

# **TERMS OF REFERENCE FOR PREPARATION OF DETAIL PROJECT REPORT (DPR) CONSISTING OF DETAILED ENGINEERING SURVEY, DESIGN, DRAWING AND COST ESTIMATE, ROAD INVENTORY OF PROPOSED ROADS.**

## **1.0 Introduction**

Nepal having poverty-stricken rural countryside communities, rural development is one of the main agenda of development. The ultimate goal of rural development is attainment of sustainable livelihood and improved well-being of rural people. In the absence of better access to the goods and services that they value the same suffers. Rural people's needs for sustainable livelihood and improved well-being are such that they require better access to information, markets and opportunities; they need better access to health, education and other goods and services.

The consulting service has to conduct detail engineering survey, design and prepare detail drawings and cost estimate according to based on the 'DoLIDAR Technical guideline (Nepal Rural Road Standards) Including criteria fulfilling in Annex A .

### **1.1. Objectives**

The overall objective of the consulting services is to prepare conduct detailed engineering survey, design and prepare detailed drawings and cost estimate of rural roads of the rural municipality . The consultant should follow the DoLIDARS's Norms, Specifications and design standard.

The specific objectives, but not necessarily limited to the following, are:

- Analyze the existing situation on topographic map as well as on field.
- Conduct detailed engineering survey of the alignment and its corridor.
- Conduct hydrological studies for cross drainage works and fixing of embankment height.
- Design the road details.
- Prepare working drawings.
- Prepare cost estimate with analysis of rates.
- Prepare survey and design reports.

### **1.2. Scope of Services**

The consulting service is to provide high quality professional services for detail engineering survey, design and prepare detail drawings and cost estimate according to the 'DoLIDAR Technical guideline (Nepal Rural Road Standards) on Planning and DoLIDARs design standard, Design and Construction of Rural Roads'. The consultant shall carry out the necessary field works along the alignment. The team personnel to be mobilized for field visit and schedule of field tasks should be prepared and should be included in the proposal. The center line should be set out with proper establishment of bench marks, as far as possible following the existing trail or alignment. The consultant shall then carry out further survey works necessary for detailed design of the road. The consultant shall be responsible for the analysis and interpretation of the data. The scope of services to be carried out by the Consultant shall broadly include, but not be limited to, the following:

### **1.2.1. Engineering Details (Field Survey)**

- The horizontal alignment of the road (i.e. centre line) should be determined within the survey strip of proposed corridor of the optimum alignment between control points specified as a result of the engineering investigation.
- Accurate traverse line shall be run along the route selected.
- In case of improvement of existing road, efforts should be made to adjust the alignment so as to match the existing road track wherever possible.
- Strip of sufficient width (10m on either side) to accommodate cut/fill and for possible shift in the centre line at the final design shall be surveyed.
- Traverse survey shall be done by Total station/Theodolite with angles using double reversed method.
- Appropriate and accurate method shall be adopted for the distance measurement between two consecutive transit stations.
- Transit stations shall be pegged and numbered following a sequential order.
- Features like buildings, monuments, cremation center and graveyards, temples, power and telephone lines, pipelines, existing roads and trails shall be located by offset measurements from the traverse line.
- Cross section shall be taken at 15-20 m interval and at closer intervals in places having abrupt slope changes or different soil type.
- Classification of soil chainage wise is absolutely necessary.
- Benchmarks shall be fixed at every 250 m intervals or at 500 m intervals in special cases. Benchmarks shall also be fixed at bridge and culvert sites.
- Check all levels with the levels of established Benchmarks by fly leveling for accuracy.
- Single datum preferably geodetic survey datum shall be used to tie up all levels.
- Grid survey at 1 or 2 m intervals may be necessary at places of sharp curves of difficult places and at all bridge sites.
- Data information should be taken on all gullies, depressions, streams and rivers where cross drainage structures are required.
- Every retaining structures, breast structures, drainage structures, slope protection measures should be supported by justification and photographs.
- Road Inventory with details such as: existing retaining walls, check dams, chutes, pipe and slab culverts, causeways, drain, rehabilitation of existing channel works and other structures and the consultant shall produce road inventory drawings as per DoLIDAR or other appropriate formats

