

**TERMS OF REFERENCE  
FOR  
FEASIBILITY STUDY, DETAILED ENGINEERING SURVEY,  
SOIL INVESTIGATION, HYDROLOGICAL ANALYSIS AND  
DETAILED DESIGN WORK OF RURAL ROAD BRIDGES**

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Name of Bridge & Road: -

District :- Rasuwa

Project code :

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**1. INTRODUCTION**

The Office of Rural Municipal Executive, Kalika Rural Municipality , Rasuwa (herein after referred as "KRMP", intends to utilize services of engineering consulting firms well experienced in the fields of soil investigation, hydrological studies, bridge engineering, river training works, environment aspects etc. for providing engineering consulting services for detail design work of proposed Bridge(s) including river training works, and approach roads.

**2. OBJECTIVE**

Objective of this job is to design a safe, reliable and cost effective bridge using the appropriate technology. The bridge is to be designed considering the availability of skilled manpower, construction material, condition of accessibility and other prevailing working conditions.

**3. SCOPE OF WORK**

The scope of work to be carried out by the consultant shall include but may not be limited to the following:

**3.1 Desk study:**

A desk study should be carried out, collecting all data, maps and information relevant to bridge design and reviewing for planning of further field survey and investigation works as well as detailed design.

### **3.2 Detailed Engineering Study and Survey:**

Detailed engineering study shall include the following:

#### **3.2.1 Technical Feasibility study:**

It should include reviewing the available data, collecting, reviewing and analysis of field data to be used in the study and conducting analysis to decide upon the technical feasibility of the bridge site(s). A cost comparison of different types of bridge shall be made and discussed with the KRMP before proceeding to bridge site for soil investigation.

#### **3.2.2 Geological and Geomorphologic study:**

In this study the following points related to the river, its catchment area and all the considered bridge sites should be studied in detail.

- (i) Topography
- (ii) Nature and structure of the surface soil
- (iii) Nature and structure of local as well as regional geology
- (iv) Other information as needed.

#### **3.2.3 Bridge Site Selection**

The most suitable site for the bridge based on the above characteristics of the site as well as the catchment area shall be selected. The selected site should be clearly indicated in the topo-map with catchments area and all the characteristic features of the chosen bridge site shall be given, in order to facilitate easy reference while designing the bridge.

#### **3.2.4 Topographical Survey**

The topographical survey of the area should cover a minimum distance of **500 m** upstream, **200 m**. downstream and **200 m** from the river banks on either sides of the river at the proposed bridge site. The Topographic map should show the following :

- (i) Contours at 1(one)m. intervals in hilly area and at 0.25 m in plain area.
- (ii) Flood lines on either sides of the river in the entire area surveyed.
- (iii) Lines with spot levels along which the bed slope of the river is taken
- (iv) Both banks of the river
- (v) Lines along which cross section of the river is taken
- (vi) Govt. and/or public establishments
- (vii) Traverse lines, benchmarks reference lines and/or points with respect to which the present topomap is prepared.
- (viii) The angle and direction of skew, if the bridge is proposed to be aligned skew.
- (ix) The Names of the nearest identifiable villages/towns etc. in either ends of the bridge.

- (x) Other information relevant to design, construction and/or maintenance of the bridge.

### **3.2.5 Hydrological Study**

For determination of all design data the consultant shall carry out a detailed hydrometrical survey and hydrological study of the river and bridge site, which shall include the following:

- (ii) Catchment area of the river up to bridge site
- (iii) Length of the river from origin up to bridge site
- (iv) Possibility of change of catchment
- (v) Nature, size and quantities of debris carried by the river
- (vi) Intensity, duration and distribution of rain in the catchment
- (vii) Vegetation, cultivation etc. of the catchment.
- (viii) Existence of reservoir's, Lakes etc. in the catchment.
- (ix) Existing bridge or other hydraulic structures across the river in the vicinity of the proposed bridge site with their details as much as possible.
- (x) General slope of the river from the critical point (origin) of the river up to bridge site and general slope of the catchment in both sides of the river.
- (xi) Cross sections covering 200m. beyond flood lines of the river at proposed bridge site, at about 500m. u/s and about 200m d/s. wherein HFL, LWL, LBL, area of the cross section, wetted perimeter and geological profile with silt factor of each strata (at proposed bridge site only) shall be indicated. (horizontal and vertical scale of the cross section shall be the same.)
- (xii) Bed slope of the river which must start from 100m. up of the U/S cross section and end at 100 m. down of the d/s. cross section.
- (xiii) Maximum discharge calculated by established formulas with different return periods and the peak discharge observed over a period of 100 years.
- (xiv) Velocity and depth of flow at the time of survey.
- (xv) Shifting of the river in the past at proposed bridge site and in its vicinity.
- (xvi) Other information required for river control, design, construction and maintenance of the bridge.

### **3.2.6 Seismological Study:**

The consultants shall collect and refer to the available data regarding the seismic records of the area. Seismic Forces : According to the Indian Standard Criteria for Earthquake Resistant Design of Structures, IRC: 6 may be followed.

