SCOPE OF WORK AND DESIGN CRITERIA

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1.0 Scope of Work

1.1 General

The Bengaluru Smart Infrastructure Limited (B-SMILE) intends to construct ROB at Byappanahalli, Bangalore including construction of elevated Rotary fly over at IOC junction and construction of road integrating Banaswadi main road and Old madras road to facilitate connectivity to new M.Visvesvaraya terminal at Byappanahalli railway station to improve the accesses to all the directions of road, including construction of Pedestrian underpass at Rotary junction for movement of pedestrians and to decongest the traffic at New Terminal Railway station. As a part of that, B-SMILE has proposing to build 2- lane uni- directional additional Road Over Bridge at LC NO: 136A at Km 345/800-900 between Bengaluru Cantonment and Baiyyappanahalli Railway station with additional two Obligatory span parallel with existing obligatory span on Right hand and approaches on either sides of obligatory spans with viaduct and RE walls.

In this behest, B-SMILE is inviting Tenders from the Eligible Tenderers on Turnkey basis based on Tenderer's own Design on the basis of Parameters fixed by the B-SMILE (Alternate Proposal is permitted and is limited to only one). The Alternate Proposal submitted by the Tenderer shall conform to the Relevant Indian and International Standards satisfying the Key Parameters fixed by the B-SMILE and shall be approved by the B-SMILE. Location of the Site is described in section 1.2 below.

Tenderers shall submit only one Proposal. Additional Proposal / s shall result in the Disqualification of the Tenderer.

The Turn key Tender based on Tenderer's own Design shall be inclusive of Cost of Topographic Survey; Geotechnical Investigation and any other Ancillary Investigations / Works and Cost of all Labours; Materials; Casting Yard; Tools and Plants and Machinery required for Fabrications, Launching, completing the various Components of the elevated Rotary with composite super structure of Steel Box Girder at IOC junction connected with Ramps as shown in the concept drawings. Works along with ROB at LC No 136 A with additional 2 obligatory spans with composite I Girder and approaches ; Construction of all ramp approaches for Rotary, ROB including, Drainage Facilities; Signage; Road Marking; Painting of all the Infrastructure developed; Illumination on the Grade Separators . Construction of Medians, Islands, BOX Culverts, compound wall for Defense wing and Railways and Temporary and Permanent Retaining Structures, etc. The Works shall include all Civil, Electrical, Mechanical, all Safety Aspects and any other Works required for the Construction and Completion of the Works in all respects and to the satisfaction of the Employer. The Quoted Rate shall be inclusive of all Taxes, Duties and Levies including Sales Tax, Municipal Taxes, Local Taxes, Octroi, ESI, all Royalties, Patent Rights, other Incidental Charges, and any other Taxes wherever applicable and shall be paid by the Contractor but Excluding GST. GST of 18% or as applicable at the time of payment shall be paid to the tendered amount separately. No claim whatsoever in this regard shall be entertained by the Employer.

1.2 Site

The Construction Site is located about 13km east of Bengaluru Railway station at Byappanahalli at the IOC junction crossing the Railway lane. This junction will operate Major link between Banasavadi and Old Madras Road also Kammanahalli Main Road and Maruthiseva Nagar. The Location of the Project is indicated in **Drawing (Further details if required shall be obtained from office)**

1.3 Works to be carried out

The Works to be carried out under this Turnkey Contract shall include

a. Preliminary Works like Setting out, Establishing and Maintenance of Permanent Benchmarks, Reference Points and Design , Preparation and obtain Approval of General Alignment of Elevated Rotary with connected Ramps to all the sides of Junction roads with approaches, And General Alignment for Additional Road Over Bridge parallel to existing at LC no 136A nearby New Railway station

b. Clearing of Site before Commencement of Work including Dismantling of ROB and Its Approaches at proposed rotary location and Site Clearance at Acquired Government and Private Property, if any.

c. Topographical Survey and Setting out of Works.

d. **Geotechnical Investigations and taking Trial Bores**: The Geotechnical Investigation Results given in this Document is only indicative and the same is shown in the Tender drawing. The Tenderer shall make his own Assessment and his Lump Sum Offer is for the whole Item of the Work, (All the Items described in this Tender Document and Drawings) and for any Variations observed at Site in respect of Levels and Soil Particulars, etc. The Tenderer's offer is deemed to have been made considering the Actual Ground Conditions at Site and he shall not be eligible for any claim whatsoever. During Execution of the Work, the Contractor shall carry out Geotechnical Investigation as per IRC: 78 at all Piers / Abutments of Rotary and ROB for LC 136A, at Selected Points of Retaining Wall, and at any other Locations required for the Design of the Works in conformity to the Prevailing Norms and Codal Provisions.

e. The Successful Tenderer, on Award of Work, shall map all the Existing Service Lines, above and below the ground level within the Battery Limit, such as Water Supply, Underground Drainage, Electrical, Telephone, Optical Fibre Cables, etc. Mapping of the Service Lines below the Ground Level shall be carried out using Ground Penetrating Radar (GPR) Equipment. Mapping shall be submitted to Authority (Client) for getting approval and estimation from all the respective Service Departments.

f. Relocation of Utility and Service Lines such as Water Supply, Underground Drainage, Electrical, Telephone, Optical Fibre Cables, etc. those are incidental and obstructing, are to be permanently diverted in an acceptable manner to the Concerned Service Departments so that not to hinder the Services of the Lines at the Cost of the Employer. The Shifting, Supervision Charges, Deposits, if any, to be payable to the Concerned Government Departments shall be borne by the Employer. The Employer will help in Liaising with the Concerned Authorities regarding the Need to shift the Service Lines in case of requirement. Based on his own Investigations as mentioned in the above Clause the Contractor shall make his own Plan for Provision / Diversion of the Service Lines and ascertain the entire Scope of Work and other Required Details by himself and the Employer shall not take any responsibility other than remitting the shifting charges /Liaisoning with the Concerned Departments as stated above. The Time Schedule of 24 (Twenty Four) Months is inclusive of the Period of Utility Shifting also and no Extension of Time would be granted due to Delay in this Work without valid reason. No Monetary Claim in whatsoever manner shall be entertained separately.

g. Removal and Relocation of Existing Bus Shelters within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer. The employer will bear the costs of removal and relocation.

h. Shifting of Existing Kerb Stones within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer.

i. Removal of Existing Traffic Signages and Signals within the Battery Limit, if any, as approved by the Employer.

j. Removal of Existing Hoardings, Advertisement Boards and Appurtenant Structures within the Battery Limit, if any, as approved by the Employer.

k. Dismantling of Existing ROB at IOC junction and Disposal of Earth / Debris of existing RCC and Masonry Structures, PCC, existing Road Pavements, RCC / SSM Drainage Structures, Tree Roots, Culverts, Medians, Kerbs, Traffic Islands, Earth Retaining Structures, Ducts, Hoarding and Advertisement Boards and Appurtenant Structures, etc. required for the Execution of the Work.

l. Construction of Temporary and Permanent Earth Retaining Structures, Compound, Barrication, Fencing, Dewatering, Drainage Facilities and all Temporary Structures wherever required during Construction.

m. Regarding of existing Ground Levels to achieve the required Vertical Clearance for ROB, Drainages, etc. including Disposal of Excavated Earth and Debris to the Location identified by the Contractor where the same shall not cause Nuisance and shall be acceptable to the Authorities concerned.

n. **Traffic Diversion**: Within project road scope area, the tenderer shall ensure that the Traffic Movement during the Construction of the Works is properly diverted, maintained and obstruction to the Traffic Movement is kept to the minimum. Traffic Movement in Construction area shall include but not be limited to the following.

- Preparation of the diversion plan in consultations with Client or his representative and shall be submitted to Client for further approval from Concern department /Police for their approval and public notification if any.
- All Necessary Arrangements required at various location as per approved plan i.e. Sign boards, Cautionary Boards and delineators to warn, inform, guide and control drivers/ riders etc. to be provided.
- Provide Skilled Flagmen for Traffic Diversion as per the Requirement of Concerned Department.
- Provide Traffic Barricades with Blinkers, Reflective Tapes, Road Delineators, Traffic Cones, Portable Signage's, Reflective Lights and other necessary Traffic Signage as required, as directed by the Concerned Authorities and as per the Specification. Construction zone area.
- Prior approval of Traffic Diversion plan from the employer is necessary. If any new diversion road work requires for smooth traffic flow Tenderer to execute work with prior approval of Authority under Additional / Variation work as per special condition clause no 67 i.e. variation.
- After Completion of the Work, if in opinion of Authority wearing course/40mm Bituminous Concrete/Micro surfacing on diverted road are requiring than Tenderer should execute the work at the cost of employer. All cost towards Maintenance of diversion roads shall be bear by the Authority and will be dealt as per special Condition Clause No. 67.

o. **Barrication around the Construction Area**

- The Contractor shall be required to keep the Site as Safe and Secure as possible at all times, including the Erection of Site Perimeter Hoarding, which shall also deter trespassers both adult and children alike, as per the Approval of the Employer.

- The Contractor shall provide a solid two meter high securely erected Barricade including Lights over Barricades at night around the perimeter of the Site as per the Approval of the Employer, with Agreed and Guarded Access and Egress Points for both personnel and vehicles.
- At each entrance to the Site, the Contractor shall erect a large Billboard warning all persons who enter the Site that they are required to wear the Appropriate Personal Protective Clothing and that no Unauthorized Access is allowable.
- Wherever the Barricade borders on Pedestrian Footpath, Lightings shall be provided to illuminate the Pedestrian Routes. The Positioning of the Barricade Line shall not reduce the Width of Pedestrian Footpath to less than 900mm.
- Site Perimeter Barricade shall be washed at least once a month and repainted at least annually.
- The Site Barricade shall need to be inspected on a regular basis in order to ensure that the Integrity of the Fencing is maintained at all times as far as practicable.

p. Providing and Erecting Project Information Display Board (minimum size 2.5m X 1.5m) at minimum ten (10) different locations in and around the Project Area as approved by the Employer.

q. The Successful Tenderer, on Award of Work, shall coordinate with KPWD, NHAI Traffic Police, BDA, BESCOM, BSNL, BWSSB, BMRCL, Indian Railways, K-Ride, KPTCL, B-SMILE and other Agencies associated with the Construction of Works and comply with their Requirements. The Employer will provide assistance only.

r. The Successful Tenderer, on Award of Work, shall prepare a detailed General Alignment Drawing for Elevated Rotary with approaches at IOC Railway Junction and for Road Over Bridge at L C No 136 A, in consultation with the concerned Railway Department. Obtain approval for detailed GAD in principle by following the railway procedures by a) submitting GAD Checklist, b) detail estimate of Proposed Circular portion of elevated rotary in ROB portion & Obligatory portion of Railway crossing at LC 136, along with c) detailed soil investigation reports for each column of circular ROB portion duly signed by investigating authority with seal on each page, showing the reduced levels on top of each bore hole and showing SBC of soil of each type of soil strata etc., before commencing work. The Employer will provide assistance only.

s. Structural design and drawing work for Foundation, sub-structure, super structure, fabrication drawings as per relevant IRC, BIS and other codes for the Elevated Rotary and Road over bridge shall be prepared. However design and drawings along with launching schemes arrangements for non-standard drawings of Railways to be proof checked by Indian Institute of Technology /Science/National Institute of Technology is mandatory for submission to Railway department at the risk and cost of the Successful tenderer for getting approval for execution.

t. After proof checking by IIT / IISc / NIT, the tenderer shall got approved the detailed design and drawings of structures of Elevated Rotary and ROB from concerned Railway department and B-SMILE and prepare Good for construction (GFC) drawings as well as other drawings as require for construction of Elevated Rotary and ROBs including approaches and other necessary structures if any.

u. Construction of Elevated Rotary and ROB at LC No 136A including Foundations, Sub Structure, Super Structure for Via Ducts and Obligatory Span, Composite bridge, Construction of Reinforced Earth Retaining Walls, RCC Retaining Walls, Backfill between RE Walls / Retaining Walls, Soil Stabilization below RE Panels, Filter Media, Kerbs, Crash Barrier, Crash barrier for ROB at LC 136A as per requirements of Defense, Complete Drainage System with Down Take Pipes, Wearing Coat, Water Proofing, Hand Rails to Crash

Barriers, Expansion Joints, Bearings, Painting, Deck and Surface Road Illumination, etc. complete in all respects as per MoRT&H / IRC / BIS Specifications.

v. The Scope shall include all the above Works within the Battery Limit. The Battery Limits for the Junctions are indicated in Concept and Alignment plan drawing no.NEZPL / DWG /PRJ/204-3 for Comprehensive plan of Elevated Rotary and ROB at LC 136A and development of Road corridors works within the Battery Limit.

w. The scope also includes construction of a compound wall of maximum 300m for defense; 300m for railways boundaries after acquire their land.

x. Commitment also includes civil work construction if required within the Railway property consist of a) Sewerage primary plant consist of Primary treatment consists of Equalization tank, flash mixer, clariflocculator, rapid gravity filter, disinfection tank and the sludge drying bed for approximate area of 4 sqmt up to limit of 100 KLD capacity b) Electrical control room for signal with a maximum area of 144 sqmt. c) Re construction of Railway Gowdan which is now abended, needs to be relocated and to be newly constructed as per plan of Railways with maximum of 210 sqmt.