### **1.2.2. Environmental Consideration**

The basic intention of environmental consideration is to develop the best possible rural road in the given environmental settings. Environmental consideration basically addresses two aspects: risks or threats, which are the likely damages to the environmental quality, services and natural wealth; and opportunity or potential in the given natural setting for road works to harness the same. Environmental considerations should, therefore, focus on avoiding or minimizing damages and, at the same time, promoting sensible use of opportunities to improve the natural

environment. So, during the detail site visit consultant should prepare the site specific Environmental Management Plan (EMP) of the proposed roads. The EMP should be prepared as per prescribed format by DoLIDAR.

### **1.2.3. Engineering Design Calculation**

Engineering design must be shown with calculation. The format should be described properly declaring the meaning and source of variable, constants and multiplication factors should be referenced and justified. Technical Guidelines on Planning, Design and Construction of Rural Roads provided by DoLIDAR should be strictly followed in design works. The road should be designed according to all weather road (well graded gravel surface)

### **1.2.4. Preparation and Presentation of Project Documents**

All project data and information collected during the above survey should be compiled as a project document. The project document should comprise of:

- report
- cost estimate, and
- construction drawings

#### **1.2.5.1. Report**

It contains the following:

- a) Background Information
  - Name of the work and its scope of activities
  - Authority and plan provision
  - History, geography, climate, etc.
  - Necessity, or other words, project justification
- b) Road's Salient Features
  - Route selection
  - Alignment
  - Environmental considerations
  - Right of way, roadway, carriageway and other cross-sectional elements
  - Salient features of road structures
  - Present / anticipated traffic
- c) Road Design and Specification
  - Road design
  - Pavement design (Gravel Surface)
  - Protection works (other than cross - drainage works)
  - Specifications
- d) **Drainage facilities including cross-drainage structures**
  - Discuss investigations carried out

- Give details of the surface / sub-surface drains and drainage measures, attach design calculations / drawings.
- Highlight and propose special measures to check soil erosion and environment.
- Discuss the proposals on small cross-drainage structures i.e. Culverts / causeways.
- In case of improvement of existing roads, list out the cross-drainage structures proposed to be improved.
- State whether any standard designs were followed.

**e) Materials, Labor and Equipment**

- Type, quantity and specifications of materials required and their availability.
- Type, number and skills of labor required and its availability.
- Type, number and specifications of tools/equipment/plants required.

**f) Rates**

- Give reference to the schedule of rates of the year adopted.
- Highlight the items for which suitable rates are not available in the schedule and for such items give reference to the analysis of rates attached to the estimate.

**g) Construction Schedule**

- Mention the proposed system of work execution to be adopted
- Mention the proposed project period.
- Discuss the prevailing and anticipated constraints to project implementation
- Draw up a construction schedule in the form of bar chart along with the responsible parties. This should be done after scheduling the activities according to the Critical Path Analysis.

**h) Miscellaneous**

- Indicate the camping, store and office requirements.
- Mention identified diversions and borrow pit.
- Mention arrangements for water supply and other site amenities.
- Indicate proposed roadside plantation and wayside amenities.
- To prepare the EMP

**1.2.5.2. Cost-Estimate**

The project's cost-estimate should provide all financial requirements and it should be realistic too. In the project's cost-estimate, it is ensured that all

- The work items are carefully listed.
- The quantities are determined to a reasonable degree of accuracy, and
- The rates provided are workable.

The cost -estimate should consist of

- A general abstract of cost , and
- The detailed cost - estimate for each major activity as described below.

General abstract of cost provides the total cost of the scheme along with a general break-down given under the

Following major heading:

- Site clearance
- Earthwork
- Sub-bases
- Bases
- Surfacing
- Cross drainage and other structures
- Provision for tools, equipment and plants
- Provision for contingencies
- Work charges of the establishment
- Quality control, etc.

