

Government of Nepal
Ministry of Local Development
Department of Local Infrastructure development and Agricultural Roads
Rural Reconstruction and Rehabilitation Sector Development Program

Norms for Detailed Engineering Survey, Soil Investigation and Detailed Design of Bridge in hilly Region

SN	Particulars	Unit	Quantity
	Type		Minor
1	Desk Study		
1.1	Bridge/Structural Engineer	md	5
1.2	Geologist	md	4
1.3	Hydrologist	md	4
1.4	Environmental Engineer	md	3
2	Detail engineering survey of the site		
2.1	Bridge Engineer	md	7
2.2	Engineering Geologist	md	5
2.3	Environmental Engineer	md	1
2.5	Surveyor(2)	md	7
2.6	Chainmen(4)	md	14
2.7	Labours(4)	md	14
2.8	Surveying equipment & logistics	LS	
3	Hydrometric and Hydrological survey.		
3.1	Hydrologist	md	1
3.2	Supervisor	md	1
3.3	Labours (4)	md	4
4	Field Test		
4.1	Excavation of 1 no. of 1m x 1m pit for soil sampling up to a depth of 3 m 3 Cum total volume	Total volume	
5	Laboratory tests		
	a) Grain size analysis (Sieve analysis)	nos	8
	b) Moisture content	nos	8
	c) Atterberg limit tests(when applicable)	nos	8
	d) Direct shear test	nos	8
6	Detailed design works		
6.1	Bridge Engineer	md	32
6.1	Geologist	md	7
6.1	Hydrologist	md	15
6.1	Environmental Engineer	md	2
6.1	Draftperson (2)	md	60
6.1	Computer operator	md	30
7	Preperation of reports		
7.1	Preperation of reports including logistics, stationery, computer hire and miscellenous works **		
	a) Main report (2draft & 5 final copies)	LS	1
	b) Design Calculation (1 draft & 2 final copies)	LS	1
	c) Detailed Drawings (2 draft & 5 final copies)	LS	1
	d) Special provisions to standard specifications. (1 draft & 5 final copies)	LS	1
	Subtotal Sum (NRs.)		
	Total (NRs.)		
	VAT (13%)		
	Contingencies@5 %		

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Norms for Detailed Engineering Survey, Soil Investigation and Detailed Design of Bridge in Plain (Terain)Region

SN	Particulars	Unit	Quantity
	Type		Minor
1	Desk Study		
1.1	Bridge/Structural Engineer	md	5
1.2	Geologist	md	4
1.3	Hydrologist	md	4
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2	Detail engineering survey of the site		
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2.7	Labours(4)	md	14
2.8	Surveying equipment & logistics	LS	
3	Hydrometric and Hydrological survey.		
3.1	Hydrologist	md	1
3.2	Supervisor	md	1
3.3	Labours (4)	md	4
4	Soil investigation		
4.1	Drilling of borehole for soil exploration		
	(Number of bore holes, Deep type)	Nos.	2
	a) In clayey,sandy soils,& gravel mixed soils		
	0 to 3m	m	12
	3m to 7.5m	m	18
	7.5m to 12m	m	18
	Subtotal drilling length	m.	48
4.2	Field tests.		
	a) Excavation of 1m x 1m pit for soil sampling		
	up to a depth of 3 m	Nos	2
	Total volume	cum	6
	b) Standard Penetration Test (SPT)	nos	26
	c) Geophysical Tests	nos	

4.3	Laboratory tests		
	a) Undisturbed soil sampling (during boring)	nos	8
	b) Grain size analysis (Sieve analysis)	nos	8
	c) Hydrometer analysis	nos	8
	d) Moisture content	nos	8
	e) Bulk and dry density	nos	8
	f) Atterberg limit tests (when applicable)	nos	8
	g) Unconfined compression test	nos	8
	h) Consolidation test	nos	8
	i) Direct shear test	nos	8
5. Transportation *			
5.1	Transportation of equipment & personnel including setting up of equipment at first borehole (E/W=1.2, C=1, MW=1.4, FW=1.5) For 1 job Factor X25000	Factor XRs.25000	
5.2	Shifting of boring/drilling equipment at site	nos	1
6	Detailed design works		
6.1	Bridge Engineer	md	32
6.2	Geologist	md	7
6.3	Hydrologist	md	15
6.4	Environmental Engineer	md	2
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	Subtotal Sum (NRs.)		
	Total (NRs.)		
	VAT (13%)		
	Contingencies @ 5 %		
	Grand total (NRs.)		

