Terms of Reference of Design of Major Bridges / Minor Bridges in the State of Meghalaya under Meghalaya integrated Transport Project.

Introduction

1. Main Objectives of the Consultancy Services

1.1 The main objective of this consultancy is

(i) to finalize the selection of the most viable/ feasible/ economical site for the construction of bridge on the existing road or on a new road to be constructed by studying the course of the stream, its meandering tendency, existence of firm banks, confluence with other streams, alternative sites, Hydraulic survey, Design Discharge, H.F.L, L.W.L, Scour depth, type of foundation, length of the structure by studying the existing bridges on the river in the vicinity(Upstream & Downstream) and span arrangements.

(ii) to undertake detailed Hydraulic survey of the finally selected site to decide the design discharge, linear waterway,scourdepth, afflux and vertical clearance above H.F.L., including sub-soil investigation etc.

(iii) to develop cost effective keeping in mind both the options i.e. Steel bridges & RCC bridges, Innovative and Aesthetically pleasing structure with due considerations given to the site conditions & Environment friendly, climate resilient keeping in consideration the hilly terrain and construction friendly designs of Bridges with latest innovative technology. The design shall conform to the specifications & design parameters contained in relevant Indian Roads Congress Codes / Ministry of Road Transport & Highways specifications/ guidelines and circulars(latest versions).

(iv) to design appropriate river training works including slope pitching, Toe wall, Guide Bunds, apron, launching apron etc, if any required with fulljustification, keeping in consideration the hilly terrain, and

(v) to transfer the technology and develop skill of PWD engineers in design of major/ minor bridges.

1.2 All the bridges are to be designed for two lane roads /highways and width of the carriageway, footpath, railing, Concrete Crash Barrier etc. is kept as per IRC Codes / Hill Roads Manual / Ministry of Roads & Highways Circulars. The same shall be got finalized in consultation with the Employer.

2. Scopes of Services

The main tasks of the consultancy services under these Terms ofReference (TOR) shall be:

Task -1: Selection of Site for the Bridge:

The selection of site of bridges is an art and requires considerable investigations. The site selection may have to start with the study of available maps before starting the reconnaissance survey. As per best industry practices, two or three possible alignments should be marked on survey sheets considering the topography of the land, land use, soil type, water bodies, river profile, straightness of the reach, width of crossing, presence of high banks etc., before taking up the reconnaissance survey. Some landmarks for easy identification during reconnaissance survey may also be marked on survey sheets.

Data of the existing bridges (in the vicinity about 50- 100 km on either side from the proposed bridge sites) including plan, length of the bridge, span arrangement, longitudinal sections and river cross sections be procured from the owning entity, if not possible, Consultant will prepare at its own. All the activities shall be carried out as per relevant IRC Codes / Specifications and best industry practices.

Task-2: Comparative feasibility study of the proposed alternative sites**:**

Consultant shall prepare a feasibility report on the basis of the merits and demerits of the different alternative sites. The same shall be discussed with the Employer and thereafter final decision about the best site will be taken and recorded. All the activities shall be carried out as per relevant IRC Codes/ Specifications and best industry practices. Before finalization of the site, the status of underground/ overhead utilities be also verified and taken into consideration. The bridge site shall be proposed in a way which helps in improving the longitudinal gradient and plan profile of the approaches of the bridge. If required, possibility of providing *skew bridge, curved bridge and/ or bridge in longitudinal gradients* may be explored. On the basis of field visits, possible sites be finalized with merits & de-merits including tentative/ likely cost, ease of construction, methodology of design/ construction, availability of specific skilled labor in the State/ nearby areas etc. and submitted to the Employer for decision. All the activities shall be carried out as per relevant IRC Codes/ Specifications and best industry practices.

After finalization of the proposed bridge site, topographic survey at the bridge site including a length of 500 m U/S & 500 m D/S, including Plan, longitudinal sections (existing / proposed road & river) and river cross section be carried out.

Task-3: Preliminary survey, subsoil investigation and hydraulic survey:

Once the best possible site is selected on the basis of Task-1 & 2 above,reconnaissance survey, detailed survey, detailed sub soil investigation and hydraulic study shall be conducted at the selected site.