The detailed cost-estimate for each major activity consists of

- Abstract of cost
- Estimate of rates for work items not covered by relevant schedule of rates and
- Chart of quarry / material sources

Where the project work is proposed to be executed in stages, the cost – estimate should be prepared for each stage separately. The cost- estimates for respective stage should be presented in a logical sequence.

### **1.2.5.3. Construction Drawings**

The construction drawings should clearly show and interpret the proposed works in relation to the existing features with other necessary information for accurate translation of the proposed in the field. All the drawings should follow a uniform standard with regard to:

- Size
- Scale, and
- Details

#### **a) Drawing size**

Drawing should be of adequate size to accommodate a reasonable length of the road or an independent structure such as a culvert in full details but, at the same time, should not be incontinently large which may require many folds.

The appropriate size of a drawing sheet is 297 mm x 420 mm corresponding to A3 size which can easily be stitched in a folio. The standard size of the folded compact is 297 mm x 210 mm.

To facilitate the stitching of drawings into a folio, a margin of 40 mm should be kept on the left hand side of the drawing sheets.

The following working drawings shall be prepared for implementation of the works using computer software or manually as appropriate:

- General plan of project site showing the distance from the project area to construction materials and quarry sites in appropriate scale. Road plan in 1:1000 scale, which shall include detailed working drawings and setting out data such as centre line coordinates, deflection angles and other parameters of horizontal alignment setting
- Description card (D-card) with full details of benchmarks and points along centre line, minimum of 4 reference points per km i.e on an average one peg in each 250 m including location sketches, level and coordinates as appropriate.
- Profile at H1:1000 and V1:200 (for hills) or V1:100 (for plains) scale indicating existing ground situations, proposed designs, existing soil type, lengths and type of drains and mass manage and haulage plan.
- Cross-sections incorporating structures at 1:200 scale at all centre line pegs at 15-20 m interval or less and 10 m either side of centre line with existing ground situations, proposed designs and data such as existing ground level, proposed ground level, area of cut, area of fill, soil type and drain type etc.
- Detailed working drawings and setting out data - centre line coordinates, deflection angles and other relevant data of horizontal alignment setting.
- Similarly, vertical alignment setting data.
- Typical working drawings for all other structures.
- Earthwork quantities (cut and fill) shall be prepared on spread sheet computer program based on cross-sections
- Bill of Quantity should be broken down and grouped contract package wise.

## **b) Component of a set of Project Drawings**

- i) Locality map-cum-site plan
  - Key map also called as locality map
  - Index map also called as site plan

Key map and index map are usually drawn in a single sheet and this sheet forms the first sheet in the folio of project drawings.

Where the length of the road is substantially long, locality map and site plan are separated in such a manner that locality map is accommodated in one sheet and the site plan on a series of sheets.

The locality map or “Key Map” should be draw to a scale of 1:250,000 and should have a bird’s eye view of the proposed work with respect to the

- Road network serving the area
- Important town / village centers, and

- Other prominent places

The site plan or “Index Map” should be drawn to a scale of 1:25000 and should show the project road with chain ages and its immediate neighborhood covering the important physical such as hills, rivers, tracks, main trails, etc.

The sheet which contains the locality-cum-site plan should have a legend to explain the abbreviations and symbols used in subsequent drawing sheets. Alternately, the legend could be shown on a separate sheet at the beginning of the folio.

- ii) The elements in a rural road are generally same for most of the length. They are:
- Width of carriageway
  - Width of roadway, i.e. formation width
  - Width of shoulder
  - Right of way
  - Side slopes
  - Pavement cross fall

It is desirable to show the above mentioned elements as a typical section instead of repeating the same details on every cross-section.

- iii) The cross-sections of the road should be presented serially according to the chainage starting from 0+000. Each sheet should accommodate a number of cross-sections.
- iv) Standard design and drawings of cross-drainage structures should be used wherever possible, thus avoiding repetitive design/drawing work for similar structures. The drawings should be prepared for all:
- Cross-drainage structures
  - Retaining walls
  - Breast walls, and
  - Other road side structures

The drawings should show clearly the details of foundation, proposed materials, etc. and should be prepared on a scale which is large enough to accommodate all details comprehensively.