### **3.2.7 Consideration on Environment Protection**

The consultant shall predict damages to the Environment and attempt to mitigate or minimize the damages by choosing appropriate site, cross-section, type of structures etc. and suggest appropriate measures in the design for protection of surrounding Environment. The RTISWP environmental policies, Environmental Protection Act and Environmental Protections Rules should be followed.

### **3.3 Subsurface Exploration**

After the selection of the proposed bridge site with alternatives and preparation of topographic maps, the Consultant shall discuss the collected hydrological data and the following points with concerned Project In-charge of the KRMP for final decision of the bridge site:-

- (ii) Design discharge
- (iii) Scour depth, Maximum Scour depth
- (iv) Linear waterway needed to be provided
- (v) Anticipated soil condition for foundation
- (vi) The most feasible proposed bridge site
- (vii) River- training & approach roads.
- (viii) Type of proposed foundation, substructure and superstructure.

The discussion will be done on the basis of the topographic maps, preliminary findings of the parameters (i to viii) above, location of the bridge with respect to the complete road network of the district. After discussion and finalizing of the bridge site/axis the consultant shall carry out subsurface exploration, which shall include the followings:

#### **3.3.1 Test pits and auguring**

Test pits and auger-holes in the riverbed to a depth as mentioned in the BOQ for determining the mean particle size of riverbed materials in each layer.

#### **3.3.2 Bore-holes, field tests and laboratory tests**

The properties of the underlying soil are determined by field and laboratory tests of the soil samples obtained from the bore holes drilled to a depth as mentioned in the next section and/or the Bill of Quantities. As far as possible, the locations of the boreholes shall be under each abutment and piers. Generally the following tests are conducted for determination of soil properties:

SN	Type of test	Frequency
1	Undisturbed Soil Sampling	at least 2 at each borehole
2	Standard Penetration Test	as required but the interval not less than 1.5 m
3	Grain size analysis	at least 2 at each borehole
4	Hydrometer analysis	at least 2 at each borehole
5	Moisture content	at least 2 at each borehole
6	Bulk and dry density	at least 2 at each borehole
7	Unconfined compression test	at least 2 at each borehole
8	Consolidation test	at least 2 at each borehole
9	Direct shear test	at least 2 at each borehole

If required by the field condition the Consultant shall conduct other types of tests. Similarly the frequency of the above tests can be increased if required. The cost of all the field and laboratory tests shall be incorporated in the cost of soil investigation works. No separate payment shall be made for the tests.

### 3.3.3 Depth of soil exploration

The depth of soil exploration from ground level shall be as follows:

SN	Type of soil	Governing depth
1	Silty, sandy, clayey soil	3 times the design scour depth, or 1.5 times the least dimension of the foundation footing, or 20 m(if required), whichever is maximum
2	Granular soil (gravels, boulders)	2 times the design scour depth, or 1.5 times the least dimension of the foundation footing, or 16 m, whichever is maximum
3	Rocks (soft or hard)	Not exceeding 8 m.

The above mentioned depths are indicative. The Consultant shall decide the actual required depth of soil investigation according to the field condition and design parameters. But in any case the Consultant shall be paid only up to the depth mentioned in the Bill of Quantities. If rock is found at the beginning or at mid-depth then the drilling works shall not exceed the depth as mentioned in the table above. In such case the payment shall be made only for the actual depth.

For example, if rock is found at a depth of 12 m. and if the maximum required depth is 16 m, then drilling shall continue only for further 4 m., and the payment shall be done for 16 m. If rock is exposed on the surface then drilling shall be done up to a depth of 8 m., and the payment shall be done for 8 m. But if the thickness of rock at

the surface is 6 m then the drilling shall continue further to the required maximum depth.

#### **3.3.4 Changes in soil strata**

N/A

#### **3.3.5 Soil exploration works to be certified**

The Department, if required, may ask the Consultant to submit the soil sample obtained from drilling works and/or a bore-log certified by the concerned KRMPor Program Office.

#### **3.3.6 Other information**

Availability of construction materials like, sand gravel boulders, timber, etc. with their engineering properties, quantities and lead up to the bridge site. Quarry site of materials with their available quantities should be shown on a sketch plan with reference to Bridge site.

### **3.4 Analysis of Data, Conclusion and Recommendation of Design Parameters.**

Based upon the above mentioned studies and investigations the consultants shall make the best use of their technical know-how and professional skill to arrive at and recommend the most cost effective design parameters. The consultant shall discuss in detail at least three different options and shall recommend the most appropriate option.

### **3.5 Miscellaneous**

If not covered by aforesaid, the Consultants shall perform other studies, explorations, tests surveys, calculations, etc. required to produce full and complete set of working drawings, specifications, bills of quantities, requirement of materials and complete cost estimates for the bridge/s including related works based upon which construction activities can be started to complete without further study and/or reference to them.

### **3.6 Detailed design and quantity/cost estimates**

Based on the collected information and results of the discussions mentioned above the consultants shall design the bridge follow the standard codes of practice, norms and guidelines.