Task-4: Fixation of length of the structure, span arrangement and selection of type of the structure:

Keeping in mind, the guidelines on aesthetics with due considerations given to the site conditions and environmental considerations issued by IRC, Ministry of Roads

Transport &Highways and best international practices, the length, span arrangement and type of the structure shall be decided. A detailed report should be submitted to the Employer for the final approval.

While suggesting type of structure, Steel or RCC, possibility of providing *integral bridge (*where piers are monolithic to the superstructure) shall also be explored which have enhanced performance during seismic/ flood conditions, improved durability, least maintenance problems and better riding quality.

Type of structure shall be finalized with due consultations with the Employer.While suggesting span arrangements, due considerations should be given to the site conditions, hydraulic data and span arrangement of the existing bridges (U/S and/ or D/S) over the river/ stream.

Design discharge, Linear Waterway, scour depth, Afflux, Vertical clearance, HFL, LWL etc. be worked out as per relevant IRC Codes/ Indian Standard Codes / Best International Codes.

Task-5: Finalization of different components of the structure i.e. Foundations, Sub-structure & Super-Structure, approach slab and Bearings etc.:

For sub soil investigation, at least two bores (one at one of the Abutment Location and one at one pier location on the other side abutment) be got done to suitable depth as per relevant IRC Codes/ Indian Standard Codes/ Best International Codes and type of foundation including depth of foundation be selected in consultation with the Employer.

Task-6: Preparation of the General Arrangement Drawing (GAD) and methodology (philosophy) of the design:

On the basis of above parameters, proper GAD of the bridge be prepared and submitted to the Employer for its consent. Before taking up the detailed designs of the various components of the structure a concept report containing the methodology (philosophy) of the design be prepared in consultation with the Employer.

Task-7: Design of different parts of the Bridge (Structure):

After finalization of GAD & methodology ((philosophy) of the design, design of various parts be carried as per the guidelines / parameters / yard sticks contained in the relevant IRC Codes / Indian Standard Codes / Best International Codes.

Analysis of the bridge shall be done on the basis of latest acceptable computer aided methods/ software. Design of various components shall be in conformity with various latest IRC Codes/ Ministry of Roads Transport &Highways guidelines and best international practices. The input data, design parameters, assumptions made in the design and final analysis results for each component of the structure shall be clearly

spelt out with proper reference of relevant codes, where required, and shall be indicated in the design report for better appreciation of the design.

Task-8: Design of river training works, if required:

Based on the site requirements, the consultant shall design the river training works like Guide Bunds, Aprons, Launching Apron, Slope Protection, curtain wall, tow wall etc. as per the relevant IRC Codes / Indian Standard Codes / Best International Codes.

Task-9: Preparation of working drawings of each component of the bridge, approach slab, river training works, and other allied works required, if any, based on the designs made as per above:

The consultant shall prepare working drawings of each component of the bridge based on the design and approach slab, river training works, and other allied works required, if any, based on the designs made as per above.

Task-10: Preparation of technical specifications of all the works involved in construction of the bridge project in totality including quality assurance plan for the same:

The consultant shall prepare technical specifications of all the works involved in construction of the bridge & allied components based on the Specifications for Road and Bridges (fifth revision) published by Indian Roads Congress and relevant Indian Standard Codes and best international practices. The same shall be reviewed by the Employer and after incorporating the comments of the Employer, the specifications shall be finalized by the Consultant.

The Consultant shall also prepare quality assurance plan for the bridge project keeping in consideration the publications of IRC, Ministry of Road Transport & Highways, Indian Standards and best international standards. The same shall be reviewed by the Employer and after incorporating the comments of the Employer, the specifications shall be finalized by the Consultant.

Task-11: Preparation of cost estimate including details of measurements, Bill of Quantities and analysis of rates:

Analysis of rates shall be carried out on the basis of Data Book published by IRC on behalf of Ministry of Road Transport & Highways; however, the rates of labour, materials and usage charges of Equipment/ Machineries shall be adopted as approved by the Public Works Department, Government of Meghalaya. Items not covered under above, shall be analyzed on the basis of prevailing market rates. Rates shall be analyzed excluding GST, provision for GST be made at the end of project cost as applicable at the time of framing cost estimate.

