.278	508	RCC Box	1.2X1.35	24.6
30.	13.392	509	RCC Box	1.2X1.35	30.9
31.	13.595	510	RCC Box	1.2X1.35	43.1

4.3 Road Under Bridges (RUB)

The Site includes the following RUB (Road Under Railway line):_Scope cover dismantling of existing structure/Ramp wherever required)

Sl No	Existing		Proposed				
	Chainage (km)	Bridge No.	Type of Structure	Span (Nos. × length) (m)	RUB	Barrel Length (m)	Approach's
1.	1.239	477A	RCC Box	4 X 3.75	RUB	14.90	As per drawings and Site conditions
2.	2.557	480A	RCC Box	4 X 4	RUB	15.90	As per drawings and Site conditions
3.	5.728	490A	RCC Box	4 X 4	RUB	7.90	As per drawings and Site conditions
4.	7.404	497A	RCC Box	4 X 3.75	RUB	14.83	As per drawings and Site conditions
5.	13.665	511	RCC Box	9 X 5	RUB	38.20	As per drawings and Site conditions
6.	13.678	511A	RCC Box	9 X 5	RUB	38.20	As per drawings and Site conditions

4.4 Deleted

The above schedule of work is covered in EPC Contract and Contractor shall complete all the works as per tender drawing, Employer's Requirement, Technical specification, GAD's, Plan & Profile, duly ensuring safety, Quality, EHS including Design / Structure validation and stability & Integrity Check for the executed by previous Contractor. The statement of works executed by previous Contractor as Annexure 1A and also highlighted in attached GAD's of various structures.

ANNEXURE – 1A**Statement of Part Works executed by earlier Contractor in Corridor-4.**

Earth work				
S. No	BSRP CH		Length	Remark
	From	To		
1	2	2.26	0.26	Partially Earth work cutting done (Width /2, Depth/2)
2	3.1	3.5	0.4	Partially Earth work cutting done (Width /2, Depth/2)
3	4.94	5.2	0.26	Partially Earth work cutting done (Width /2, Depth/2)
Total Length			0.92	

ERS PCC- Section 1				
S. No	BSRP CH		Length	Remark
	From	To		
1	2.26	2.28	0.02	
2	2.28	2.30	0.02	
3	2.30	2.34	0.04	
4	2.44	2.46	0.02	
5	2.46	2.48	0.02	
6	2.48	2.50	0.02	
7	2.56	2.58	0.02	
8	2.58	2.60	0.02	
9	2.60	2.62	0.02	
10	2.68	2.70	0.02	
11	2.70	2.72	0.02	
12	2.72	2.74	0.02	
13	5.24	5.26	0.02	ERS PCC Concreting done 140 m further work not take up Earth back filling done on top of PCC
14	5.26	5.28	0.02	
15	5.28	5.30	0.02	

16	5.30	5.32	0.02	
17	5.32	5.34	0.02	
18	5.34	5.36	0.02	
19	5.36	5.38	0.02	
Total Length			0.400	

ERS Raft - Section 1				
S. No	BSRP CH		Length	Remark
	From	To		
1	2.700	2.720	0.020	
2	2.440	2.460	0.020	
3	2.296	2.320	0.024	
4	2.260	2.280	0.020	
5	2.280	2.296	0.016	
6	2.320	2.340	0.020	
7	2.460	2.480	0.020	
8	2.480	2.500	0.020	
9	2.580	2.600	0.020	
10	2.560	2.580	0.020	
11	2.720	2.740	0.020	
12	2.700	2.700	0.000	
13	2.600	2.620	0.020	
14	2.680	2.700	0.020	
Total Length			0.260	

ERS Wall - Section 1				
S. No	BSRP CH		Length	Remark
	From	To		
1	2.440	2.460	0.020	
2	2.296	2.320	0.024	
3	2.260	2.280	0.020	
4	2.280	2.296	0.016	
5	2.320	2.340	0.020	
6	2.460	2.480	0.020	
7	2.480	2.500	0.020	
8	2.580	2.600	0.020	
9	2.560	2.580	0.020	

10	2.720	2.740	0.020	
11	2.700	2.720	0.020	
12	2.600	2.620	0.020	
13	2.680	2.700	0.020	
Total Length			0.260	