y. Providing Gantry, Traffic Signals, Traffic Signages, Road Marking and Granite name plate engraver along with necessary Pedestals, Foundation Stone, Stone for Inauguration Ceremony as per Specifications and as per the Approval of the Employer.

z. Necessary Drainage Arrangement as per Specification. The Levels and Dimension Details for Drainage Arrangement shown in the Tender Drawing are only indicative. The Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study and get the Drawing approved by the Employer before Execution.

aa. Set up of Field Laboratory.

bb. Adequate Street Lighting / Junction Lighting Arrangements as approved by the Employer during Construction.

cc. **Removal / Disposal**: Removal / Disposal of Excess / Disused Earth, Soils, Debris and Materials from the Construction Site. Further, it is the responsibility of the Contractor to identify the Dumping Yard Location and to dispose the Excess / Disused Earth, Soils, Debris and Materials to the same identified Dumping Yard where the same shall not cause Nuisance and shall be acceptable to the Authorities concerned.

dd. Dewatering in Foundation, Trenches, Drainages, wherever required, and pumping out to Locations as directed by the Employer.

ee. All Necessary Safety Measures / Precautions to be adopted at Site as per the Instructions of the Employer.

ff. Providing and maintaining Furnished Site Office for the Supervisory Staff of the Employer and his approved Representative.

gg. Making good the Road Surface as per IRC Standards, which are damaged / worn out during Construction of the Work and restoring the same to the Original Status.

hh. Any other Items of Works, which are not specifically enumerated in the Tender Document, but required for Functioning of all the Infrastructures Developed and as per the Directions of the Employer.

ii. Construction of Architectural Features required for Good Aesthetics of the Infrastructure developed.

jj. Painting with Approved Colour, Shade, Make and Type shall be provided for the various Elements as per the Specifications given in the Tender Document.

kk. The Contractor shall ensure Cleanliness of the Work Area and its surroundings by deploying Man Power for the same. The Contractor shall have to ensure proper Brooming, Cleaning and Washing of Work Area till the Currency of the Contract including Disposal of Sweepage. Nothing extra shall be payable on this account

ll. Cleaning of the Site after Execution and before handing over the Project to the Employer.

mm. Maintenance of all the Infrastructural Facilities developed for a Defect Liability Period of 24 months, which will run concurrently from the Date of the Physical Completion of the Project and on issuance of Completion Certificate by the Competent Authority and for a Maintenance Period of 24 months, which will run concurrently from the next day of Completion of Defect Liability Period and on issuance of Defect Liability Completion Certificate by the Competent Authority. For maintenance of steel bridge and other components refer Indian Railways Bridge Manual-1998

oo. The detailed scope of work shall be finalized at the time of award of work and the tender document also forms part of the contract document

2.0 Design Criteria

2.1 General and Approach to Work Site

The General Site Particulars are shown in the Topographical Map. Refer Tender Drawings no. **NEZPL/DWG/PRJ/204-2**

2.2 Benchmarks and Setting out of Works

a. The Standard Benchmark and its Reduced Level with reference to which the Work shall be carried out is the GTS Benchmark available nearest to the Site. The Employer does not take the responsibility about the Correctness of the Levels indicated in the Drawings. The Contractor has to establish at least fifteen Benchmarks in the Site of Works with Reduced Levels clearly marked on them. The Contractor shall be solely responsible for the accuracy of the Benchmark Levels and for maintaining the same throughout the Contract Period.

b. The Works shall be set out in accordance with the Drawings approved by the Employer.

c. The Contractor shall be responsible for the True and Proper Setting out of the Works and for the Correctness of the Positions, Levels, Dimensions and Alignments of all Parts of the Works and for the Provision of all Necessary Instruments, Appliances and Labours in connection therewith. The Contractor shall give at least 48 hours' notice to the Employer of his intention to set out or give Levels.

d. If at any time during the Progress of the Work, any Error appears or arises in the Positions, Levels, Dimensions and Alignments of any part of the Work, the Contractor shall at his own expenses and risk, rectify such Errors to the satisfaction of the Employer.

e. The Checking of any setting out of any line or level by the Employer or his approved Representative shall not relieve in any way the Contractor of his responsibility for the Correctness thereof and he shall carefully protect and preserve all the Benchmarks, Site Rails, Pegs and other Things used in the setting out of Works.

f. All Duties concerning Establishment of a Set of Benchmarks, Permanent Stations, Centre Line Pillars, etc. for performing all the Functions necessary at the Commencement and during the Progress of Work till the Physical Completion of all the Items of the Work in question, shall be carried out by the Contractor at his own risk and cost.

f. The Centre Line of the Elevated Rotary and its approaches, ROB, Piers of Flyovers, Abutments, RE Walls, Surface Level Roads / Slip Roads, Corridor, Electrical room for Railways, Drainage Facilities and the Foundations shall be established by Total Station Equipment and the Centre Line Marks shall be engraved on smoothly finished masonry or concrete pillars of such dimensions and constructed at such intervals and places as may be directed by the Employer or his approved Representative and shall be maintained in proper manner throughout the Period of Construction. The Contractor shall submit a Drawing showing the Alignment of Elevated Rotary Flyovers, Road Over Bridge, Surface Level Roads / Slip Roads, Corridor and Drainage

Facilities within 15 (fifteen) days from the Date of Signing of Agreement.

g. He shall also keep proper Record of such Permanent Benchmarks established denoting therein their Correct Levels.

h. The Work of Establishment of all such Benchmarks shall be carried out by only experienced and skilled staff of the Contractor with the help of precise instruments suitable for this type of Work. The instruments used shall be checked for their accuracy and for permanent adjustments before the commencement of the Work and also at frequent intervals during the progress of the Work.

j. All such Benchmarks established by the Contractor shall be subject to check and approval of the Employer or his approved Representatives. If any Variations noticed in the Work as result of improper establishment or maintenance of such Benchmarks, it shall be rectified at the Contractor's own Risk and Expense.

2.3 General Requirements

In order that the Tenderer's Proposal qualifies as an Alternative Design, it shall generally fulfill the following Requirements.

a. It shall ensure Soundness of the Structure, its Durability and Aesthetics as a whole in harmony with the surroundings. A Report on the Aesthetic Aspect shall be compulsorily in the Technical Bid.

b. It shall ensure Speedy and Practicable Construction.

c. It shall lead to Appreciable Economy in the Design.

d. It shall be accompanied by Detailed Drawings and Detailed Description of Work and Specification of Materials and Items. If called upon, the Tenderer shall explain his Proposal through Power Point Presentation during Tender Evaluation Stage before Opening of Financial Bid.

e. At the time of Detailed Design, the Contractor shall not deviate from the Basic Scheme proposed by him for the purpose of Tender. At the same time, it is mandatory on the part of the Contractor to strictly adhere to all the Geometric Details indicated in the Tender Drawing. The Length of the Ramp could marginally change based on Structural Scheme and Designs after Approval by the Employer.

f. The Alignment of the Elevated Rotary Flyovers, Road Over Bridge, Surface Level Road and Drainage Facilities, Electrical/Godown rooms building and ancillary works for Railways , compound wall shown in the Drawings appended with the Tender Document shall be followed by all the Tenderers, and if Any alteration / modifications in alignment plan is proposed by the bidder in the better way resulting with further reduction of the cost of land acquisition and project cost will be subjected to employer approval,

g. The Superstructure shall have required numbers of Expansion Joints for better Riding Surface.

h. Only Single Pier Type Structure shall be considered for Elevated Rotary Flyovers, Pier Shape shall be aesthetically pleasing, preferably elliptical / circular / ornamental Piers of Classical Design, etc. In this regard, the Decision of the Employer is final and binding.

i. The Tenderer shall note that it is a Requirement for Qualification that the Works warrant that the Structure proposed shall be aesthetically pleasing and easy to maintain considering the Importance of the Work Location.

2.4 Specifications for Design and Codes to be followed

The Design of Structural Components of all the Works shall conform to the Relevant Specifications and Criteria laid down in the following Latest Indian Road Congress Publications with Amendments / Revisions issued up to the Date of Issue of Notice Inviting Tenders.

The Hierarchy for the following Codes of Practice is as follows:

a.

IRC: 5 : General Features of Design
IRC: 6 : Loads and Stresses
IRC: 15 : Construction of Concrete Roads
IRC: 18 : DESIGN Criteria for Pre-stressed Concrete Road Bridges (Post-Tensioned Concrete)
IRC: 21 : Standard Specifications and Code of Practice for Road Bridges.
IRC: 22 : Composite Construction (Limit State Design)
IRC: 24 : Steel Road Bridges
IRC: 35 : Road Markings
IRC: 37 : Design of Flexible Pavements
IRC: 38 : Design of Horizontal Curves for Highways and Design Tables
IRC: 39 : Standards for Road-Rail Level Crossing (I Revision).
IRC: 44 : Cement Concrete Mix Design for Pavements
IRC: 54 : Lateral and Vertical Clearances at Underpasses for Vehicular Traffic
IRC: 58 : Design of Plain Jointed Rigid Pavements for Highways
IRC: 65 : Recommended Practices for Traffic Rotaries
IRC: 67 : Road Signs
IRC: 71 : Abbreviations and Symbols in Documents and Plans.
IRC: 78 : Foundation and Substructure
IRC: 79 : Road Delineators
IRC: 83 : Metallic Bearings
(Part I)
IRC: 83 : Elastomeric Bearings
(Part II)
IRC: 83 : POT, POT cum PTFE, PIN and Metallic Guide Bearings
(Part III)
IRC: 86 : Geometric Design Standards for Urban Roads in Plains
IRC: 92 : Designs of Interchanges in Urban Areas
IRC: 103 : Pedestrian Facilities
IRC: 112 : Concrete Road Bridges
IRC: SP: 19 : Manual for Survey, Investigation and Preparation of Road Projects.
IRC: SP: 23 : Vertical Curves for Highway
IRC :SP: 37 : Guidelines for Evaluation of Load Carrying Capacity of Bridges.
IRC: SP: 42 : Road Drainage
IRC: SP: 50 : Urban Drainage
IRC: SP: 56 : Steel Pedestrian Bridges
IRC: SP: 57 : Quality Systems for Road Construction
IRC: SP: 90 : Manual for Grade Separators and Elevated Structures

MoR : Indian Railways Bridge Manual-1998

IS: 2911 (All Parts) : Pile Foundations

The Latest Revision of the above Codes shall be followed.

b. Any IRC Standard Specifications and Codes of Practice or Criteria for Road Bridges other than "a" above, but published upto the Last Date of the Issue of Notice Inviting Tender.

c. For any Item not covered by “a” and “b” above, MoRT&H Specifications for Road and Bridge Works published by Ministry of Surface Transport (Roads Wing), Government of India (Latest Edition).

d. For Items not covered by any of the “a”, “b” and “c” above, Standards and Specifications, Provisions of Bureau of Indian Standard (BIS) Codes of Practice.

e. IRC: SP: 33 Guidelines on Supplemental Measures for Design, Detailing and Durability of important Bridge Structures (if applicable).

e. For Items not covered by any of the above Standards and Specifications, Sound Engineering Practice and Provisions of Relevant Codes of other Nations shall be referred. In this regard, Decision of the Employer shall be final and binding on the Contractor.

2.5 Order of Precedence in case of Conflict

In Case of Conflict between difference parts of Tender Document, the following Order of Precedence shall prevail.

1. Design Criteria as specified in Tender Document.
2. Instructions to Tenderers.
3. Special Conditions of Contract.
4. General Conditions of Contract.
5. MoRT& H / IRC Specifications.
6. Codes of Practice.

2.6 Soil Investigation to be carried out by the Contractor

The Contractor shall carryout complete Soil Investigation at his own risk and cost. The Boreholes shall be taken at the Final Locations of each Pier / Abutment, at Selected Points of Retaining Wall, at elevated Portion of Rotary/Road Over bridge and at any other Locations required for the Design of the Works prior to the Commencement of the Work to ascertain the Levels of Rock and its Quality, to obtain SBC at different Depths, Soil Stratification, Ground Water Table, etc. The Termination Level of the Borehole shall be determined by conducting SPT Tests. Three consecutive SPT Tests at an interval of 1.5m each with 'N' values greater than 100 shall be carried out before termination. If rock is encountered, Drilling shall continue upto 3m in rock with Rock Samples taken for Testing. All the Soil / Sub Soil Investigations and its Frequency shall be strictly in accordance with the Relevant Codal Provisions.

a. During Execution of the Work, the Samples from the Bore taken at each Foundation shall be tested and analyzed in the Laboratory approved by the Employer for establishing Design Parameters. Tests such as Standard Penetration Test, Compression and Shear Test on Undisturbed Soil Samples, Pressure Meter Test, Crushing Strength of Rock, California Bearing Ratio (CBR) Test, Plate Load Test, etc. shall be carried out in conformity with the MoRT&H Specifications. The Contractor shall submit the entire Data to the Employer along with his own / Laboratory Recommendations and obtain approval for the Design Parameters. Necessary Interpretation of the Result of Tests shall be furnished to the Employer for scrutiny of Design of Foundations.

b. The Cost of these Tests and Interpretation of the Test Results shall be considered, as incidental to the Main Work and the same shall be included in the Tendered Amount.

c. While checking the Stresses at the Base of Foundations, it shall be ensured that under the Worst Combination of Forces no Tension is permitted. The Safe Bearing Capacity at the Foundation Level shall be verified during Construction so that to ensure that the Stresses imposed on the Foundation Strata are within Permissible Limits.