Design Standards

Table 3: Bridge Design Standard and Criteria

Design Standard	Design Criteria	Remarks										
Loadings: IRC Class A single lane, or HS:20-44 single lane 32.4 Gross weight Footpath Loading: Wearing Coat	NRS-2027 4th Revision 500 kg/sqm 200 Kg/sqm	Adopted Min. loading as compared to DOR										
Seismic Forces:	Horizontal Load = 0.10G Vertical Load = 0.05G	AASHTO -16 th Edition										
Wind Load:	240 Kg/sqm – For girder and 360 Kg/sqm – For trusses	AASHTO – 16 th Edition										
Temperature variation for Expansion joints	+/- 25 degree centigrade	AASHTO 1977										
Geometric standard: Number of Lanes: Footpaths as per site condition Vertical Clearance Note: overhead wires, poles etc. shall be at least 7.0m above the road surface.	Single lane 4.25m Where needed 1.0m footpaths provided 4.75m	AADT <200 vehicles per day Recommendation of IRC										
Bridge Classifications (a) Classification on Span Length Culverts: Up to 6.0m span Minor Bridge: 6 > L < 25m Medium Bridge: 25 > SL < 50: TL < 100m Major Bridge: SL > 50m: TL up 100m (b) Classification on Design Life: <ul style="list-style-type: none"> • Temporary Bridge • Semi-permanent bridge and • Permanent Bridge Vertical clearance (Free Board): Min. vertical Clearance: In case of channel for high level bridge normally between 1 and 2m above HFL to allow floating debris to pass unhindered. Note: The free board for the approach to high-level bridges shall not be less than	L = or < 6m 6 > Span length < 20m Length up to 20m: SL < 20m SL > 50 and Length up to 100m Minimum Vertical clearance: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Discharge (cum/sec)</th> <th>Vert. Clearance in mm</th> </tr> </thead> <tbody> <tr> <td>Less than 200</td> <td>600</td> </tr> <tr> <td>201 – 500</td> <td>800</td> </tr> <tr> <td>501 -2000</td> <td>1000</td> </tr> <tr> <td>2001 -5000</td> <td>1500</td> </tr> </tbody> </table>	Discharge (cum/sec)	Vert. Clearance in mm	Less than 200	600	201 – 500	800	501 -2000	1000	2001 -5000	1500	
Discharge (cum/sec)	Vert. Clearance in mm											
Less than 200	600											
201 – 500	800											
501 -2000	1000											
2001 -5000	1500											

Design Standard	Design Criteria		Remarks								
2000mm. For aggrading rivers in Himalayan foot-hills and flood plain areas of Churiya range, the free board shall be suitably increased above 2000mm.	5000 above	and More than 2000									
Material Specification Concrete grade	<table border="1"> <thead> <tr> <th data-bbox="753 522 967 606">Concrete Grade</th> <th data-bbox="967 522 1175 606">28 days strength</th> </tr> </thead> <tbody> <tr> <td data-bbox="753 606 967 648">M15 (1:2:4)</td> <td data-bbox="967 606 1175 648">15N/SQMM</td> </tr> <tr> <td data-bbox="753 648 967 690">M20 (1:1.5:3)</td> <td data-bbox="967 648 1175 690">20N/SQMM</td> </tr> <tr> <td data-bbox="753 690 967 730">M25 (1:1:2)</td> <td data-bbox="967 690 1175 730">25 N/SQMM</td> </tr> </tbody> </table>		Concrete Grade	28 days strength	M15 (1:2:4)	15N/SQMM	M20 (1:1.5:3)	20N/SQMM	M25 (1:1:2)	25 N/SQMM	
Concrete Grade	28 days strength										
M15 (1:2:4)	15N/SQMM										
M20 (1:1.5:3)	20N/SQMM										
M25 (1:1:2)	25 N/SQMM										
Reinforcement:	All reinforcing bars shall be of High Yield Strength Deformed Bars (Grade designation S 415) confirming to IS: 1786.										
Specification	Standard Specification for Road and bridges – 2001.										