MIB Ground improvement		
S. No	Location	Remark
Section 1		
1	MIB 480	150 mm Sand 600 mm Boulder & 150mm Sand
2	MIB 481	150 mm Sand 300 mm Boulder & 150mm Sand
3	MIB 482	150 mm Sand 300 mm Boulder & 150mm Sand
4	MIB 484	150 mm Sand 300 mm Boulder & 150mm Sand
5	MIB 485	150 mm Sand 600 mm Boulder & 150mm Sand
6	MIB 486	150 mm Sand 600 mm Boulder & 150mm Sand
7	MIB 488	150 mm Sand 300 mm Boulder & 150mm Sand
8	MIB 489	150 mm Sand 300 mm Boulder & 150mm Sand
9	MIB 490	150 mm Sand 400 mm Boulder & 150mm Sand
10	MIB 495	150 mm Sand 300 mm Boulder & 150mm Sand
11	MIB 496	150 mm Sand 600 mm Boulder & 150mm Sand
12	MIB 497	150 mm Sand 600 mm Boulder & 150mm Sand

MIB PCC			
Section 1			
S. No	Location	Remark	Priority
1	MIB 480	PCC Conrete done as per approved drawing	2
2	MIB 481	PCC Conrete done as per approved drawing	2
3	MIB 482	PCC Conrete done as per approved drawing	2
4	MIB	PCC Conrete done as per approved drawing	2

	484		
5	MIB 485	PCC Conrete done as per approved drawing	2
6	MIB 486	PCC Conrete done as per approved drawing	2
7	MIB 488	PCC Conrete done as per approved drawing	2
8	MIB 489	PCC Conrete done as per approved drawing	2
9	MIB 490	PCC Conrete done as per approved drawing	2
10	MIB 495	PCC Conrete done as per approved drawing	2
11	MIB 496	PCC Conrete done as per approved drawing	2
12	MIB 497	PCC Conrete done as per approved drawing	2

MIB Raft		
Section 1		
S. No	Location	Remark
1	MIB 480	MIB Raft concreting & Reinforcement done
2	MIB 481	MIB Raft concreting & Reinforcement done
3	MIB 482	MIB Raft concreting & Reinforcement done
4	MIB 485	MIB Raft concreting & Reinforcement done
5	MIB 486	MIB Raft concreting & Reinforcement done
6	MIB 489	MIB Raft concreting & Reinforcement done
7	MIB 490	MIB Raft concreting & Reinforcement done
8	MIB 495	MIB Raft concreting & Reinforcement done
9	MIB 496	MIB Raft concreting & Reinforcement done

MIB Wall		
S. No	Location	Remark
Section 1		
1	MIB 480	MIB Wall concreting & Reinforcement done
2	MIB 481	MIB Wall concreting & Reinforcement done
3	MIB 482	MIB Wall concreting & Reinforcement done
4	MIB 485	MIB Wall concreting & Reinforcement done
5	MIB 486	MIB Wall concreting & Reinforcement done
6	MIB 489	MIB Wall concreting & Reinforcement done
7	MIB 490	MIB Wall concreting & Reinforcement done
8	MIB 495	MIB Wall concreting & Reinforcement done
9	MIB 496	MIB Wall concreting & Reinforcement done

MIB Slab		
Section 1		
S. No	Location	Remarks
1	MIB 480	MIB Slab concreting & Reinforcement done
2	MIB 481	MIB Slab concreting & Reinforcement done
3	MIB 482	MIB Slab concreting & Reinforcement done
4	MIB 485	MIB Slab concreting & Reinforcement done
5	MIB 486	MIB Slab concreting & Reinforcement done
6	MIB 489	MIB Slab concreting & Reinforcement done
7	MIB 490	MIB Slab concreting & Reinforcement done
8	MIB 495	MIB Slab concreting & Reinforcement done
9	MIB 496	MIB Slab concreting & Reinforcement done

MJB Test Pile			
S. No	MJB	Remark	Priority
Section 1			
1	513	IVTP Boring & Concreting	2
2	513	IVTP Reinforcement	2
3	513	ILTP Boring & Concreting	2
4	513	ILTP Reinforcement	2
Section 3			
1	537	IVTP Boring & Concreting	1
2	537	IVTP Reinforcement	1
3	537	ILTP Reinforcement	1
4	537	ILTP Boring & Concreting	1

ANNEXURE - 2

RIGHT OF ACCESS TO THE SITE

TIME FOR ACCESS TO THE SITE

The railway land and private land is available for execution of the works and will be handed over immediately upon Commencement of work. Any balance land will be handed over progressively in accordance with the requirements of the approved Contractor's Programme, and commensurate with the physical progress of the Works.

After award of the work, The Engineer shall grant the Contractor right of access to, and /or possession of, the Site progressively for the completion of Works. 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.

If any delay in access to, and possession of the site, the extension of time as per relevant clause of contract shall be given for the delay of affected portion of the works.

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.

In case any operation connected with traffic necessitates diversion, obstruction or closure of any road, Railway or any other Right of Access, the proposal shall 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.

ANNEXURE - 3
ALIGNMENT PLANS (GAD)

The proposed final alignment plan of the BSTP line is attached, for reference and guidance. This is based on survey conducted by the Authority.