The consultants shall produce detailed quantity estimate of the bridge and its accessories. They shall collect information on sources of materials and their lead distances and prepare rate schedules and cost estimates based on the standard norms of DoLIDAR (as far as possible) and prevailing district rates.

### **3.7 The checklist**

The detailed requirements of the design report are given in the checklist at the end of this TOR. Before submitting the report the consultants should verify whether it complies with the checklist.

## **4. SUBMISSION OF REPORTS AND PRESENTATION OF THE WORKS**

In accordance with RTISWP standard and procedures the consultant shall submit his reports as under:

### **4.1 Field Report**

This report will contain bridge site plan showing alignment of bridge foundations and locations of bore holes, logs with description of samples taken at every change of strata. Preliminary field report shall be submitted to KRMP in two copies and should be discussed with KRMP. This should contain Index map as well as location map of the bridge with respect to complete road network of the district.

### **4.2 Preliminary Design Report**

This report shall contain the preliminary design concepts and short descriptions relating to the proposed structure and its major components, e.g. superstructure, pier, foundations river training/ bank protection structures, approach road etc. It shall include location of proposed foundations and arrangement of the bridge components along with comparison between the possible alternative types. This report shall be submitted in **Two** copies and the content shall be discussed with KRMP before proceeding to the detail design of the bridge.

### **4.3 Draft Final Report**

This report shall in all respect be complete, containing all the required components of the design and be presented in clear and easy to refer formats as per the general design guidance attached. The complete set of the report shall consist of:

- (i) Volume I – Main Report
- (ii) Volume II – Drawings
- (iii) Volume III – Design Calculations
- (iv) Volume IV – BOQ and Special Provisions to Standard Specifications, if any
- (v) Appendices

Please refer to the checklist provided with this TOR for number of copies and detailed requirements of the reports. The draft report will forward to the LRBSU for the verification.

#### **4.4 Final Report**

LRBSU will verify the content of the report against the Terms of Reference and the checklist. The LRBSU may also discuss upon the technical content of the report and may suggest some changes if thought necessary. While preparing the Final Report the consultants shall consider the comments/suggestions and make corrections or amendments if required. It does not, however, relieve the consultants of their responsibility over the technical content of the design. The final report shall be submitted in stipulated number of copies as indicated in the checklist.

#### **4.4 Soft copy (electronic copy) of the design**

Apart from the bound report the consultants shall submit soft copies (electronic copies) of the final report in CD-ROMs as specified in the checklist.

### **5 TIME SCHEDULE**

If not indicated otherwise in the contract documents the consultant shall complete the assigned works as per the following schedule:

- (i) Field Report & Preliminary Design Report within 5 (Five) weeks started from the date of signing of the Agreement.
- (ii) Draft Report within 9 (Nine) weeks started from the date of the submission of the field report.
- (iii) Final Report within 2 (two) weeks after receiving KRMP's Comments and suggestions on the draft report.

### **6 USE OF COMPUTERS**

The Consultant is encouraged to use computers and appropriate analysis and design software. If such software is used the report should contain information on:

- Basic methodology of the analysis/design procedure adopted in the software
- Modeling concepts and applied model(s)
- Input and output parameters



## 7 WORKING TEAM

The working team for field and office works should necessarily consist of the following Key Personnel together with adequate supporting manpower.

SN	Personnel	Minimum academic qualification	Minimum years of general experience
1	Team Leader(Bridge/Structural Engineer)	M.Sc. in Structural Engineering/Equivalent (preferably Structural Engineer)	5 years
2	Sociologist/Economist	Masters degree in Sociology/Economic/Equivalent	3years
3	Engineering Geologist/ Geotechnical Engineer	Masters degree in Geology/Geotechnical	3 years
4	Hydrologist/Road/Environment Engineer	B.E. Civil Engineering or Masters degree in Hydrology	3 years
5	Senior Surveyor	Senior surveyor Course	3 years

**If the Consultants wish to apply for more than one job/package then separate Bridge/Structural Engineer (Team Leader) shall be proposed for each job/package.**

## 8 DEFECT LIABILITY

### 8.1 Responsibility for survey and design

Submission of the final reports does not relieve the consultant from their responsibility to the design. They shall bear full responsibility for:

- (i) Authenticity of all the field data including socio-economic, environmental, topographic, hydrological and geological information;
- (ii) Correctness of the design and all the calculations;
- (iii) Correctness of the drawings;
- (iv) Correctness of any other details related to construction

### 8.2 Assistance during construction phase

During construction the consultants, upon written request from the DDC/DTO, shall visit the bridge site and provide necessary technical assistance. The consultants shall be paid for such visits (travel cost and daily allowances) as per the approved norms. But if any changes in the design are required, the consultants shall furnish it free of cost as per the Condition of Contract.

### 8.3 Acceptance of responsibility

The Consultants may be asked to submit signed Statement of Acceptance of Responsibility as mentioned above in sections 8.1 and 8.2 attached together with the final report.