Government of Nepal

Ministry of Local Development

**DEPARTMENT OF LOCAL INFRASTRUCTURE DEVELOPMENT AND AGRICULTURAL
ROADS (DoLIDAR)**

**Rural Reconstruction and Rehabilitation Sector Development Program
(RRRSDP)**

Project Coordination Unit (PCU)

TERMS OF REFERENCE

FOR

**DETAILED ENGINEERING SURVEY, SOIL INVESTIGATION AND DETAILED DESIGN OF
BRIDGES**

June, 2009

Name of Bridge:.....**Name of River**.....
Name of Road:.....
Location:.....

1.0 INTRODUCTION

RRRSDP/ PCU of DoLIDAR, intends to utilize services of engineering consulting firms well experienced in the field 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. The bridge shall have **4.25m** carriageway width without footpaths. Bridge that falls on Rural Roads shall be designed for **IRC Class A or AASHTO HS:20-44** loading. Super structure of the bridge(s) shall have as far as possible identical designs, including the bearings and expansion joints and parapets.

2.0 OBJECTIVE

Bridge/s is to be designed for a design life of more than 50-years and with low maintenance cost. Structures must harmonize with the surroundings and present a pleasing appearance. The maximum possible use of identical spans and elements in the design will be appreciated for the sake of economy. Test boring and foundation analysis should extend sufficiently below the lowest foundation level, where pressures are substantially dissipated. This depth shall be determined by analysis and shown on the design report.

3.0 SCOPE OF WORK

The consultants shall perform detailed technico-economical analysis (technico-economical impact if bridge is shifted at other possible location in the reasonable up and/or down stream of suggested bridge site) along with related works herein to attain the desired objectives. The consultant shall be responsible for accuracy, interpretation, analysis of all data received and for the conclusion and recommendations in their report. The mentioned scope of work to be carried by the consultant shall broadly include but not limited to the following:

(a) Desk Study

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

(b) Detailed Engineering Study Survey

Detailed engineering study shall include:

(1) Technical Feasibility Study:

It should include:

- reviewing the available data
- collecting, reviewing and analysis of field data to be used in the study
- 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 PCU/RRRSDP Bridge before proceeding to bridge site for soil investigation.

(2) Geological and Geomorphologic Study

In this study the following points related to 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) 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 reservoirs, lakes etc in the catchment.
- (ix) Existing and/or existed bridges or other hydraulic structures across the river in the vicinity of the proposed bridge site with their details as much as possible. If the proposed bridge is suggested to build in lieu of the existing/damaged structure, the salvage value of the same must be worked out and provided in the report.
- (x) Other information as per need.

(3) Bridge Site Selection and Environmental Impact Study

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 map and all the characteristic features of the chosen bridge site shall be given, in order to facilitate easy reference while designing the bridge.

The environmental impact study shall be carried out i.e. identifying the environmental changes due to the proposed structures and the outcomes of the study need to be

presented clearly in the form of recommendations and subsequently be considered in detail design. DoLIDAR environmental guidelines are to be followed.

(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 from either side at the proposed bridge sites. The topo-map should show the following:

- (i) Contours at 1 (one) m intervals in hilly area and at 0.3 m in plain area
- (ii) Flood lines on either side of the rivers in the entire area surveyed
- (iii) Lines with spot levels along which the bed slope of the river taken
- (iv) Both banks of the river
- (v) Lines along which cross-section of the river taken
- (vi) Govt. and/or public establishments
- (vii) Traverse lines, benchmarks including reference lines and/or points with respect to which the present topo-map 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 village/town etc. in either ends of the proposed bridge
- (x) Other information pertinent to design, construction and/or maintenance of the proposed bridge

(5) Hydrological Study

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

- (i) Catchment area of the river up to bridge site
- (ii) Length of the river from origin up to bridge site
- (iii) Slope of the river from the critical point (origin) of the river up to bridge site
- (iv) Cross-sections covering 200 m beyond flood lines of the river at proposed bridge site, at about 500m up-stream and 200 m down-stream wherein HFL, LWL, LBL, area of cross-section, wetted perimeter and geological profile with silt factor of each strata (at proposed bridge site only) shall be indicated. However, the scale of the drawing for horizontal and vertical should be the same.