Task-12: Proof Checking of Designs/ report etc., submitted by the design consultant

PMU (MIDFC)/ PWD Govt of Meghalaya will appoint a proof consultant (preferably any Indian Institute of Technology (IIT) of the Country for the proof checking of the Designs/

reports submitted by the design consultants. Design consultants shall be responsible for giving proper support for the proof checking of the designs/ reports. Any discrepancies/ modifications required by the proof consultants, shall be made good by the design consultant to the satisfaction of the proof consultant.

3. Reporting Requirements

The Consultant shall submit the following Reports:

a) Inception Report: to be submitted within thirty days after the date of commencing the services. The Inception Report shall specify the detailed methodology, staffing schedule and the inputs required from PWD, Government of Meghalaya to deliver the services.

b) Topographic survey sheets along with proposed bridge locations & longitudinal/ cross sections, hydraulic calculations, sub-surface investigation reports, design methodology (philosophy) report and General Arrangement Drawing (GAD).

c) Design reports of various components of bridge and river training works.

d) Technical Specifications and quality assurance plan

e) Cost Estimate, details of measurements, Bill of Quantities and analysis of rates

f) Monthly progress reports in six copies to be delivered by 7th day of each month

g) Final Report: Upon completion of the services containing the full reports

4. Consultant's Team

4.1 The project will finance a Design Consultant to support to provide timely high quality work and Consultants are encouraged to propose a staffing plan and mobilization plan that best suits the needs of the project. 40 man-months of key professionals are anticipated to be required for this assignment over a period of twenty-four(24) months. Consultants shall make the provision accordingly in their financial proposals.

4.2. The core team of the key personnel of the Design Consultant will consist of:

a) Senior Bridge / Structural Design Engineer (Team Leader)

b) Hydrologist / Drainage Engineer

c) Senior Geotechnical Engineer

d) Senior Quantity Surveyor

4.3 The experience and qualifications of the key personnel would be as under:

Sl. no.	Position	Professional Experience	Educational Qualification	Specific Expertise
1	Senior Bridge / Structural Design Engineer(Team Leader)	Minimum of 20 years Experience in engineering related field, out of which at least 7 years should be in the design of structures / major river bridges (length more than 60 M) .	Essential: (i) Graduate in Civil Engineering (ii)Post Graduate in Structural Engineering Above both the degrees should be from a recognized institute of repute and should have been done as regular full time course. Degrees obtained by distance learning or through part time facility shall not be considered.	He should have proven record of project management of the infrastructure projects especially roads/highways involving major bridges. He should have thorough knowledge of specifications / Codes (National and International) related to design of major structures especially river bridges. He should have experience of Design (at its own i.e. independently) of at least five nos. standalone river major bridges (more than 60 m long) during the last five years. He should have experience of Design of bridges with the help of latest acceptable computer aided methods / software. He should have experience of design of at least five nos. major (more than 90 m long) steel and composite bridges.

2	Hydrologist / Drainage Engineer	Minimum of 15 years Experience in engineering related field, out of which at least 7 years should be on hydraulic studies.	Essential: (i) Graduate in Civil Engineering (ii)Post Graduate in Hydraulics / Hydrology Engineering Above both the degrees should be from a recognized institute of repute and should have been done as regular full-time course. Degrees obtained by distance learning or through part time facility shall not be considered	The person should have at least experience of 5 years in highway bridge (river) projects. The person should be fully familiar with the acceptable study methods in different situations. He should have experience in determining flood levels, discharges, model study preparing schemes for proper cross drainage and determining the regime / waterway widths for bridge projects.
3	Senior Geotechnical Engineer	Minimum of 15 years Experience in engineering related field, out of which at least 5 years should be in the field of soil / sub soil investigations for the design of foundations of structures.	Graduate in Civil Engineering with Post Graduate Degree in Civil Engineering with specialization in Geotechnical Engineering / / Soil Mechanics & Foundation Engineering. Above both the degrees should be from a	He should have experience in conducting and evaluation of soil / sub-soil investigation results. He should have experience of designing of foundation of major structures especially river bridges. Have in depth knowledge of various types of foundations i.e. shallow foundations & deep foundations (well foundations, Pile Foundations etc)