2.7 Restrictions on Type of Structures

The following Types of Structural Arrangements shall not be permitted.

a. Structures, which require imported material of major quantity for which foreign exchange will have to be arranged by the Employer.

b. A Design in which Stability of one or more Span is endangered due to the Failure of some other Span / Spans.

c. Concrete Structures with Hinges / Half Joints / Articulations.

d. Super Structures with Joints at the tips of long cantilevers with Hinges including Pendulum Type Bearings, Gap Slab, etc.

e. Transversely Continuous Wide Deck resting on separate Foundations at Support Locations.

f. Piers in the form of Multiple Columns or "Y" Columns.

2.8 Concept and Alignment plan of Elevated Rotary Flyover and ROB at LC No 136A

The concept and alignment plan of elevated rotary proposed at IOC junction with its approaches integrating with at grade road proposal up to NH junction at old madras road including proposal of New ROB at LC No 136 has been prepared and enclosed as stated elsewhere. Concept plan with alignment is prepared keeping in view of minimum land acquisition both in private and government properties. The land acquisition plan no NEZPL/DWG/PRJ/204-5 also enclosed to understand the proposed right of way. The successful tenderer shall follow the concept plan for profile design within the proposed right way shown in LA plan without changing the concept. If there is any deviation in concept plan by minimizing the structural length as per the site condition up to the limit of 500m as decided by employer, contractor shall obtain prior approval from B-SMILE before commencement of design under this contract.

2.8.1 Elevated Rotary Flyover and Pedestrian Underpass

An elevated rotary of Four lanes unidirectional type flyover has been proposed at IOC Railway Junction where rail crosses the sub arterial road of Banasavadi- Maruthisevanagar in one direction and Kammanahalli to Old madras road in another direction which connects the Outer Ring road and National Highways 4 & 7 respectively and junction is very close to New Baiyappanahalli terminal Railway Station are proposed within the railway boundary near the junction. The rotary has been designed to connect the four arms of the cross road with approaches. The Salient Features of the Elevated Rotary Flyovers with Approaches are given below. Lengths of approaches shown below are tentative and may vary depending on ground levels at the time of detailed design.

- **Elevated Rotary at IOC Junction**

Number of Lane	: 4 lanes unidirectional
Total width of Elevated Rotary	: 15.0m
Minimum Carriageway Width	: 14 m
Minimum Vertical Clearance	: 6.525m
Radius of the Rotary	: 32.50m
Circumferential length at C/L of Rotary	: 255.0m
	: 1 x 81.31m
Viaduct Span with Steel Box Girder	: 1 x 68.50m
	: 1 x 56.00m
	: 1 x 48.00m

Shape of Steel Box Girder	: Trapezoidal shape Open at Top
Number of Box Girder at each span	3

Further, Length of elevated rotary viaduct span has been fixed in consultation with sub-urban railway department K-Ride to minimize the interference of Piers with the proposed railway lane and to minimize the railway land at grade. Length of Viaduct Span shall be maintained with all other Requirements such as Protection to the Piers, etc. as indicated in the Tentative General Alignment Drawing no. NEZPL/DWG/PRJ/204-4 - 1 to 4 including Plan and Section details of all the Railway Spans**.** Further, Extra Widening of Carriageway at Curve Portion as per IRC: 86 with Design Speed of 30 kmph shall be provided.

- **Approaches to Elevated Rotary at IOC Junction**

- **Four lane Up/Down ramp approach to Rotary from Banasawadi road**

Number of Lane	: 4 lanes divided bi- directional
Total Width of approaches	: 17.0m
Minimum Carriageway Width	: 2 X 7.5m
Median	: 1.0m
RCC Crash barrier	: 2 x 0.5m
Maximum Vertical Gradient	: 5% (1 in 20)
Length of Approaches	: 205.0 m
Length of Viaduct Span	: 4 x 30.00m
Length of End spans	: 1x20.0m
Length of Solid Ramp	: 65.0 m

- **Two lane Up ramp approach to Rotary from Banasawadi road**

Number of Lane	: 2 lanes uni- directional
Total Width of approaches	: 8.5m
Minimum Carriageway Width	: 1 X 7.5m
RCC Crash barrier	: 2 x 0.5m
Maximum Vertical Gradient	: 5% (1 in 20)
Length of Approaches	: 205.0 m
Length of Viaduct Span	: 4 x 30.00m
Length of End span	: 1x20.0m
Length of Solid Ramp	: 65.0 m

- **Up/Down ramp approach to Rotary from Kammanahalli side**

Number of Lane	: 4 lanes divided bi- directional
Total Width of approaches	: 17.0m
Minimum Carriageway Width	: 2 X 7.5m
Median	: 1.0m
RCC Crash barrier	: 2 X 0.5m
Maximum Vertical Gradient	: 5% (1 in 20)
Length of Approaches	: 205.0 m
Length of Viaduct Span	: 4 x 30.00m
Length of Solid Ramp	: 85.0 m

- **Down ramp Towards Baiyappanahalli Terminal Railway station & Up ramp to Rotary from Indiranagara (Old Madras road)**

Number of Lane	: Two lane unidirectional
Total Width of approaches	: 8.50m

Minimum Carriageway Width	: 2 X 3.5m
RCC Crash barrier	: 2 X 0.5m
Maximum Vertical Gradient	: 5% (1 in 20)
Length of Approaches	: 205.0 m
Length of Viaduct Span	: 4 x 30.00m
Length of End spans	: 1x20.0m
Length of Solid Ramp	: 65.0 m

- **Central Down ramp from rotary to Baiyappanahalli Terminal Railway station beyond and towards Old Madras road**

Number of Lane	: Two lane unidirectional
Total Width of approaches	: 8.50m
Minimum Carriageway Width	: 2 X 3.5m
RCC Crash barrier	: 2 x 0.5m
Maximum Vertical Gradient	: 5% (1 in 20)
Length of Approaches	: 1150.00 m
Length of Viaduct Span	: 33x 30.00m
Length of Solid Ramp	: 160.0m

- **Up/Down ramp approach from Rotary to Maruthisevanagara road**

Number of Lane	: 4 lanes divided bi- directional
Total Width of approaches	: 17.0m
Minimum Carriageway Width	: 2 X 7.5m
Median	: 1.0m
RCC Crash barrier	: 2 x 0.5m
Maximum Vertical Gradient	: 5% (1 in 20)
Length of Approaches	: 1496.0 m
Length of Viaduct Span	: 47 x 30.00m
Length of Solid Ramp	: 86.0 m

Typical Cross Section of Approaches to Rotary are shown Tender Drawings attached.
Extra Widening of Carriageway and Super Elevation at Curve Portion as per IRC: 86 with Design Speed of 30 kmph shall be provided.

Pedestrian Underpass

The facility of footpaths for pedestrian movements has not been proposed on elevated rotary/approaches to avoid pedestrian conflicts with vehicular traffic. To facilitate pedestrians to cross the railway line, a separate pedestrian underpass is proposed below the rotary to meet the railway safety requirements.
The Salient Features of the Pedestrian Underpass with Approaches at Railway crossing are given below.

- **Proposed Pedestrian Underpass**

Length of Pedestrian Underpass	: 152m (considering future track)
Type of Structure	: RCC Box type
Width of PUP	: 5.2M
Clear height of PUP	: 2.75M
Earth cushion over slab	: 0.5m
Rail with Ballast on earth cushion	: 0.75m
Entry/Exist to PUP	: Steps and Ramp width of 1.2m

Typical Cross Section of PUP at IOC Junction Railway Crossing Below Rotary is enclosed in the Tender

drawing.

2.8.2 Road Over Bridge

Additional Road Over bridge is proposed for LC No:136A at KM 345/800-900 between Bengaluru Cantonment and Baiyappanahalli Railway Station. Railway department has recently constructed Road Over Bridge for this LC No: 136A with two lane configurations, B-SMILE and Railway is now taken up to construct additional Road Over Bridge with same configuration of existing one which has constructed recently. Obligatory span is with composite girders with two spans at railway lane portion are proposed as existing ROB on RHS. The Salient Features of the New ROB with Approaches and Additional composite girder at Railway crossing are given below

- **Proposed Road Over Bridge at LC No: 136A on LHS of Existing Obligatory span**

Obligatory Railway Span

Number of Lane	: 2 lanes unidirectional
Number of Span	: 2 x 35m
Total width of ROB	: 12.0m
Minimum Carriageway Width	: 1 X 7.5m
Kerb	: 2 x 0.55
Footpath	: 2 x 1.5m
Crash Barrier	: 2 x 0.20m
Vertical Clearance	: 6.525m
Camber (bi-directional)	: 2.5%

Approaches to Obligatory Railway spans

a) Towards Byyappanahalli Railway station

Total Length of Approach	: 175.0m
Viaduct Length	: 91.5m
RE- Wall Solid approach	: 83.5m
Number of Viaduct Span	: 3 x 30.5m
Number of Lane	: 2 lanes unidirectional
Total width of Approach	: 8.5m
Minimum Carriageway Width	: 2 X 3.25m
Crash Barrier	: 2 x 0.5m
Vertical Clearance	: 6.525m
Maximum Vertical Gradient	: 5% (1 in 20

b) Towards Old Madras side

Total Length of Approach	: 465.0m
Viaduct Length	: 274.5m
RE- Wall Solid approach	: 190.5m
Number of Viaduct Span	: 9 x 30.5m
Number of Lane	: 2 lanes unidirectional
Total width of Approach	: 8.5m
Minimum Carriageway Width	: 2 X 3.25m
Crash Barrier	: 2 x 0.5m
Vertical Clearance	: 6.525m
Maximum Vertical Gradient	: 5% (1 in 20)

The Structural Configuration for the Road Over Bridge and Approaches is shown in Tentative General Alignment **Drawing no DWG/PRJ/204-4-5 to 6 .**

The Design Criteria and Viaduct Requirements to be adopted for the Tenderer's Proposal are furnished in the next

Section. The Viaduct Portion for Rotary, ROB and Approaches Span shall not be less than as indicated in the **Drawing No. DWG/PRJ/204-4-1 to 4 for** ROTARY Junction and **Drawing No. DWG/PRJ/204-5 to 6 for** ROB at LC No 136A respectively and shall have a Minimum Vertical Clearance of 6.525 m between bottom level of Soffit and Rail Formation Level.

The Work of Construction of Elevated Rotary Flyovers and ROB to be carried out under this Contract Shall include the following.

a. Construction of Elevated Rotary Viaduct and its approaches and ROB AT LC 136A viaduct and its approaches complete with Disposal of Surplus Earth; Wearing Coat over Deck; Crash Barrier with Railing over it; Construction Joint; Expansion Joints between Viaducts, Approach Slab, etc. and complete as per Specifications mentioned in the Tender Document.

b. Construction of Reinforced Earth Retaining Walls along with Approach Slabs, Friction Slabs; Pavement over Earth Filling and Ramp Terminal on either side; Side Drains for the Approaches as per the Requirements; Backfilling with Filter Media, Retaining Walls as per the Requirement; Disposal of Surplus Excavated Earth; Crash Barriers with Railing; Expansion Joints in Retaining Walls, Approach Slabs, etc. as per the Specifications mentioned in the Tender Document.

c. Wearing Coat of the Deck Portion of the Flyovers/ROB comprises of 25mm thick Mastic Asphalt and shall be placed before Laying of 40mm Bituminous Concrete (BC) after the Application of Tack Coat.

d. The Pavement for Solid Ramp Portion is flexible and crust shall comprise of 500mm Subgrade, 200mm thick Granular Sub Base (GSB), 250mm thick WMM with an asphalt layer of 80mm thick DBM & 40mm BC.

e. Steel crash barrier raised over RCC crash barrier ramp towards old madras road side for ROB at LC 136A in defense land as per requirement of Defense.

f. Construction and Painting of Kerbs, Steel Girders, Concrete Structures of Rotary &ROB, Providing Over Head Gantry at all 4 sides approaches and 2 sides at ROB locations, Traffic Signage's, Road Marking such as Lane Marking, Direction Marking, etc. as per the Specifications mentioned in this Tender Document.

g. Illumination above and below Flyovers as per the Specifications mentioned in this Tender Document.

2.8.3 Design Data

Design of Elevated Rotary Flyovers/Approaches/ROB shall be based on latest IRC / BIS Codes, Special Publications by IRC, relevant and latest Ministry Circulars and Latest Edition of MoRT&H Specifications.

a. **Location**
The Locations of the Elevated Flyovers and Road Over Bridge are given in the Drawings as mentioned in Clause No. 1.2 of this Section.

b. Type of Bridge

Elevated Rotary flyover is proposed for design as curved bridge with Steel box Girder of Trapezoidal in shape is proposed as the span arrangements are more than 50m and longest is 82m. The torsional properties of the closed section is advantageous in this type in reducing and simplifying the support arrangements and are also extremely efficient in carrying torsional loads found in this type of curved bridge and these bridges special analysis and detailing are required.