- (v) The drawing should include the slope of the river at the proposed bridge site which should be extended 300 m U/S and 200 m D/S along the centerline of the river
- (vi) Maximum discharge shall be calculated by established formulas with different return periods
- (vii) The peak discharges calculated for a returned of 50-years shall be taken as a maximum discharge
- (viii) Velocity and depth of the flow at the time of survey
- (ix) Shifting of the river course in the past (if any) and the vicinity of it
- (x) Other information required for river control, design, construction and/or maintenance of the bridge

(6) Seismological study

Nepal being a seismic prone zone, a seismic consideration needs to be taken into account while designing a bridge structure. To workout the seismic coefficient – the design standard and criteria RRRSDP (recently proposed by BS) or IRC: 6-1966 (Reprint 1985) may be followed.

(7) Sub-surface Exploration

After the selection of proposed bridge site with alternatives and preparation of topo-sheets, the consultants must discuss along with the collected hydrological data and the following points with the DTOs in the respective district and PCU/BS in the headquarter for the final decision to carryout the soil exploration and design of the bridge:

- Design discharge
- Scour depth, maximum scour depth
- Linear waterway
- Anticipated soil condition for foundation
- The most feasible proposed site
- River training and approach roads
- Type of proposed foundation, sub-structures and superstructure

After discussion with the consultant, PCU/ concerned DTO will approve the bridge site at which the soil investigation shall be carried out including relevant required tests etc. as mentioned hereunder.

- (1)No. of bore holes (depending upon the river) each to a depth as explained in preferably at a possible locations of abutments and piers with conduction of SPT

- (2)No. auger holes in the river to a depth ofm for determination of mean particle size of riverbed materials in each layer.
- (3) The depth of soil exploration from existing ground level must not exceed as mentioned below (unless otherwise necessitated by the type of bridge):
- In the silty sand and other sand strata – 4 times of the designed scour depth
 - In strata of gravel and boulders – 2.5 times of designed scour depth
 - In soft rock – a maximum of 8m, and
 - In hard rock – a maximum of 3 m
- (4) Depth of soil exploration carried out must be certified by the concerned DTO chief for each bore hole and should be submitted in plastic bags duly labeled to the concerned DTO for the record and for further testing.
- (5) Laboratory Test
- (a) Natural moisture content
 - (b) Sieve analysis
 - (c) Hydrometric analysis
 - (d) Atteberg's limit
 - (e) Specific gravity
 - (f) Unconfined compression test
 - (g) Direct shear test
 - (h) Consolidation test
 - (i) Tri-axial tests
 - (j) Other tests as per need
 - (k)

(Note: - Only the test quantified in the Bill of Quantities are payable)

- (6) Determination of bearing capacity including other engineering properties of each layer of soil with respect to assumed factor of safety and proposed type of foundation
- (7) Recommendation of type of bridge, and its foundation, depth of foundation
- (8) Other necessary soil survey as found essential for design and construction of the bridge

- (9) Availability of the construction materials like: sand, gravel, boulder timber etc with their engineering properties, and lead up to bridge site. Quarry site of material with their available quantities should be shown on a sketch plan with reference to bridge site
- (10) If the soil strata is found to be different from mentioned in the bill of quantities, the consultant should immediately inform (report to concerned DPO/DTO) and the concerned project office, and keep them informed about the change of strata till the drilling work is finished for each bore holes

(c) 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 his technical know-how and professional skill to arrive at and recommend the most cost effective design parameters. In his recommendations the consultants shall discuss in detail at least two (2) different options and shall give full justification in support of the chosen one and recommended by him for further design.

(d) Analysis and Discussion

The consultant shall submit a certified copy by concerned DTO chief of field data in the form of field report along with analysis and interpretation, and recommendations. After discussion with consultant on their recommendation, PCU will approve (with some change if felt necessary) the proposal and accordingly the consultant may proceed for further investigation and analysis.