			recognized institute of repute and should have been done as regular full-time course. Degrees obtained by distance learning or through part time facility shall not be considered	
4	Senior Quantity Surveyor	Minimum 15 years of Experience out of which at least five years experience as Senior Quality Surveyor in supervision of road projects	Graduate in Civil Engineeringfrom a recognized institute of repute as a regular candidate. Degree obtained as Part Time or through distance learning will not be accepted.	At least 5 years experience in major Highway (National Highways) Construction supervision projects or preparation of detailed project report including cost estimate as Quantity surveyor He should be well versed with computer.

4.4 The function of team leadership will be dealt with by the Senior Bridge/ Structural Design Engineer. The Senior Geotechnical Engineer can also be designated as team leader with prior approval of the PWD/ PMU (MIDFC).

4.5 During the implementation of the project, the Team would need to be supplemented with support staff and associated specialists and advisers from time to time to provide support in accomplishment of various assignments indicated above. Provision for the same be made in the financial proposals.

5. Inputs by the PWD / PMU(MIDFC)

5.1 (i) Traffic census data , Lead Chart showing location of quarries and copy of the Schedule of Rates of PWD , Government of Meghalaya .

(ii) Provide help in procuring required data about the rivers from the concerned departments of Government of Meghalaya.

(iii) Details of available right of way (ROW) of the road

5.2 The Design Consultant should arrange for his office space, accommodation at Shillong, Meghalaya as required (Plinth area nearly 400 - 500 Sqft) including electricity & water and watch & ward facilities. The design and analysis of data etc. can be undertaken by the consultant, if desired by the consultant, from their home office. However for day to day liaison work / meetings with the employer & other officers of the State Government, as well as collection of data from site or concerned departments of the State Government, consultant shall have to open a liaison office at Shillong.

5.3 The Design Consultant should provide for their own all the logistics, consumables, furniture's, furnishers, Computers, Laptops and equipment, software, satellite imaginaries etc. required for providing services smoothly and the consultants shall make the provision in their financial proposal accordingly.Furniture/ furnishers / Computers / Laptops / equipment etc. purchased against the project at the cost of the MITP shall always be the property of MITPand after completion of the services, the consultants shall handover the same to the MITPin working condition.

5.4 For local transportation cost, the consultants shall make provision for the rentalof vehicles including running and maintenance charges towards transportation in their financial proposals. No provision for the purchase of vehicles shall be made by the consultants in the financial proposals.

6. Deliverables:

Quarterly progress reports and other reports as per the Task 3 narrated above. In addition, the consultants will be required to provide its comments on various documents and reports to be prepared during the course of the implementation of project. Review reports on various project related documents shall also be submitted by the consultants as required by the PMU (MIDFC).

Quantity: Six (6) sets of each submission in hard copies in English and Electronic copy in PDF and MS word format suitable for posting on PWD, Government of Meghalaya websites.

7.Schedule of Completion of Tasks of Consultant: Five (5) Months.

8. Schedule of Services: Under the services, submissions shall be stage wise as under:

Stage No	Contents	Time period
I	Inception Report	15 Days from the date of Commencement of services
II	Topographic survey sheets along with	30 Days from the date of

	proposed bridge locations & longitudinal / cross sections, hydraulic calculations, sub-surface investigation reports, design methodology (philosophy) report and General Arrangement Drawing (GAD)	Commencement of services (Submissions be made bridge wise, first submissions of one bridge within 40 days, thereafter every 15 days interval.)
III	Design reports of various components of bridge, approach roads and river training works including working drawings.	50 Days from the date of commencement (Submissions be made bridge-wise, first submission of one bridge within 45 days after the approval of stage-II works, thereafter every 15 days interval.)
IV	Technical Specifications and quality assurance plan	60 days from the date of Commencement of services
V	Cost Estimate, details of measurements, Bill of Quantities and analysis of rates	120 Days from the date of commencement (submissions be made bridge-wise, first submission of one bridge within 45 days after approval of Stage-III works by the employer and thereafter every 15 days interval)
VI	Final Completion Report of the consultancy	Within 150 days from the date of Commencement of services