Type of bridge proposed for ROB at LC no 136A is composite I Girder.

c. Road Geometrics
Elevated Rotary Geometrics should be based on IRC: 65 Recommended Practices for Traffic Rotaries. The Standards for Road Geometrics adopted in the Design of the Viaducts and Ramps should be essentially based on IRC: 92 "Guidelines for the Design of Interchanges in Urban Areas" and the Salient Features are as follows.

i. **Vertical Gradient**
Maximum allowable Vertical Gradient for all Entry and Exit Ramps shall be limited to **5% (1 in 20)**.

ii. **Clearances**
Minimum Vertical Clearance between Rail Formation Level and bottom level of Soffit of Elevated Rotary Flyovers/ROB shall be 6.525m as per Hand book on Railway Construction under clause 10.2.2 selection of ROB/RUB Parameters mentioned.

iii. **Elevated Rotary Design**

Rotary design should be based on the traffic operations of diverging, merging and weaving. The design elements include design speed, radius at entry, exit and the central island, weaving length and width, entry and exit widths should be as per IRC-65. The Radius of Rotary should be designed with minimum radius of 1.3 times of entry curve. The entry to the rotary should not be straight, but a small curvature of about 20 and 25 metres to be introduced. The exit radius should be 1.5 to 2 times than the entry radius of the rotary so that the vehicles will discharge from the rotary at a higher rate. The width of the weaving section should be higher than the width at entry and exit preferably between 6 to 18m and weaving length available at the intersection should be between 18 to 90m. The traffic rotary shown in concept and alignment drawing no NEZPL/DWG/PRJ/204-3 is designed as per standards and is reducing the complexity of crossing traffic by forcing them into weaving operations.

d. **Minimum Viaduct Span**
Minimum Span of Viaduct adopted shall not be less than as indicated in the **Drawing No. DWG/PRJ/204-4-1 to 4** and **Drawing No. DWG/PRJ/204-5 to 6** respectively **for Rotary and ROB** and shall be approved by the Employer.

e. **Obligatory Span**
Minimum Length of Obligatory Span for Railway Crossing shall be as shown in the **Drawing No. DWG/PRJ/204-4-1 to 4** and **Drawing No. DWG/PRJ/204-5 to 6**

f. R**equirement of Steel Box Girder**

The recommended minimum web depth for web girder is 1.5m is requirement for inspection accessibility. The minimum width for the girders bottom flange width is 1.2m to allow for workers to complete fabrication of various internal girder details. The average distance center to center of flanges of adjacent boxes shall not be greater than 1.2 times and not less than 0.8 times the distance center to center of the flanges of each box.
Bottom tension flanges is designed with 30mm thick and web plate with 30mm (may varies as per actual), the minimum thickness of web plate should not be less than 8mm. Girders should be designed with Internal K-Frames to control distortion of the box girder. The provision of opening in the middle facilitates access in walking down the middle of the box during construction or routine maintenance inspections. Wide flanges also need to be stiffened to carry sufficient load and to avoid buckling.

Steel work of girders should be Metalizing with sprayed aluminum after surface preparation by Sand/grit blasting, followed by one coat of etch primer (IS:5666) & one coat of Zinc Chrome primer (IS:104) and two coats of aluminum paint (IS:2339) duly conforming to all relevant specifications and process given under Clause 39 of IRS-B1-2001.

Since Rotary is significant plan curvature, single bearings of spherical type be used at all supports, since the curvature of the line of supports generates torsional restraint.

The Initial design of Steel Box Girder is detailed in Drawing No DWG/PRJ/204-4-1 to 3

2.8.4 Description of Work and Viaduct Provisions for Alternative Proposals

a. **Alignment and Location**

The Alignment, Longitudinal Section and Obligatory Portion should be in accordance as shown in **Drawing No. DWG/PRJ/204-4-1 to 4** and **Drawing No. DWG/PRJ/204-5 to 6** Respectively for Rotary and ROB and shall be got approved by the Employer.

b. **Layout of Flyovers**

The Layout of Flyovers shall satisfy the following criteria as indicated on the enclosed Drawings and Supplementary Data.

i. Minimum Vertical and Horizontal Clearance in the Rail Location.
ii. Minimum Length to be covered by Open Spans as required from Consideration of Aesthetics and from Visibility for Low Level Traffic.
iii. Ruling Gradient.
iv. Minimum Length of Summit Curve as 30.00m and Valley Curve as 30.00m shall be adhered to.
v. Any other Criteria as shown on the Drawings.

c. **Road Level on the Flyovers and Roadway Particulars**

i. The proposed Road Particulars and Carriageway Widths shall be as per Drawing No. DWG/PRJ/204-4-1 to 4 and Drawing No. DWG/PRJ/204-5 to 6 **Respectively for Rotary and ROB.**

ii. The Vertical Profile of the Finished Surface of Deck Slab and Wearing Course shall be in the form of a smooth curve where change in Gradient occurs. The Design of Curves (Vertical / Horizontal) shall be approved by the Employer. The Design Speed shall be 40 km / hr. Super Elevation, Camber and Widening on Curves shall be suitably considered. Super elevation need not be provided for elevated rotary flyover.

2.8.5 Design Loads

a. **Live Load**

The Elevated Rotary Flyovers shall be designed as per IRC: 6 (Latest Edition).

b. **Wind Forces**

Wind Forces shall be considered as per IRC: 6 (Latest Edition).

The Appropriate Wind Force on 9m high Lighting Pole @ 25 m c / c shall be considered in the Design.

c. **Seismic Force**

The Flyovers shall be designed for Appropriate Seismic Force as per the Provisions of IRC: 6 (Latest Edition).

d. **Earth Pressure**

i. The Soil Properties for Embankment shall be in accordance with MoRT&H Specification. The Properties of Embankment like Dry Density of Soil 1.85 t / cum; Saturated Density 2.00 t / cum.; $\Phi = 300$ and $C = 0$ shall be considered for Tendering Purpose. At the time of preparation of Final Design, Soil Parameters shall be considered based on the Test Results of the Approved Material.

ii. Saturated Density of the Backfill (minimum 2 t / cum.) shall be considered for calculating Active Earth Pressure for Tendering Purposes.

e. **Temperature Range**

i. For Design of Structure to account for Temperature in Formula, $(DL) = \alpha Lt$
The value of "t" shall be $\pm 17^0C$
Where α = Coefficient of Expansion or Contraction

L = Length of the Member
(DL) = Expansion / Contraction due to Temperature Variation in appropriate Units.

ii. The Superstructure shall also be designed for Effects of Distribution of Temperature across the Deck Depth. For Calculation of Thermal Forces Effect of 'E' Value of Concrete shall be taken as 50% of the Instantaneous Value so that to account for Effects of Creep on Thermal Strains.

2.8.6 Durability

a. Minimum Grade of Concrete shall be as below.

PCC for Levelling Course	M15
RCC for Open Foundation, and Sub Structure and Super Structure	M35
RCC for Super Structure	M45
RCC for Pile and Pile Cap	M35
Prestressed Concrete	M45

b. **Minimum Cement Content, Diameter of Bar and Cover Requirements**
For Plain Cement Concrete (PCC), Reinforced Cement Concrete (RCC) and Pre Stressed Concrete (PSC), the Value given below regarding Minimum Cement Content and Maximum Water Cement Ratio shall be followed.

Plain Concrete		**RCC / PSC**	
Minimum Cement Content Kg / cum.	Maximum Water Cement Ratio	Minimum Cement Content Kg / cum.	Maximum Water Cement Ratio
240	**0.45**	**420/440**	**0.45 / 0.40**

c. The Minimum Nominal Diameter of Reinforcement shall be 8mm.

d. The Minimum Clear Cover to Reinforcement for all Grades of Concrete shall be as below.

Structural Element	**Clear Cover**
Slab	40mm
Web / Column	40mm
Footing / Raft slab	75mm
Cable Duct	75mm
Pile Foundation	75mm

2.8.7 Foundation

Planning of foundations: Deep foundations are, in general, costlier as compared to the open foundations. The Elevated Rotary and ROBs locations don't have water flowing around them, so scour is not a concern and the depth of foundation can be kept smaller also. If the soil conditions dictate or there is some other advantages like ease of construction, reduction in duration of caution order, during that time must go in for deep foundations like piles. If such constraints are not there open foundations shall be adopted, if feasible from bearing capacity considerations.

a. **General**

The Soil strata at the location of construction of Elevated Rotary and Road over Bridge at LC No: 136A is very hard and stiff with Non- cohesive soil. As could be seen from the geotechnical investigation indicated in the tender drawing, the hard strata could be seen below the ground at a depth of 3-6m with N- value greater than 100. At few locations the hard strata starts varies to a depth of 10 to 13m.

Generally, Open foundation is considered to the extent of twenty five percent of foundation for sub structures and balance area where strata of good bearing capacity is not available near the ground, the space is restricted

to allow for spread/open foundation, in those cases the foundation of the structure has to be taken deep with the purpose of attaining a bearing strata which is suitable and which ensures strictly and durability of structure. The details of the deep foundation to be provided and Open foundations are given below.

The Piles shall be bored Cast – in – Situ type and socketed into rock. The Construction of Pile Foundation shall conform to relevant Specifications of IS: 2911 unless specified otherwise in the Documents.

b. **Quality of Pile Concrete, Pile Caps, etc.**

The Grade of Concrete for the Pile shall be minimum M35. The Cement Content for Piling Work shall be minimum 390 kg / m^3 with Ordinary Portland Cement.
Grading and other Requirements of Coarse and Fine Aggregates, Water and Concrete shall be as specified for Concrete Works in the Contract Document.

c. **Length / Dia of Pile**

The Piles are essentially End Bearing and shall be socketed into the Hard Strata at least to a Depth as recommended in IRC: 78 (Latest Edition). The Presence of Hard Strata shall be established by conducting SPT Tests in the Pile Bore. These Tests shall be conducted in every Pile and no Extra shall be paid on this account. On ascertaining the Hard Strata through SPT, further Chiselling shall be done for Socketing. The Number of Drops of a given Chisel Falling at a constant fall for a specific depth of penetration shall be noted and these Chiselling Criteria (in terms of number of drops) shall be used to ascertain Hard Strata in the surrounding bores. The Contractor shall submit the Design Calculation for Pile Load Capacity to the Employer on the basis of the Results of Initial Load Test on Piles. The Test Pile shall be installed as directed by the Employer.

Metal Casings with thickness not less than 5mm shall be used to support the unstable sides from the top of the Borehole to the Soft Rock Level.
Minimum Length of the Embedment: A minimum depth of embedment of 9m (including Socket Length) in Soil shall be maintained where the Pile cannot be driven any further. However, the Termination Level of the Pile shall be as per Specific Instructions of the Employer or his approved Representative. In the event of presence of Rock or very Hard Strata at a shallow depth, the Contractor shall be advised by the Employer regarding the Termination Level and the same shall be in conformity with the Codal Provisions.

Pile Diameters: Piles of minimum 1000mm dia or above shall be used for the Flyovers.

i. **Boring**

Boring Equipment and Accessories shall generally conform to IS: 2911 (Part I / Section – 2). Boring may be done by either Rotary or Percussion Equipment. In case of Unstable Soils, the Boring Tools used shall be such that Suction Efforts are minimised. Stabilization of the Sides of the Boreholes shall be done by the use of Bentonite Slurry or Casing. The Size of the Cutting Tool shall not be less than the Diameter of the Pile by more than 75 mm.

ii. **Drilling Mud**

The Drilling Mud shall be used at least from the Level of Subsoil Water or from the Level of Bottom of Guide Casing depending upon the Site Conditions and the Hole shall then be always kept almost full with the suspension, which shall preferably be kept in motion. The Density and Composition of the Suspension shall be such that to suit the Requirements of the Ground Condition and to maintain the Fine Materials from the Boring in Suspension. A 5% Bentonite Suspension would be generally suitable and its quality shall conform to the Specification given in Appendix A of IS: 2911 (Part I / Section 2).

iii. **Cleaning of Borehole Bottom**

The Bottom of the Hole shall be cleaned very carefully before Concreting Work is taken up. The Cleaning of the Hole shall be ensured by careful operation either by Flushing with the Fresh Drilling Mud through the bottom of the hole or by Air Lifting Process. To lift the Spoil at Founding Level before Concreting, Borehole shall be agitated by jetting with Fresh Drilling Mud with relatively higher pressure than that used

during Boring or Air through Tremie Pipe. While boring by use of Drilling Mud, the Specific Gravity of the Mud Suspension in the vicinity of the bottom of Borehole shall be determined at Suitable Interval and Record. Consistency of the Drilling Mud Suspension shall be controlled throughout the Boring and during Concreting Operation, in order to keep the Hole stabilised as well as to avoid Settlement of the Mud.

d. **Founding Level for Piers / Abutments**

The Technical Proposal / GAD shall indicate Founding Level at each Pier / Abutment Location. The Turnkey offer shall include for possibility of Cost of Variation if any between the Actual Founding Level and the Founding Level considered for the Purpose of Bidding. No Extra Payment shall be made in this regard after Finalization of the Turnkey Contract Price.

e. **Ramp / Retaining Walls**

The Solid Ramp Portion of the Flyovers shall be constructed with Reinforced Earth Retaining Structure or RC Retaining Wall designed aesthetically. The Abutments and Returns shall be designed for Live Load Surcharge equivalent to Earth Fill of 1.2m height respectively. The Minimum Density of Filling for Calculations of Surcharge Pressure shall be 2 t / cum. The Surcharge Effect shall be considered for the Purpose of Evaluating Earth Pressure only and not for Vertical Loads.

f. **Pile Foundation**

i. Only Bored Cast – in – Situ Piles shall be accepted.

ii. The Pile Foundations shall be designed as per the Requirements of IS: 2911 (Part I/Section 2) (Latest Edition).

iii. The Contractor shall carry out the Initial Pile Load Test at his own expense. The Design Capacity assumed for the Piles shall be verified by the Initial Load Testing of Test Piles in non working areas, in the vicinity of the Flyovers Site. These Piles shall be tested for 2.5 times the Design Load. Additional Two Piles for each diameter, which are actually going to be used for Piers and Abutments, shall be tested for 1.5 times the Design Load. Minimum Number of both these Tests to be carried out for each Diameter of Pile shall be two (2) each. The Contractor shall carry out the Pile Load Tests as per the Amendments to Existing Methodology of Pile Load Testing by the Task Force for Quality Assurance in Public Construction dated 22 – 10 – 2011 and IS: 2911 (Part 4).

iv. Annular Piles filled or unfilled shall not be accepted.

v. Design with Single Row of Piles shall not be accepted.

vi. Design shall ensure that no Pile is subjected to Tension.

vii. Concreting shall be done, by Tremie Method after ensuring proper Tip Zone Cleaning by Flushing only.

viii. The Top of Concrete in Pile shall be brought above the cut off level by minimum 750mm to permit removal of all Laitance and Weak Concrete before Pile Cap is laid.

g. Open Foundation

Open Foundation may be provided where the foundations can be lied in a stratum which is in erodible and where the strata is hard at shorter depth.