(e) Detail Design

If not covered by aforesaid, the consultants shall perform other studies, exploration, tests, surveys, calculations etc. warranted to produce full and complete set of construction plans (drawings), specifications, bill of quantities, requirement of material 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 him. This must include the following maps and /or drawings with details indicating thereon:

- (1) Counter map of bridge site as mentioned in (b)
- (2) Map of full catchment area
- (3) L-section of river bed and X-sections of river as mentioned in (c)
- (4) Map of shifting of river bed
- (5) Bore logs with all details
- (6) Lay out plan and profile of the bridge including approach roads on either side
- (7) Plan and profile of river training and other protection works

- (8) Detailed drawings of structural elements like foundations, piers, abutments, capping beams, deck, beams/trusses etc. The detail drawings must contain specification, arrangement of reinforcements including laps etc. Beside this, volume of works including the quantities of materials required should be provided.

4. REPORTS

In accordance with RRRSDP/DoLIDAR standard and procedures the consultants shall submit their reports as under:

(a) Field Report

This report will contain bridge site plan showing alignment of bridge foundations and location of bore holes/logs with description of samples taken at every change of strata. Preliminary field report shall be submitted to DTO/PCU in two (2) - copies and should be discussed with PCU/BS. This should contain Index Map as well as location map of the bridge with respect to complete rural road network of the district.

(b) Preliminary Design Report

This report shall contain the preliminary design concepts and short description relating to the proposed structure and its major components, e.g. superstructure, pier, foundations, river training works and protection works, approach road etc. It shall include locations of proposed foundations and arrangement of the bridge components along with the comparison between the possible alternative types.

This report shall be submitted in **three (3) copies** and the contents shall be discussed with DTO/PCU/BS before proceeding to the detailed design of the bridge.

The consultants should produce:

- A plan and longitudinal section of the river to scales of 1/1000 horizontal and 1/100 vertical
- At least three cross-sections plotted to a natural scale of 1/100, one at the proposed site and one each at the U/S and D/S limits of the plan
- Information on the terrain and other in the vicinity of the proposed site should be marked on the plan as well as the direction of the flow of the river and the location of the cross-sections
- The longitudinal section should indicate the highest and ordinary flood levels and the low water level as well as the lowest bed level

(c) Draft 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 guidance attached. This must contain and not necessarily be limited to:

- An index map showing the location of the proposed bridge, existing road network system, and general topography of the area, business centers /important places with banking administrative and medical facilities.
- The location map of the bridge with respect to complete road network of the district
- Photographic views of the proposed site(s) and existing structures, if any
- Findings, analysis, conclusions and recommendations of the consultants with all necessary calculations
- Complete set of detailed drawings
- Volume of works, requirement of materials and equipment, analysis rates, estimated cost of individual items and of the project as a whole, BOQ etc.
- Plan and programme of construction of bridge and related works giving sequence of execution of the individual items
- Advice of the consultants which he feels essential for construction and maintenance of the bridges and related works.

This report shall be submitted in **3 (three) copies** for review and comments by RRRSDP/DTO/PCU. Out of 3-copies, one copy is to be submitted to the DTO-chief for his comments.

(d) Final Report

After all corrections and incorporation of all the comments and suggestions to the submitted draft report, **separate reports for each bridges** shall be submitted to PCU (RRRSDP) in **5 (five) copies**.

(e) Design Calculations

Detailed design calculations with all necessary reference and related figures and sketches shall be submitted in **3 (three) copies**.

(f) Bill of Quantities (BOQ), and Special Provision

The BOQ in accordance with GON practice shall be submitted inCopies.

(g) Special Provisions to Standard Specifications

Special Provisions to Technical Specification DoLIDAR -1999 and or Standard Specification For Road and Bridges – 2001 shall clearly be identified, define all technical aspects of the items of works not covered by the standard specifications mentioned above in most precise way and be produced and submitted as a separate document for each of the bridge in **10 (ten) copies**.