9. Payment Schedule: Payment schedule shall be as below:

	Stage of Payment	**Payment Percentage**
1	Stage-I (Submission of Inception Report	10(ten)percent of the contract amount excluding sub-soil investigation cost included in the total contract amount
2	Stage-II (Topographic survey sheets along with proposed bridge locations & longitudinal / cross sections, hydraulic calculations, design methodology (philosophy) report and General Arrangement Drawing (GAD)	20(twenty) percent of the contract amount excluding sub-soil investigation cost included in the total contract amount, Payment will be released bridge wise on the proportionate basis.
3	Stage-III (Design reports of various components of bridge and river training works.) including working drawings.	40(forty) percent of the contract amount excluding sub-soil investigation cost included in the total contract amount, Payment will be released bridge wise on the proportionate basis. Approval will be accorded only after the approval by the Proof Consultant. Proof Checking of the main design of the bridge and river training works will be got done by the

		Employer at its own cost (Employer's cost) through some Indian Instituteof Technology (IIT).
4	Stage-IV (Technical Specifications and quality assurance plan)	10(ten) percent of the contract amount excluding sub-soil investigation cost included in the total contract amount.
5	Stage-V (Cost Estimate, details of measurements, Bill of Quantities and analysis of rates)	10(ten) percent of the contract amount excluding sub-soil investigation cost included in the total contract amount, Payment will be released bridge wise on the proportionate basis.
6	Final Completion Report of the consultancy	10(ten) percent of the contract amount excluding sub-soil investigation cost included in the total contract amount.
7	Sub-soil investigation reports	Actual cost provided in the contract cost after completion of the sub-soil investigation and submission of reports to the Employer. Bridge wise cost will be paid against submission of report.

10. Sub Soil Investigation Cost:

10.1 The Consultants are directed to quote the rate for sub – soil investigation including testing of the soil materials in a bracket of 5m intervals i.e. 0to 5 m depth, 6 to 10 m depth, 11 to 15 m depth, 16 to 20 m depth, 21 to 25 m depth, 26 to 30 m depth and 31 to 35 m depth.

11. Computation of total cost of the proposals:

For evaluating the total cost of the proposal, cost for sub – soil investigation including testing etc. shall be taken only for a depth of 35 m only i.e. depth of bore holes will be considered as 35 m. In case the depth goes more or less than 35 M, payment will be adjusted for the rate quoted by the consultants for the concerned slab.

12. Composition of Review Committee to monitor Consultant's Works:

A reviewing committee consisting of the following officers of PWD, PMU (MIDFC), Govt. of Meghalaya shall review the progress of the work and reports to be submitted by the consultant:

1. Secretary, PWD, Government of Meghalaya, Shillong
2. CE PWD(Roads), Meghalaya, Shillong.
3. CE(NH), PWD(Roads), Meghalaya, Shillong, Nodal Officer
4. Concerned Superintending Engineer & Executive Engineer PWD(Roads)
5. Assistant Chief Engineer, Central Roads Branch (World Bank)

Assistant Chief Engineer, Central Roads Branch (World Bank) will be Member Secretary of the above review committee.

13. Procedure for review of reports:

1. Review committee may also hold meetings with the consultant as necessary to discuss reports submitted and review the progress etc.

2. The Consultant would give detailed program of completion of each of the activity for which the Consultant is responsible. The program may be prepared in the form of bar charts / CPM charts / PERT charts or any other latest technique which can be updated with the help of available computer package. For monitoring the progress Consultant would submit Monthly Progress Reports in 6 copies by 7^{th} day of each month.

3. The review committee will review the reports submitted by the Consultant, give suggestions and modifications, if any, within 15 days of receipt and would be the sole authority to approve the reports.