Excavation should be done in such a way that surrounding soil can stand by itself by suitable sloping the sides. When the excavation has to be deep or when the side slopes are not stable, suitable shoring may be provided from top using timber planks, walling piece and struts.

2.8.8 Substructure

a. **Dimensions**

i. Dimension of any Element of Sub Structure shall not be less than 300mm.

ii. All RCC Piers shall be of Solid Type.

iii. The Height of Pedestals on Pier Cap supporting Bearings shall not be more than 500mm.

b. **Protection to Pier**

For the Piers located in the Crossing of Low Level Roads, Protective Island of a minimum height of 1.0m and having a Clear Distance of 250mm from the Face of Pier shall be provided. The Gap between the Pier and the Island Wall shall be filled with Sand. Suitably Designed and Aesthetically Pleasing Fencing made out of Steel Members and painted with Protective Paint shall be fitted on the Top of Wall of the Island.

c. **Layout and Design**

i. All Bearings shall preferably be supported directly on Pier Stem. Bearings resting on Overhangs are acceptable provided the Differential Deflection of Pier Cap is accounted for in the Transverse Analysis of Superstructure.

ii. Dead Man Anchors or Friction Slabs shall not be accepted behind Abutment for relieving Moments.

iii. Scope for Accessibility for Inspection of Bearings and Arrangement for Lifting of the Superstructure for Future Replacement of Bearings shall be provided for in the Design of Sub Structure and Superstructure. The Positions of Flat Jacks shall be distinctly marked on the Drawing and the Structure.

iv. Tall Piers shall be checked for Deflection under Horizontal and Eccentric Forces. Pier, Bearings and Expansion Joints shall be suitably designed.

2.8.9 Superstructure

a. **Deck Slab**

Deck Slab Thickness shall not be less than 230mm.

b. **Box Girders**

i. For Pre Stressed Concrete Structure where Cables pass through Webs, minimum Web Thickness shall be greater of 150mm + outer dia of Duct or 250mm, whichever is greater. Not proposed in this project.

ii. The Cross Diaphragms shall be minimum, one number at each Support and at ends of Cantilever, if any. In addition to Abrupt Change in Soffit Geometry, Stiffening Frame or Diaphragm shall be provided to cater to the Forces arising out of Change in Direction.

iii. Minimum Thickness of Diaphragms at Supports shall be 500mm and those of other Locations shall be 300mm.

c. **RCC Box**

The following Method of Analyses and Design of Box Girder are acceptable.

i. Calculate the Main Girder Moments, Shear Forces and Tensional Moments as for a Single Beam for all Loading Conditions.

ii. Also add to above, the Forces due to the Restraint of Warping Torsion at the Ends.

iii. In addition, calculate the Bending Moments in the Roadway Slab considering the Slab, the Web and Soffit Slab as a Closed Frame.

iv. Reinforcement in the Slabs and Webs due to the Transverse Moments must be provided in addition to the Steel, which is required for Shear or Torsion in the Box as a Main Girder.

v. Distortion of Box Girder due to Transverse Moment can be neglected if a minimum number of Diaphragms are provided.

vi. In the absence of Rigorous Analysis (A) for the Tensional Moment (B) for Forces due to Restraints of Warping Torsion at ends, the Design Live Load Moments and Shear Force in the Longitudinal Direction shall be increased by 20% and Transverse Reinforcement Steel be increased by 5%.

d. Prestressed Concrete Box

i. Minimum Un tensioned Reinforcement as per Clause 15 of IRC 18 (Latest Edition). The Spacing of the Bars shall not exceed 200 mm c / c. The minimum Diameter of Bars to be used is 10mm.

ii. Method of Analysis and Design of Box Girder shall be the same as detailed for RCC Box Girder.

iii. No Tension under Full Permanent Design Load.

e. **Prestressing Steel**

i. The Prestressing Cables to be used shall be made using Low Relaxation HT Strands of size 12.7mm / 15.2mm conforming to 1S: 14268.

ii. All Prestressed Members shall have Spare Cables laid to the Profiles approved by the Employer. The number of Spare Cables shall be at least 5% of the Cables required as per the Design, subject to a minimum of one Cable per Girder / Web. These Cables shall be permitted to be removed fully or partly after the Final Stage of Pre Stressing, if they are not required and Holes grouted.

iii. The Maximum Permissible Jacking Force shall not exceed 90% of 0.1 % Proof Stress. 0.1 % Proof Stress shall be taken as 85% of Minimum Ultimate Tensile Strength (UTS).

iv. Arrangement for External Pre Stressing shall be got approved from the Employer.

f. **Prestressed Concrete Girder and Slab**

Concrete Girder and Slab type Superstructure shall satisfy the following Stipulation.

i. Minimum Thickness of Slab shall be 200mm.
ii. Minimum Thickness of Web shall be 250mm.
iii. Where Prestressing Cables pass through Webs, the Thickness shall be same as that stipulated for Webs of Box Girder.
iv. For Prestressed Girders, the Criteria stipulated in **2.8.9** will be applicable.

g. **Precast Girders**

i. For Ease and Speed of Construction, it is recommended that Precast Concrete Superstructure may be adopted. While designing such Elements / Structure, Aspects of Durability and Minimum Maintenance shall be kept in view. Criteria of Minimum Dimensions as per **2.8.9** shall be applicable.

ii. Precast Panel Slab Deck / Girders and Cast – in – Situ Slab Construction shall be designed as Composite Construction.

iii. Cross Prestressing in Superstructure shall not be allowable in general. However, the Nominal Prestress provided to the extent of keeping various Girders together will be allowable.

iv. In Pre Cast Construction, the Performance of Joints is especially critical for the Integrity of a Structural System. The Geometric Configuration of a Joint, in addition to the Selection of an Appropriate Interface Material contributes to the proper Short Term and Long Term Performance of the Structure. The Design of Joints shall allow for Movements due to Shrinkage, Thermal Effects and Possible Differential Settlements.

v. Proper Lifting Arrangements shall be arranged by the Contractor for handling the Pre Cast Unit. The Components shall be designed for Lifting and Erection of Loads and Stresses. Lifting and Handling

Positions shall be clearly defined particularly at Critical Locations. Indelible Identity, Location and Orientation Marks shall be put on all Segments as and when necessary.

h. **Precast Segment**

In order to achieve Better Speed of Construction, Pre Cast Segmental type Construction may be adopted for Superstructure. Following Aspects shall be taken into account while Designing and Constructing using the following Techniques.

i. Requirements regarding Minimum Dimensions, Reinforcements, Prestress, etc. shall be as per **2.8.9**.

ii. For Construction with Continuous Spans, the Portion over Piers, the Key Segments and End Segments at Expansion Joints may be Cast – in – Situ. All other Segments shall be Pre Cast. For Simply Supported Spans, all the Segments shall preferably be Pre Cast.

iii. All the Segments shall be match – cast.

iv. The Shear Keys at the Face of Segments shall be as under.
- On each Web, Single Key or Multiple Keys shall be provided. These keys shall be designed to transmit Shear Forces.
- On the Top and Bottom Slabs, Keys shall be provided to maintain Alignment and Level.

v. Formwork shall be Robust and the Foundations of the Casting and Stacking Yard shall be designed to safely support all Applied Loads without Undesired Deformations or Settlements.

vi. In order to achieve Smooth Profile of Pre Stressing Cables and to prevent Entry of Cement Slurry at the Joints of Matching Segments, PVC Pipe shall be inserted through the Cable Duct of both the Segments (i.e. Matching Segment and Segment being cast) at the time of concreting.

vii. The Work shall be executed by specially Experienced Team of Pre Stressing Professionals.

viii. Bond Breaking Agents shall be used while casting the Segments so that the Segments can be easily separated after casting. Scheme for Pre Casting of Segments shall be approved by the Employer.

ix. The Joints between Adjacent Segments shall be treated with appropriate Epoxy Formulation to facilitate Erection and to fill Cavities, if any. While applying Epoxy, care shall be taken to see that the Epoxy does not block the Openings of the Cable Ducts. Epoxy shall be applied on the Interface of both the Segments and the Joint subject to a minimum Pressure of 2.0 Kg / Sqcm for a period of 24 hours till the Epoxy sets. This may be achieved by Temporary Pre Stress or any other Means. Permanent Cables shall then be introduced in the Ducts and after Pre Stressing the required No. of Cables in the Specified Sequence, the Temporary Pre Stress may be released.

x. The Method of Erection of Segments shall be such that the Desired Geometric Profile of the Loop Deck is obtained.

xi. The Segments shall be checked for Stresses during Handling and Erection and Necessary Calculations shall be submitted for the Employer's Approval.

xii. External Pre Stressing Cable System is allowable for Segmental Pre Cast Superstructure.

xiii. Calculations for Segment Casting Dimensions shall be submitted for the Employer's Approval taking into account the Effect of Creep and Shrinkage.

xiv. Reference may be made to the Document "Guides to Good Practice Recommendations for Segmental Construction in Prestressed Concrete" published by FIP and 'State of the Art Report on Materials and Systems for External Prestressing".

NOTE: The Tenderer may submit his Alternative with Composite Structure. The Composite Section shall be limited to Superstructure only with Girders in Steel and RCC Deck Slab.

2.8.10 Bearings below Superstructure

Bearings under Superstructure shall be within the External Line of the Pier / Abutment. The Bearings shall be provided below the Diaphragm at Suitable Locations.

a. The Types of Bearings generally allowable are as follows.

Span	Type of bearing
For Effective Spans up to 18m	Elastomeric Bearings
For Effective Spans more than 18m	Spherical/POT cum PTFE / POT

b. The Bearings shall be easily accessible for Inspection / Maintenance.

c. Scope for Lifting the Superstructure for future replacement of Bearings shall be provided in the Design of Bearing. The Scheme of Lifting shall be indicated in the Drawing to be submitted along with the Technical Bid.

d. Inspection of Bearings by the Director General of Supplies and Disposal (DGSD) during manufacture is essential. The Contractor shall have to produce Necessary Certificate and Inspection Marks from the DGSD at his own Cost.

e. The Bearings shall conform to the Requirements of the MoRT&H Specifications.

f. The Dimensions of the Top Plate of the Bearing shall be such that the Contact Surface of the Superstructure projects beyond the Edge of Bearing Plate by a minimum distance of 50mm at any Location.

2.8.11 Expansion Joint

Elastomeric Strip Seal Type Expansion Joint conforming to Clause 2607 of MoRT&H Specifications shall only be allowable. Calculations for the Adequacy of the Expansion Extent for which the Joint is selected by the Tenderer shall be submitted in the Technical Bid along with Name of Manufacturer and their Technical Details. During Installation of these Joints, Manufacturer's Engineer shall be required to supervise the same including Thermal Pre Setting, if required.

2.8.12 Crash Barrier

Concrete Crash Barrier shall conform to Clause 809 of MoRT&H Specifications. The Tenderer may propose Alternate Type of Crash Barrier in the Technical Bid. It will be necessary to provide a 50mm dia MS Tube Hand Rail 300mm above the Crash Barrier and supported at Suitable Intervals. No Welding shall be done for Connections. Crash Barriers shall be provided with Employer's Emblem as per the Approval of the Employer.