In addition, the possibility of reducing BSTP corridors to the extent SOD permits also shall be explored to optimize the land requirement.

ANNEXURE – 4

TREE CUTTING AND FOREST CLEARANCES

Forest clearances: The permission for obtaining tree cutting/translocation completed with BBMP and Forest Department. The removal of trees is under the scope of the Contractor and will be paid under Schedule-C.

ANNEXURE - 5**TIME SCHEDULE FOR REVIEW OF DRAWINGS BY THE
AUTHORITY/ENGINEER**

Sl. No.	Item	Preparation by	GC Review with time limit (NO NO) days from Contractor submission	Bi-RIDE Review after GC approval with time limit (GFC)
1	Alignment Design Report	Contractor	15 Days	7 days
2	L-Section	Contractor	15 Days	7 days
3	GAD of ROB and minor bridges.	Contractor	15 Days	7 days
4	GAD of Elevated viaduct	Contractor	15 Days	7 days
5	Structural drawings of ROB	Contractor	15 Days	7 days
6	Structural drawings of Elevated Viaduct	Contractor	15 Days	7 days
7	Structural drawings of Minor bridges	Contractor	15 Days	7 days
8	GADs of RUBs	Contractor	15 Days	7 days
9	Structural Drawings of RUB's	Contractor	15 Days	7 days
10	Drainage Plans	Contractor	15 Days	7 days
11	Protection Work Design and Drawings	Contractor	15 Days	7 days
12	Earth Retaining Structure Structural drawing	Contractor	15 Days	7 days
13	a) Test Pile drawing	Contractor	15 Days	7 days
14	b) Girder drawing	Contractor	15 Days	7 days
15	c) Working pile drawings	Contractor	15 Days	7 days
16	d) Pile cap drawings	Contractor	15 Days	7 days
17	e) Pier and pier cap/Portal-drawings	Contractor	30 Days	7 days
18	f) Pedestal & Bearing drawings	Contractor	15 Days	7 days
19	g) Superstructure and parapet drawings	Contractor	15 Days	7 days
20	Earthwork in Embankment and Cutting drawings, retaining wall, Drain at Ramps etc.,	Contractor	15 Days	7 days
21	Temporary structures design	Contractor	15 Days	7 days

ANNEXURE - 6
APPLICABLE PERMITS

1 APPLICABLE PERMITS

1.1 The Contractor shall obtain, as required under Applicable Laws, the following Applicable Permits:

- (a) Permission of the State Government for extraction of boulders from quarry;
- (b) Permission of Village Panchayats and Pollution Control Board for installation of crushers;
- (c) Licence for use of explosives;
- (d) Permission of the State Government for drawing water from river/reservoir;
- (e) Licence from inspector of factories or other competent Authority for setting up batching plant;
- (f) Clearance of Pollution Control Board for setting up batching plant;
- (g) Clearance of Village Panchayats and Pollution Control Board for setting up asphalt plant;
- (h) Permission of Village Panchayats and State Government for borrow earth; and
- (i) Any other permits or clearances required under Applicable Laws.
- (j) Fire NOC from Karnataka State Fire and Emergency Services Department
- (k) Traffic Diversion NOC/permission from Bangalore police commissioner /Deputy commissioner Traffic Police

ANNEXURE – 7**PROVISIONAL CERTIFICATE**

- 1 I/We, (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated (the "**Agreement**"), for construction of the section (km to km) in the State of in- BSTP (the "**BSTP Project**") on Design and Construction basis through (Name of Contractor), hereby certify that the Tests in accordance with the Agreement have been undertaken to determine compliance of the BSTP 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 BSTP 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 Contractors have agreed and accepted that they will 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 BSTP 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 BSTP Project is hereby provisionally declared fit for entry into operation on this the day of 20.....

ACCEPTED, SIGNED, SEALED
AND DELIVERED

For and on behalf of
CONTRACTOR by:
(Signature)

SIGNED, SEALED AND
DELIVERED

For and on behalf of
AUTHORITY's ENGINEER by:
(Signature)

ANNEXURE - 8

COMPLETION CERTIFICATE

- 1 I/We, (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated (the "**Agreement**"), for construction of thesection (km to km) of in the State of in- BSTP (the "**BSTP Project**") on Design and Construction basis through (Name of Contractor), hereby certify that the Tests in accordance with the Agreement have been successfully undertaken to determine compliance of the BSTP Project with the provisions of the Agreement, and the authorisation by the Commissioner for Railway Safety under Applicable Laws has been obtained.
- 2 It is certified that, in terms of the aforesaid Agreement, all works forming part of Railway Project have been completed, and the BSTP 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 prevail.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Authority's Engineer by:

(Signature)

(Name)

(Designation)

(Address)