#### **1.2.5.4. Bill of Quantities**

Bill of quantities of a project should cover all the required items listed in the cost estimate. All the details of labor and materials should be given as a break-down under respective work item. In general, quantities of the work items and their units should be given in the approved format.

### **1.2.5.5. Schedules of Labor and Materials**

Schedules of labor and materials are essential, in advance, for construction planning and management purposes.

### **1.3. Use of Computer and Design software**

Consultants are encouraged to use computers and appropriate design software. The consultant should submit the soft (electronic) copy of reports of the total output of the works.

### **1.4. Liaison with engineer in-charge**

The consultants are required to maintain close liaison with the Rural Municipality Engineer. Draft design for alignment, earthwork and pavement design and other technical aspects of the design shall be discussed with the Client Engineer for approval prior to proceeding with the final detailed design.

### **1.5. Client's Proposed Composition of Staff**

#### a) Professionals:

- Team Leader
- Civil engineer
- Geologist/Geo tech engineer
- Environmentalist
- Surveyor

#### b) Support Staffs

- Sub Engineer
- Auto CAD Operator

### **1.6. Qualification and Experience:**

**a) Team Leader:** The Team Leader will take the overall responsibility for the execution of the work in accordance with the TOR and also for the co-ordination of all professional inputs.

He will be responsible to the Client. He will also maintain close contact with the CAO of the Rural Municipality to ensure that the contract is implemented in accordance with the government's policies and objects.

The team leader should have a Master degree in civil engineering and should preferably have a Master's Degree in the field of Highway/Transportation. He should have 7 years of general experience in road sector and 3 years in specific experience in similar nature of works as design/construction supervision of road projects



**b) Civil Engineer:** should have wide experience and expertise in planning, detail engineering surveying, designing and construction of rural roads, including:

- ❖ Must have completed Bachelor's Degree in Civil Engineering.
- ❖ More than 3 years' experience in planning, detail engineering survey, design and construction supervision of roads.
- ❖ Must be registered in Nepal Engineering Council.

**c) Geologist/Geo tech engineer:**

- ❖ Must have completed Bachelor's Degree in Geology/Geo tech Engineering or B.E in civil Engineering.
- ❖ More than 5 years' experience in related field.
- ❖ Must be registered in Nepal Engineering Council.

**d) Environmentalist :**

- ❖ Must have completed Master's Degree in Environmental Science/ Engineering.
- ❖ More than 5 years' experience in related field.
- ❖ Must be registered in Nepal Engineering Council in case of Engineering background.

**e) Sub engineer/Surveyor**

- ❖ Must have completed Diploma in Civil Engineering.
- ❖ More than 2 years experience in detail engineering survey, design and construction supervision of rural roads.

**f) Auto CAD Operator**

- ❖ Must have completed Assistant Sub-Engineer course in Civil Engineering or auto CAD course
- ❖ More than 3 years experience in Auto CAD to prepare design drawing of road works.

## **1.7. Duration of the Study and Reporting**

The duration for the assigned task is two month. The consultant shall submit the following reports:

- i) Inception report** The consultant shall submit 2 (Two) copies of Inception report within 2 week of signing the contract agreement for the consulting services.
- ii) Draft report:** The consultant shall submit 2 (Two) copies of the draft report within 1.5 months of signing the contract agreement for the consulting services. The report should have two volumes. **Volume I** should contain the main report and cost estimate and **Volume II** should contain detail engineering drawings, maps and contract documents (bidding documents, Technical specifications of each packages)
- iii) Final report:** The consultant shall submit 3 (Three) copies of final reports within 15 (Fifteen) days after receiving comments, incorporating comments and suggestions on the draft reports. The report should be also in two Volumes of each, as mentioned for draft report. The final report and maps should be in hard as well as in soft copies in CD.