2.8.13 Drainage

Drainage of Storm Water collected on the Rotary Flyovers/ROB is essentially based on
IRC: SP: 42 "Guidelines on Road Drainage"
IRC: SP: 50 "Guidelines on Urban Drainage"

The Drainage Spouts shall conform to Clause 2705 of MoRT&H Specifications. The Tenderer shall indicate the Drainage Spouts and its Disposal to natural Storm Water Drain in the Drawings submitted with the Technical Bid.

The Drainage Spouts shall be connected to a Cast Iron Runner Pipe of diameter not less than 150mm and taken down by Down Take Pipes of suitable diameter through the Pier or at Approved Locations. These Pipes shall be connected to Longitudinal Drains below Surface and the Water finally being disposed off into natural Storm Water Drain using appropriately designed RCC Box Culverts for Crossings.

At Ground Level, Catch Water Drain with GI Gratings at Top shall be provided at each end of the Flyovers. Drainage of Water collected at the Deck Level shall be effectively conveyed to Tertiary Drains at Ground Level through Appropriate Box Culverts across Surface Level Roads. The Drains shall be connected to the nearest natural Storm Water Drain. The Turnkey Cost shall include for all these Items.

The entire System including all Arrangements / Details shall be included in the Cost.

2.8.14 Wearing Coat

A Bituminous Wearing Coat of Uniform Thickness shall be provided for Smooth Riding Surface and shall conform to Clause 2702.1 of MoRT&H Standard Specifications for Road and Bridge Works (Latest Edition). The Cross Sections indicated in the Drawing no **DWG/PRJ/204-1 TO 6** for Rotary and ROB at LC 136A shall be strictly adhered to.

2.8.15 Approach Slab

The Approach Slab shall conform to Clause 2704 of MoRT&H Standard Specifications for Road and Bridge Works (Latest Edition).

2.8.16 Electrical Works

The Tenderer shall include the Cost of Lighting above and below the Flyovers in his Turnkey Tender and shall carry out all the Electrical Works as per relevant Codal Provision. The Tenderer shall indicate the proposed Lighting Arrangements as per relevant IS Codes and the existing Street Lights in the Drawings submitted with the Technical Bid. The Lamination shall be average of 40 lux throughout above and below the Flyovers.

2.8.17 Integrity Test

Low Strain Integrity Test shall be carried out for all the Piles in conformation to ASTM D 5882 from an Empanelled Consultant in the Ministry of Shipping, Road, Transport & Highways. The Tenderer shall include the Cost of Conducting this Test in his Turnkey Tender.

2.8.18 Painting

Painting with Approved Colour, Shade, Make and Type shall be provided for various Elements as follows.

i.	Steel Box Girder / Steel I girder	With two coats of epoxy paint conforming to RDSO spec M&C/PCN/123-11
ii.	Viaducts and RE Panels / Retaining Wall	Anti Carbonate Painting as per Specifications.
iii.	Kerbs for Medians, Footpath, etc. and Guard Railings, Grills and other MS Items, wherever required.	Two Coats of approved Enamel Paint over Two Coats of Zinc Phosphate Grey Primer.
iv.	MS Hand Rails over Crash Barrier	Two Coats of Epoxy Paint over a Compatible Primer after Cleaning the Surface with Sand Blasting.

2.9 Load Test

a. Before commencement of work contractor at his own risk shall perform the vertical and horizontal test as initial load test on test pile and on routine piles for elevated rotary and ROB as per relevant IRC code. Apart from the above test in case a Structure or a Component of Structures proposed by the Contractor in the opinion of the Employer is of Unusual Nature, then the Employer shall have the Right to call upon the Contractor to carry out Model Testing and / or Load Testing of the Structure or Component to prove its Suitability. The Cost of such Test shall be borne equally by the Contractor and the Employer if the Test Results are Satisfactory. In case the Test Results are not satisfactory, the Cost of Testing shall be entirely borne by the Contractor.

b. If required by the Employer, the Contractor shall have to carry out a Load Test on anyone Unit of the Bridge Structure for the Design Static Loads or their equivalent and in a manner as may be decided by the Employer.

c. The Employer may also instruct that a Load Test shall be made on any part of the Bridge Structure if in his opinion such a Test be deemed necessary for anyone or more of the Reasons specified below.

i. The Work Test Cubes failing to attain the Specified Strength.
ii. Shuttering being prematurely removed.
iii. Concrete being improperly cured.
iv. Any other Circumstance(s) attributable to the Negligence on the part of the Contractor which in the Opinion of the Employer results in the Structure or part thereof being of less than the expected Strength.
v. Any Reasons in case of Doubtful Quality or Soundness of Structure.

d. If the Load Test is to be made
   i. For anyone or more Reasons mentioned in (b) above, the Cost of the same shall be Reimbursable to the Contractor at the rate tendered by him, provided the Test Results thereof are found to be Satisfactory.
   ii. Wholly or partly for the Reasons given in (c) above, the Test shall be carried out by the Contractor, at no extra Cost to the Employer.

e. In the Event of Load Testing being ordered by the Employer, the Contractor shall
   i. Prepare well in time all Necessary Calculations and Details of Arrangements for such Load Testing, e.g. the Magnitude of the Test Load, Mode and Method of Carrying out the Test, the Application of Loads, Duration of Keeping the Load, the Equipments to be provided and Observations to be made during and after Placing the Loads in Position, etc.
   ii. Make all Necessary Arrangements for Observations, Centering, Equipments, etc. that may be needed for Measuring the Settlement, Deflections, etc. required for the Test, to the entire Satisfaction of the Employer and
   iii. Provide Labour and make all Observations during the Test.

f. After the Test, the Contractor shall submit a Report on the Results of the Tests. The Employer shall then communicate as to whether the Test has been satisfactory or not. Any Further Tests or Reconstruction or Strengthening as may be necessary shall be decided.

g. Any Defect noticed in the Structure or any Damage done to the Bridge, at the Time of Testing, which affects or is likely to affect the Strength of the Bridge, shall be rectified by the Contractor at his own Cost by Remedial Measures or Replacement as approved by the Employer.

h. When the Tests are declared by the Employer as having been completed, the Contractor shall remove all Loading, which might still be on the Bridge as well as on the surroundings.

i. Only Design Load is to be superimposed for Prestressed Concrete Superstructure. IRC: SP: 37 shall be followed for Load Testing. Necessary Correction for Variation in Deflection due to Temperature Variation throughout the day shall be applied.

2.10 Slip Roads, other Surface Level Roads, Culverts and Junction Improvements

The Work of **Approach Road i.e. Solid Ramp Portion** to be carried out under this Contract. The Total Scope of Road work is 2100 m considering both side.as per followings:

a. Construction of **Approach Road i.e Solid Ramp Portion** including Dismantling of Existing Structures coming on the Carriageway such as Govt. Buildings, Compound, Drains, Footpaths, Kerbs, Medians, Parapet Walls; Construction/widening of Culverts/Box culverts; etc

- Slip Roads beyond the Lengths of the approaches to Elevated Rotary Ramps are to be merged with Existing Roads through a Taper / Transition of 1 in 15.

b. Construction of Medians; Kerbs, Footpath, Storm Water Drains with Drain Cover Slabs where ever missed and necessary, Traffic Signages, Overhead Gantry, Road Marking such as Lane Marking, Pedestrian Marking, Direction Marking, STOP and STOP Lines, etc. as per the Specifications given MoRT&H and Kerb Painting as per the Specifications mentioned in this Tender Document.

c. The Construction of Medians, Kerbs and Footpath shall conform to Clause 407, 408 and 409 of the MoRT&H Specifications for Road and Bridge Works (Latest Edition).

d. Dismantling of Existing Road Over Bridge at IOC Junction with down ramp loop, etc. and reconstruction with

Elevated Rotary with approaches as per the structural design mentioned above section 2.8.

2.11 Submission of Elevated Rotary/ROB design Reports for Railway approval

After award of work, Successful Tenderer shall submit the following design reports for railway Approval

1. Design basis report of the bridge stating the salient features of bridge, i.e span, skew angle span arrangements, longitudinal eccentrics, depth of girders, type of superstructure STEEL, R.C.C., PSC, composite, type of bearings arrangement with sketch showing fixed/free ends, curvature if any and the details of parameters codes, load combinations cases, wind, seismic zone etc. For drawings of non-standard span of Railways must duly proof checked by IIT/IISc, NIT/approved consultants for this purpose before submitting the detail design.

2. Soil report of the railway bridge site with bore hole at each railway pier and abutment location and also shown on sketch showing the bore holes locations w.r.t to pier/abutment positions. The recommendations of the soil consultant for the open foundation/pile foundation if applicable clearly stating the pile length with safe loads for two three alternates.

3. The feasibility of the structure or components must be checked in all respects by the tenderer before submitting the design to Railway/ B-SMILE office and signed by the authorized signatories of Tenderer.

4. The drawing must be submitted in preferably A-I size only in prescribed/standard format.

5. The design/drawing of the test pile is to be submitted if applicable for the approval as per the codal provisions duly proof checked by IITs lNIT/approved consultants.
6. The software/staad files hard copy as well as soft copy must be submitted with the design note used in design for help in checking the design.

7. PSC Superstructure has to be as per IRC-112, Composite Superstructure has to as per IRC-24

8. Stress summary should be prepared for each component of the bridge i.e. pile or open foundation as applicable, pile cap/foundation slab and beam, pier, pie cap, stating the actual stresses vs permissible stresses or steel provided vs steel required.

9. A certificate from the proof checking agency on successful Tenderer letter head stating that the design and drawing of the bridge has been checked by me and found in order as per the latest IRC codal provisions.

2.12 Safety precautions and measures to be observed during execution of Elevated Rotary/ROB works in Railway and Adjoining areas

The works required to be done under traffic block protection, are to be carried out only in the presence of Railway Engineering officials. The Railways supervisor has to certify safe conditions for passage of trains before resumption of traffic. Following important activities of works shall be carried out under supervision of Railways nominated Supervisor

a) Excavation at foundation/Ground level near to Railway track.

b) Concrete casting and/or masonry very close to Railway track.

c) Erection of temporary structures near to running lines.

d) Casting of structures like girder/slab over Railway track.

e) Stage-Pre-stressing of girders when placed across Railway tracks properly supported.

f) Launching of precast/pre-assembled girders across Railway tracks.

g) Any work of lifting, side shifting and slewing of girders over the Railway track.

h) Dismantling of temporary structures, shutters, scaffolding etc. adjacent to and above the Railway track.

i) For carrying out activities of casting, erection, launching, handling and dismantling as listed above, the Contractor's Engineering shall furnish the Construction Programme in advance to Railway Supervisor Engineer. No such work should be taken up in absence of the Supervising Railway Engineer. For the activities which are to be done in presence of the Railway Engineer, prior intimation shall be given in writing and acknowledgement obtained from Railway's representative. Such activities of work shall not be carried without the presence of Railway Engineer.

2.13 Traffic Management Plan and Safety Requirement in work zone area.

Before any road work commences, The Tenderer shall prepare the diversion plan in consultations with Client or his representative and shall be submitted to Client for further approval from Concern department /Police for their approval and public notification if any. The Tenderer shall provide necessary Signs and delineators shall use to warn, inform, guide and control drivers/ riders at Start/End of Points of Projects and at the points from where traffic should be take diversion /redirection for smooth flow of traffic or location where as per approved diversion plan during construction period. The diversion plan should be prepare in such a way that there shall be a minimum inconvenience for the travelling public Further, The Tenderer shall maintain the Work zone safety and construction vehicle movement in project area with all safety precautions.

The Tenderer shall include the Cost of Maintaining the Existing Road Traffic e worthy i.e. reapirs of wear and tears Site handed over to him. The Tenderer shall include in his Cost the Cost of Safety of Roads and Junction Treatment for smooth flow of Diverted Traffic during Construction. Further, it may be noted that the Resurfacing of Road shall be carried out periodically as per the Instruction of the Employer during Construction Period and also finally before handing over the Work. The Turn Key Amount quoted is deemed to include Repetitive Asphalting.

2.14 Traffic Signs, Markings and other Road Appurtenances

Traffic Signs, Markings and other Road Appurtenances shall conform to Clause 800 of the MoRT&H Specifications for Road and Bridges (Latest Edition) and shall be shown in the Drawings submitted with the Technical Bid. Road Markings shall conform to IRC: 35 (Latest Revision) and Road Signs shall conform to IRC: 67 (Latest Revision). The Tenderer shall submit the Detailed Drawings of the Signages required as per the relevant IRC Specifications. Overhead Gantry by indicating Destinations as per the Approval of the Employer shall be provided at the Approved Location. Signages shall be provided with Retro Reflective, Micro Prismatic Reflectionised Stickers. Advanced Direction Boards with similar Specifications as above shall be provided at Locations mandated by IRC and as directed by the Employer.

2.15 Drainage System

The Contractor shall carry out Hydraulic Study in the entire Catchment Area, which is having influence on the Battery Limit of the Project, in order to assess the Quantity of Runoff to be drained off from the Battery Limit. For this purpose, the Contractor shall map the Storm Water Drainage System, which passes through the Battery Limit. He shall calculate total Quantity of Runoff, which precipitates on the Battery Limit Area and enters the Battery Limit Area. The Contractor shall work out a Comprehensive Drainage System for Disposal of Runoff collected in the Elevated Rotary/ROB, on Surface Level Road by Gravity Flow only and the Drain shall be connected to the nearest Natural Storm Water Drain and as per the Approval of the Employer.
All Drainage System shall conform to Clause 309 of MoRT&H Specifications for Road and Bridges (Latest Edition).