(h) Liaison with the concerned District Technical Offices (DTOs/DPOs)

Consultants should and must keep the concerned DTOs/DPOs/PCU well informed about the ongoing works.

5. TIME SCHEDULE

The consultants shall complete the assigned works as per the following schedule:

- (a) Field Report within 4 (four) weeks started from the date of signing of Agreement.
- (b) Draft Report within Weeks from the date of submission of the field report.
- (c) Final Report within two weeks after receiving DTO/PCU/BS comments on the draft report

Note:

The following should be compiled with at the proposed bridge site:

- (i) Center line of the proposed bridge must be fixed, for this 3-RCC posts (1: 2: 4) of 150 * 150 mm in section and 750 mm length each should be installed projecting 150 mm above the ground at the two banks of the river along the center line of the bridge.

- (j) Similar posts (at least one post at each bank) should be fixed in the right of way and beyond the zone of inundations for Bench Marks, whereon BM No. and elevation must be written in fast colour. If permanent structures are available in the vicinity of the bridge site, they can be used for BM in lieu of the posts.
- (k) All center line and BM posts should be connected with sufficient permanent reference points

6. CONSIDERATION ON ENVIRONMENTAL ASPECTS

The consultant is required to 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. DoLIDAR/DOR environmental guidelines are to be followed.

7. USE OF COMPUTERS

The consultants are encouraged to use computers and appropriate software. But the software to be used in engineering design works must be approved by PCU/RRRSDP. Further, the reports should contain adequate information on methodology adopted in the programme, summarized flow-diagram, description of formula used in the program, data required for input and result obtained in output etc. It does not, however apply to a Word Processing software, but formula used in Spreadsheet must be described.

8. WORKING TEAM

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

- Bridge / Structural Engineer
- Geo-technical Engineer / Engineering geologist
- Hydrologist

9. PERSONNEL REQUIREMENT

Bridge Engineer/Structural Engineer -1

The Bridge Engineer/Structural will be a qualified civil engineer with specialization in Bridge Engineering and / or Structural Engineering. The Bridge Engineer should have at least 7 years of general experience and 5 years of specific experiences in bridge design works. **He should have successfully carried out design of at least 2- bridges before.**

The Bridge Engineer will undertake the following task:

- Review the reports (Soil investigation, Hydrological Investigation, Detailed engineering survey)
- Carry out the detail structural design work of each component of a bridge structure e.g. foundation, sub-structure, superstructures including the design of secondary works of bridge bearing, expansion joints, approach roads, wing walls etc.)
- The design report should include all necessary design calculation of each component
- Undertake additional tasks related to bridge as required by PCU/DPOs
- Bridge engineer will act as a team leader in carrying out the overall work

(a) Engineering Geologist/Geo-technical Engineer - 1

The expert should have a master degree in geo-technical engineering or master in geology with bachelor degree in civil engineering. S/he should have at least 7-years of general experience and at least 5 years of experience in relevant field.

The Geologist/Geo-technical Engineer will undertake the following tasks:

- Review the survey report, hydrological report and location of the bridge site
- Carry out geo-technical investigation as described in **Para 3 (7)**
- Analyze the soil investigation report and based on it recommend the type of foundation to the bridge structure
- Undertake additional tasks related to the bridge foundation as desired by PCU/CISC/DPOs

(b) Hydrologist - 1

The Hydrologist will be professionally qualified hydrologist or civil engineer with elective subject of hydrology.

The hydrologist should have at least 5 years of general experience and 3 years of specific experience in study and investigation of hydrological works for bridges.

- The hydrologist will undertake all the work as described in **Para 3 (5)**
- Recommend the necessary data for the design of bridge structure
- Undertake additional tasks as required by PCU/CISC/DPOs

10.0 MODE OF PAYMENT

Mode of payment to the consultant will be as under:

10.1 Mobilization Advance

- Mobilization advance will be paid to the consultant after the survey team is mobilized to the site. Mobilization advance will be paid as 20 % (twenty percent) of the quoted rate.
- On submission of the Draft Report – 40 % (forty percent) of the quoted amount will be paid.

10.3 Final Payment

Final payment will be made to the consultants after submission of the Final Report.