However, the Levels and Dimension Details for Drainage Arrangement shown in the Drawings are only indicative. The Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study.

The Tenderer shall indicate a Comprehensive Drainage Arrangement System in the Drawings to be submitted at the time of execution.

The Lump Sum Cost quoted by the Tenderer shall include rectification and restoration to the proper drainage work. During the Construction, the Water, which is met with, shall be pumped into the Roadside Drains. At no point it shall be pumped into BWSSB Sewer / Sanitary Lines.

2.16.1 Carriageway Improvement Works

The Works to be carried out under this Turnkey, Contract shall include

j. Improvements to Carriageway for the Stretch mentioned above and shall be as per the Instructions of the Employer / his representatives. It is inclusive of dismantling of existing Black Topped Surface, and Disposing of Disused Materials and where ever the roads within the project limit is completely damaged is to be re constructed with the pavement crust with subgrade , GSB,WMM and Bituminous layers as per MORT&H Specifications as specified above . Scope of work limited to pavement composition with respect to Length, width, thickness, with total area of 7913 sqmt are shown in the Table at section 2.17

ii. Providing and applying Tack Coat on the Prepared Black Topped Surfaces at 2.5 kg per 10 Sqm as per MoRT&H Specifications.

iii. Providing and fixing Pre Cast Solid Concrete Kerb Stones of Size 600mm X 300mm X 150mm made out of CC M15 and finished with CM 1:3 Plastering and Finishing, Cutting, etc.

v. **Road Marking with Hot Applied Thermo Plastic Compound with Reflectorising Glass Beads on Bituminous Surface along Edge Line near Footpath and Median, Centre Broken Line and Zebra Crossing near Junctions as per the Instructions of the Employer / his Representatives:** Providing and laying of Hot Applied Thermoplastic Compound 2.5mm thick including Reflectorising Glass Beads at 250gms per Sqm area, whereas Thickness of 2.5mm is exclusive of Surface Applied Glass Beads as per IRC: 35 (Latest Edition). The Finished Surface shall be level, uniform and free from Streaks and Holes and shall be completed as per MoRT&H Specifications. The minimum kerb length should be 3778m and area of asphalting with 80mm DBM& 40mm BC should not be less than 15338sqmt

vi. Providing and fixing of Road Stud of Size 100 X 100mm, die cast in Aluminium, Resistant to Corrosive Effect of Salt and Grit, fitted with Lens Reflectors, installed in Concrete or Asphaltic surface by Drilling Hole 30mm upto a Depth of 60mm and bedded in a suitable Bituminous Grout or Epoxy Mortar, all as per Specifications of BS: 873, Part 4 along Edge Line near Footpath and Median, Centre Broken Line and Zebra Crossing near Junctions as per the Instructions of the Employer / his Representatives.

The contractor shall carry out the carriageway maintenance works at grade

The Contractor shall carry out the Carriageway Improvement works at required locations at grade within the Battery limit.

2.16.2 Paved Pedestrian Crossing

The Works of providing Paved Pedestrian Crossing of 3m wide to be carried out under this Turnkey Contract shall include

i. Scarifying Top Bituminous Surface or Surface Dressing or Premix Carpet including Picking up Scarified Materials, Stacking of old Serviceable Materials and complete as per MoRT&H Specifications.

ii. Providing and applying Tack Coat on the Prepared Black Topped Surfaces at 2.5 kg per 10 Sqm as per MoRT&H Specifications.

iii. Providing and laying Bituminous Concrete of 30 – 45mm compacted thickness with 40 – 60 TPH Batch Type Hot Mix Plant & above using Crushed Aggregates of Grading II, pre mixed with Bituminous Binder at 5.4 to 5.6% by weight of total Mix and Filler using Bitumen 60/70, laying with a Hydrostatic Paver Finisher with Sensor Control to the required Grade Level and Alignment, rolling with Smooth Wheeled, Vibratory and Tandem Rollers to achieve the desired compaction as per MoRT&H Specifications.

iv. Providing and laying Heavy Duty Cobble Stones 75mm thick Interlock Pavers, using Cement and Course Sand for Manufacture of Blocks of Approved Size, Shape and Colour with a minimum Compressive Strength over 50mm thick Sand Bed and compacting with Plate Vibrator having 3 Tons Compaction Force thereby forcing Part of Sand underneath to come up in between joints, final compaction

of Paver Surface Joints into its final level and complete as per the Instructions of the Employer / his Representatives.

v. Providing and fixing Precast RCC Slab of 100mm thick for Side Wall in Cement Concrete 1:1.5:3 using Graded Granite Jelly 20mm and Downsize with Steel Reinforcement, including Form Work, Curing and Concrete Finished Surfaces on both sides, etc. and complete as per the Instructions of Employer / his Representatives.

2.16.3 Pipe Duct

The Works to be carried out under this Turnkey Contract shall include

i. This Work includes required Excavation, providing RCC pipe duct across the road at Kammanahalli, Maruthi sevanagara side, Railway station road for a total length of 48 m

ii. Excavation, providing and laying of Plain Cement Concrete of minimum 100mm thick, Providing and laying of Class NP3 Hume Pipe of 300mm diameter at 2.5% Slope

iii. Packing the sides and above the Hume Pipe with Controlled Earth as per the Instructions of the Employer / his Representatives.

The Contractor shall provide Shoulder Drain on either side of the Carriageway at an interval of not less than 15m c/c at the location of waterlogging area where drainage is not proper. Further, the Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study and get the Drawing approved by the Employer before Execution.

2.16.4 Road Side Existing Drain

The main objective of this Work is to facilitate Free Water Flow in the Road Side Existing Drain collected from ROW and from adjoining Properties. The Works to be carried out under this Turnkey Contract shall involve two types of Works along the length of existing drain within the project area irrespective to the scope of work mentioned in the clause 2.17.10

- Removal and resetting of Drain slab.
- Desilting of existing drain for smooth flow.

2.16.4.1 Construction of new RCC Drain covered with new RC Precast Slab

This involves Construction of RCC Drain of 750m length with Dimension 1m Width X 1.0m Depth along the road at missed locations with RC Precast Slab of minimum 100mm thick.

The above Work involves the following Items.

- ❖ Earthwork Excavation for Drain, levelling of Excavated Surface with the sides neatly dressed.
- ❖ Disposal of the Disused Materials.
- ❖ Providing and laying minimum 100mm thick PCC M15 in Open Foundation and complete as per MoRT&H Specifications.
- ❖ Providing Open Box Type RC Wall of minimum thickness 200mm with Design Mix M20 including all necessary Dewatering, Centering, Shuttering, etc. as per the Approved Design.
- ❖ Backfilling and Compaction behind the Side Walls with Approved Earth.
- ❖ Providing and fixing of Precast Perforated RC Slab of minimum 100mm thick for Cement Concrete 1:1.5:3 using Graded Granite Jelly 20mm and Downsize with Steel Reinforcement, including Formwork, Lifting, Curing and Concrete Finished Surfaces on both sides, etc. and complete as per the Instructions of the Employer / his Representatives.

Further, the Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study and get the Drawing approved by the Employer

before Execution. The Hydraulic study includes planning and construction of Rain water collection system and harvest of the same at Rotary and RoB locations.

2.17.1 Kerb

The Works of providing and fixing Kerb Stones at required/missing/damaged locations to be carried out under this Turnkey Contract shall include

- Providing and fixing Precast Solid Concrete Kerb Stones of Size 600 X 300 X 150mm made out of CC 1:2:4 and finished with CM 1:3 Plastering and finishing, cutting, etc. in the Median and at the edge of Footpath at required locations within the overall project limit of 3778m length.
- **Painting of Kerb Stones:** Painting two coats after filling the Surface with Synthetic Enamel Paint in approved shades on new Plastered Concrete Surfaces as per MoRT&H Specifications for the entire Stretch of Corridor.

2.17.2 Footpath

The Works of providing Footpath with minimum area of 5589 sqmt including at damaged locations to be carried out under this Turnkey shall include

2.17.2.1 Providing and fixing Interlocking Cobble Stone Paver

This Work shall include the following Items.

2.17.2.1.1 Required Earthwork Excavation.

2.17.2.1.2 Disposal of Disused Materials.

2.17.2.1.3 Surface Levelling.

2.17.2.1.4 Providing and laying Cast – in – Situ RCC Slab of 200mm thick for Side Wall with Design Mix M20 with minimum OPC Cement @ 320 kg / cum, including all necessary Dewatering, Centering, Shuttering, etc. and complete as per the Instructions of Employer / his Representatives.

2.17.2.1.5 Providing and laying minimum 50mm thick Sand Bed.

2.17.2.1.6 Providing and laying Heavy Duty Cobble Stones 60mm thick Interlock Pavers, using Cement and Coarse Sand for Manufacture of Blocks of Approved Size, Shape and Colour with a minimum Compressive strength over 50mm thick Sand Bed and compacting with Plate Vibrator having 3 Tons Compaction Force thereby forcing Part of Sand underneath to come up in between joints, final compaction of Paver Surface Joints into its final level and complete as per the Instructions of the Employer / his Representatives.

2.17.3 Illumination

The Illumination Works to be carried out under this Turnkey Contract shall include Replacement, Fixing and Laying of Damaged Box Tunnels, LT Cables, Earthing Requirements, Poles, Fixtures and Painting of Poles and complete as per the Instructions of the Employer / his Representatives.

2.17.4 Traffic Signage and Marking

This Work to be carried out under this Turnkey Contract shall include providing and fixing of Retro Reflectorised Cautionary, Mandatory, Informatory Sign as per IRC: 67 (Latest Edition) made of high intensity grade sheeting, fixed over Aluminium sheeting, 1.5mm thick supported on a Mild Steel Angle Iron Post 75mm X 75mm x 6mm firmly fixed to the ground by means of Approved Designed Foundation with M15 Grade Cement Concrete 45cm X 45cm X 60cm, 60cm below Ground Level as per the Approved Drawing and complete as per MoRT&H Specifications. (All signages shall be as per IRC 67- To be tested by Retroreflectometer)

2.17.5 Board Display Information

The project displaying information, such as 'Name of work, Tender cost, Name of Contractor, Work completion and liability period etc', having rectangular shape of 1.20m x 0.90m size to be display under this contract at the locations as decided by the Employer/his Representatives and cost of the display information board is deemed to be included in the quoted rate.

2.17.6 Project Cost estimate

The estimate for the project has been arrived based on the concept and alignment plan considering the quantities of

all the items as mentioned in the scope of works. The tenderer shall study the concept drawings and scope of the work thoroughly in detail before submission of tender. The successful tenderer shall be responsible to complete the above entire scope of work including preparation of detailed design working drawings and obtaining GAD approval from Railways/ B-SMILE within the quoted contract amount under no variation. Elevated Rotary is designed with of Steel Box Girder with top open Trapezoidal section per span for a circumferential length of 255m with 4 different spans, of which super structure of 1 x 81.31m, 1 x 68.5m, 1 x 56.0m, & 1 span of 48.0m, and a longest span of 81.31m with varying depth of Girder from 1.5m to 2.5m, and each span with 3 nos of steel box girders. The additional support if any other than the tender drawings for the above railway spans for elevated rotary are provided as approved by Railways are claimable as per Special Conditions of Contract clause No 66 of this contract. The type of deck slab proposed for ROB at LC No 136A is with I- Girder with composite slab. The approaches to elevated rotary and for ROB at LC No 166A are proposed with PSC I-Girders.

The minimum scope of work as described in the above sections is summarized in the table below. (For Information only)

Sl No	Description	Unit	Length m	Width m	Depth m	Area sqmt
1	Elevated Rotary and PUP Structural length and width details					
2	ROB at LC 136A Structural length and width details					
3	New RCC Drain	**mt**	750			
4	CROSS DUCT Single row	mt	48			
5	Footpath	mt	3726	1.5		5589
6	Kerb	mt	3778			
7	GSB	mt	1055	7.5	0.2	7913
8	WMM	mt	1055	7.5	0.25	7913
9	DBM	mt	1055	7.5	0.05	7913
10	BC	mt	1055	7.5	0.04	7913
11	<0.9SQMT DIRECTION BOARD		15	0.9		13.5
12	>0.9SQMT DIRECTION BOARD		15	1.5		22.5
13	Gantry	No (4 locations)	6			
14	Compound wall Defense	Mt	300			
15	Compound wall Railway	Mt	300			
16	STREET LIGHT POLE	No	484			
17	Led lights	No	484			
18	single braket	No	351			
19	Double braket	No	448			
20	1.1kv LT cable	Km	3.17			
21	Railway waste water primary treatment plant	Kld	100			
22	Railway Electrical room	Sqmt	144			
23	New godown construction for Railways department	Sqmt	210			

3.0 Documentation, Instrumentation, etc.

a. All Drawings shall be made in Latest Version of AutoCAD and the Soft Copies on CDs and ten Hard Copies of Prints of all Approved Drawings and "As Built" Drawings shall be supplied by the Contractor to the Employer at Free of Cost as per the Agreed Programme.

b. CDs and ten Hard Copies of all Approved Design Calculations shall be submitted by the Contractor to the Employer at Free of Cost as per Agreed Programme.

c. Five Video CDs of 180 minutes duration each of the Elements covering the Different Phases of Construction from Start to Finish shall be supplied by the Contractor to the Employer at Free of Cost.
d. Three Copies of "Maintenance Manual" describing Access Arrangements, Important Obligatory Precautions from the Point of View of Structural Safety and Procedure for Minor and Major Repairs of each Component of the Elements, Renewals of Finishes and Treatments periodically including Guarantee / Warranty Certificates shall be supplied by the Contractor to the Employer at Free of Cost.
e. Three Copies of "Quality Assurance Manual" covering Designs and Drawings, Mix Designs, Materials, Testing, Soil and Rock Properties, Statistical Quality Control, etc. shall be prepared by the Contractor and submitted to the Employer at Free of Cost well before Starting the Work.
f. Three Copies of "Safety Manual" covering necessary Safety and Precautions to be adopted by the Contractor as per Requirements and as per Standards during execution of the Work.
g. Three Copies of "Construction Manual" covering Various Aspects of Construction Methods, Difficulties faced and how they are overcome during Execution, etc. shall be supplied by the Contractor to the Employer at Free of Cost at the Time of Finalisation of Work.
h. The Contractor shall install Fixtures and Fastenings provided by the Employer for housing any Instrumentation that may be useful for the Employer at Contractor's Cost.
i. Fixing Arrangement for Internal and External Lighting shall be approved by the Employer and executed by the Contractor.

4.0 Programme of Submission and Approval of Designs and Drawings

The Programme for submission of Designs and Drawings is as listed out below.

Details	**Time from Award of Work**
Award of Work	0
Submission of Topographic Survey Drawing along with the Soil Investigation Report, Hydraulic Study Report, Details of Utility Mapping	2 Weeks
Horizontal and Vertical Geometrics, GAD and Construction Methodology and Schedule	3 Weeks
Traffic Diversion Schemes / Traffic Management Schemes during Construction, Quality Assurance Manual, Safety Manual, Physical Model of the Project	5 Weeks
Inception Report and Detailed Design Parameters	7 Weeks
Design and Construction Drawings of all Foundations and Preliminary Design of Entire Elevated Rotary and its approaches Structure	8 Weeks
Design and Construction Drawing of Road Over Bridge , Abutments and Reinforced earth/Retaining Walls in Approaches, all Piers and Abutments of ROB	9 Weeks
Design and Construction Drawing of all Superstructures	12 Weeks
Design and Construction Drawing of Balance Items of Work	16 Weeks
Submission of As Built Drawings, Video CD, Maintenance Manual, Construction Manual	2 Weeks after Completion of Work

The Total Period available for Submission of all Detailed Design and Drawings from the Date of Award of Work is 20 Weeks, which will be submitted in accordance with the Approved Construction Schedule.

The Design shall be submitted in Sufficient Details and as lucidly as possible so that to enable Quick Proof Checking by the Employer or his approved Representative. All the Design Calculations along with Corresponding Construction Drawings marked as "Good for Construction" will be submitted. The Corrected Designs are to be submitted as Record Designs within 15 Days of Approval of the Drawings. If the Record Designs are not submitted within this Time Frame then a Penalty at the rate of **Rs. 100000/-** per day shall be charged for every day of Delay in Submission of the Record Designs. The Corrected Designs and Drawings would be cleared within 3 weeks of submission subject to Compliance of all Points. Any other Component, which requires Redesigning on Account of Exigencies of the Site like Redesigning the Foundations for Utilities, etc. during the Duration of the Works, shall be approved as expeditiously as possible. Such Designs shall be submitted within 10 days of taking a Decision to

redesign the Component. Analysis and Design shall be done using Computer with Recognised Software. The Contractor shall submit with Design, the Detailed Description of Method of Analysis with Explanatory Notes and submit Sample Manual Calculations for adequate number of Typical Cases. The Computer Programme as submitted will be further tested by Comparison with Solutions of Worked Examples. Drawings and Designs shall be in SI Units. Calculations shall be neat and clear, preferably typed and printed and supplemented by Full Explanatory Notes and Sketches wherever required. All Construction Drawings of Initial Submissions and Final Approval shall be in AutoCAD only.

If during the scrutiny of Detailed Design Calculations and Working Drawings, any Changes therein which are found necessary in the Opinion of the Employer, the same shall be incorporated without altering the Turnkey Quotations. It is entirely the Responsibility of the Contractor to submit properly Prepared and Completed Designs in good time to enable the Employer to approve them in time.

The Contractor shall submit 2 sets of Advance Copies of the Drawings and Design Calculations to the Employer or his approved Representative with a Forwarding Letter to the Employer. Once the Design and Drawings have been finalised by the Employer, the Contractor shall forward eight sets of Drawings incorporating Corrections, if any, for the Final Approval.

After Completion of each Stage of Work, 3 Sets of Record Plans and One Set of Final Design Calculations based on the Work as actually executed on Site, shall be supplied by the Contractor in Bound Volumes to the Employer.

Approval to Drawings, Designs and Design Calculations by the Employer shall not in any way relieve the Contractor of his Responsibility for the Correctness, Soundness and Structural Stability and Safety of the Structure.

The Approved Drawings and the Design Calculations of the Elements shall be the property of the Employer.

The Contractor's Designer or Consultant shall compulsorily attend all the Review Meetings conducted by the Employer from time to time without any extra cost and shall also remain present as and when required during the Checking of Designs for Clarifications, if required.

As Built Drawings shall be submitted within 4 weeks from the Date of Completion of Works. Penalty of **Rs. 1000000/-** shall be levied for every week delay in submission of as Built Drawings beyond the Stipulated Deadline. An amount of **Rs. 10000000/-** shall be withheld from the Contractor's Final Bill until the As Built Drawings are submitted.

5.0 Construction Schedule

The Construction Schedule and the Methodology of Construction shall be so planned that there is Minimum Obstruction to Traffic during Construction and the entire Work can be completed in minimum possible time.

6.0 Site Office

The Contractor shall provide and maintain Furnished Site Office at the Project Location for the Supervisory Staff of the Employer and his approved Representative. It shall have minimum 40 Sqm of Floor Area and shall include all Items like Electric Supply, Electrical Items, Telephones, Lights, Fans and Complete Wiring, Drinking Water Supply and Hygienic Toilet Facilities completed along with Furniture as listed below.

i.	Executive Table (for the Employer)	: 1 No.
ii.	Executive Chair (for the Employer)	: 1 No.
iii.	Table (for Employer's approved Site Representative, Accountant, Head Clerk and Visitors)	: 6 Nos.
iv.	Ordinary Chair Type I (for the Employer, Accountant, Head Clerk and Visitors)	: 3 Nos.
v.	Table (for all other Staff)	: 2 Nos.
vi.	Ordinary Chair Type II (for all other Staff and Visitors)	: 6 Nos.
vii.	Steel Almirah 1980mm X 915mm X 485mm	: 1 No.
viii.	Steel Almirah 1270mm X 765mm X 440mm	: 1 No.

ix. Racks – 5 Tier 1800mm X 900mm X 375mm made of Slotted Angles and M.S. Sheets : 3 Nos.

x. Ceiling Fans – 1400mm size. Ceiling Fans shall be of Approved Make and Colour : 3 Nos.

xi. Computer with Printer, Scanner
Core 15 – 650 Processor (4M CACHE, 3.20 GHZ) with 4GB DDR3 RAM, Hard Disc Capacity 500 GB, 22X DVD Writer, 17" size TFT Colour Monitor, HP / Laser Printer of 80 Columns, 104 Keyboard, Optical Mouse with Mouse Pad and HP Scanner along with Broad Band Connection : 2 Nos.

xii. Photo Copier : 1 No.

7.0 Field Laboratory

The Contractor shall provide and maintain adequately equipped NABL Accredited Laboratory own or associated with NABL Accredited firm as required for Site Control on the Quality of Material and the Works. It shall have a minimum of 40 Sqm Area. The Field Laboratory shall be located as directed by the Employer or his approved Representative. It shall be provided with Amenities like Water Supply, Electric Supply, etc. The Laboratory will have all Services, Furniture, Equipments, etc. Minimum of the following Items shall be provided in the Field Laboratory. Any Additional Items as required for Testing / Evaluation in line with the Standard Procedures and Codal Provisions shall also be provided.

7.1 General

i. Oven – Electricity Operated, Thermostatically Controlled, Range upto 200^0C, Sensitivity 1^0C — 1 No.

ii. Plat form balance 300 kg capacity — 1 No.

iii. Balance 20 kg Capacity – Self Indicating Type — 1 No.

iv. Electronic Balance 5kg Capacity – accuracy 0.5 gm — 1 No.

v. Water Bath – Electrically Operated and Thermostatically Controlled with Adjustable Shelves, Sensitivity 10^0C — 1 No.

vi. Thermometers — 4 Nos. each
a. Mercury – in – Glass Thermometer ranges 0 to 250^0C
b. Mercury – in – Steel Thermometer with 30 cm Stem, ranges up to 300^0C

vii. Glass Wares, Spatulas, Wire Gauzes, Steel Scales, Measuring Tape, Casseroles, Pans, Enameled Trays of Assorted Sizes, Pestle Mortar Porcelain Dishes, Gunny Bags, Plastic Bags, Chemicals, Digging Tools like Pickaxes, Shovels, etc. — As Required

viii. Set of IS Sieves with Lid and Pans 450mm Diameter with Sizes of
63 mm, 53mm, 37.5mm 26.5mm, 13.2mm, 9.5mm 6.7mm and 4.75mm — 1 Set
200 mm Diameter of Sizes 2.36 mm, 2mm, 1.18 mm, 600 micron, 425 micron, 300 micron, 150 micron and 75 micron — 1 Set

ix. Water Testing Kit for pH, SO_3 and Cl — 1 Set

x. First Aid Box — 1 Set

7.2 For Soils and Aggregates

i. Rifle Box — 1 No.

ii. Atterberg's Limits (Liquid and Plastic Limits) Determination Apparatus — 1 Set

iii. Compaction Test Equipment both 2.5 kg and 4.5 kg Rammers (Light and Heavy Compact Efforts) — 1 Set

iv. Dry Bulk Density Test Apparatus (Sand Pouring Cylinder, Tray, Can, etc.) complete — 1 Set

v. Speedy Moisture Meter complete with Chemicals — 1 Set

vi. Posthole Auger with Extensions — 1 Set

vii. Core Cutter Apparatus complete with Dolly, Rammer, etc. — 1 Set

	viii. Flakiness and Elongation Test Gauges	1 Set
	ix. Standard Measures of 30, 15 and 3 litres Capacity along with Standard Tamping Rod	1 Set
7.3	**For Cement and Cement Concrete**	
	i. Slump Test Apparatus	1 Set
	ii. Compression and Flexural Strength Testing Machine of 200T Capacity with Additional Diameter for Flexural Testing	1 Set
	iii. Cube Moulds for Concrete Tests	40 Nos.
	iv. Surface Moisture and Density Meter for Soil, Aggregate and Concrete	1 No.

8.0 Casting Yard

The Contractor shall make his own Arrangements for the Construction and Maintenance of Casting Yard required for the Work. The Quoted Rate shall be deemed to be inclusive of the Element of Cost towards the above.

9.0 Disputes

In case of Disputes arising between the Contractor and the Authority in approving the Designs and chocing of specification of work, the matter may be referred to the Director (Technical), B-SMILE. The Decision of the Director (Technical), B-SMILE shall be Final and Binding on the Contractor.

10.0 Maintenance after Defect liability period.

The maintenance part includes routine maintenance relatively with short-life –spans such as, wearing course, Expansion joints, paint, etc. During Maintenance period ensure the continued safety of road users. It excludes any work leading to improvement of the structures, whether by strengthening to carry heavier loads by widening or by vertical realignment of the road surface. The maintenance operation begins with the opening of the bridge to traffic. In fact, bridge member starts ageing the day its concrete is poured. It excludes repairs of any damage caused by exceptional causes like landslides, earthquakes, cyclones, fire, etc., but it includes preventive maintenance.

Maintenance of bridge structures includes washing, painting, scraping and patching of curbs, rails, deck joints, concrete and steel bridge components like keeping areas around bearings shall be kept free of debris, dust, oil / grease etc., Replacing all the loose rivets by sound rivets, Observing Cracks in steel works and taking preventive measures to arrest the propagation. Observing Corrosion and action for its prevention. Protective Coatings by painting. Maintenance painting of metallised girders. Maintenance of welded girders. Observation on Detachment of Concrete Deck Slab from Steel girder and Taking Preventive Measures. Drainage system shall be thoroughly cleaned and repaired as necessary before the onset of monsoon. Protective surface coat, where provided, shall be maintained. Cleaning to be done with hand and power tools, such as a high-pressure wash. Washing removes water- soluble surface contaminants, existing coatings, rust and oil and grease and care must be taken with the disposal of wash water and debris. Severely corroded areas of a bridge will need abrasive spot blasting and priming before painting. Maintenance work on at grade road within the project battery limit is excluded during the maintenance period.

The tender amount is inclusive of maintenance cost and no separate payment shall be paid.
For routine maintenance of steel bridge components, refer Indian Railways Bridge Manual-1998