Note:- Before replacing proposed staff approval is required from client.

## **1.8 Indicative Reporting Outline**

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## **5. Quantity Survey and Cost-Estimate**

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  - 5.1.8 Cost of pavement construction if any
  - 5.1.9 Cost of road side development works if any

- 6. Conclusion
- 7. Recommendation

## **1.9. Proposal Submission**

The consultants shall submit technical and financial proposals under two-envelope system. The technical and financial proposals must be enclosed in separate wax sealed envelopes, clearly mentioning the type of proposal (Technical and Financial) and name of the task on the envelope. Then both the sealed envelopes must be enclosed in an outer waxed sealed envelope, clearly stating the name of proposal, purchaser's address and the firms' name and address.

## **1.10. Payment Schedule**

The payment schedule will be as per the following:

After submission of inception report = 30% of the total contract amount.

After submission of the draft report = 50 % of the total contract amount.

After submission and approval of the final report = 20% of the total contract amount.

ANNEX A :

**Road Geometrics Design Standards and Surfacing Options**

<b>Road Geometrics Design Standards</b>				
<b>Sr. No</b>	<b>Road Components</b>	<b>Design Standards</b>		<b>Remarks</b>
		<b>Terai</b>	<b>Hills</b>	
1.	<b>Carriageway Width (m)</b> • Traffic < 100 VPD • Traffic>100VPD<400VPD	3.00 3.75	3.00 3.75	
2.	<b>Shoulder Width (m)</b>	1.50	0.75	On both sides
3.	<b>Roadway Width (m)</b> • Traffic < 100 VPD (see notes below) • Traffic>100VPD<400VPD	6.00 6.75	4.50 5.25	Excludes width of drain, parapet & retaining wall top
4.	<b>Right of Way (m)</b>	20.00	20.00	10m RoW on either side from the road centerline
5.	<b>Corridor of Impact or COI (see notes below)</b>	As specified in as per the provision of the Environmental and Social Management Framework (ESMF) of SNRTP		COI will be the minimum width to cover the actual road construction boundary plus 1.00m on each side of the construction line.
6.	<b>Design Speed</b> • Ruling • Minimum	50 40	25 20	
7.	<b>Stopping Sight Distance (m)</b>	45.00	20.00	
8.	<b>Lateral Clearance (m)</b> • Normal • Minimum	1.50 1.00	1.00 0.50	
9.	<b>Vertical Clearance (m)</b>	5.00	5.00	
10.	<b>Radius of Horizontal Curves (m)</b> • Ruling • Minimum	≥90.00 60.00	≥20.00 12.50	Exceptional case: 10m
11.	<b>Hairpin bends</b>			
	Desirable Spacing (m)	NA	100	Distance between two bends
	Minimum Radius (m)	NA	12.5	Exceptional Case: 10m
	Minimum Roadway width at	NA	5.5	For curves with radius <12.5m

	apex(m)			provide 7.00 width
12.	<b>Gradient (%)</b>			
	Ruling	5	7	
	Limiting	6	10	
	Exceptional	7	12	
	Maximum for Bridge approach	5	6	
	Minimum in hill roads	NA	0.50	
13.	<b>Extra Widening (m)</b>			
	For curve radius $\leq 20$ m	1.5	1.5	
	For curve radius 20 -60 m	0.60	0.60	
	For curve radius $> 60$ m	Nil	Nil	
<b>Road Geometrics Design Standards</b>				
Sr. No	Road Components	Design Standards		Remarks
		Terai	Hills	
14.	<b>Camber minimum (%)</b>			
	Earthen Roads	5	5	Hills: Unidirectional camber sloping either towards hill side or valley side Terai: both side camber from center line
	Gravel Roads	4	4	Hills: Unilateral camber in carriageway sloping towards hill side Terai: both side camber from center line
	Bituminous Roads	3	3	Hills: Unilateral camber in carriageway sloping towards hill side Terai: both side camber from center line
15.	<b>Passing zone/Bus lay Bys</b>	Width 2.5m in addition to carriageway width and length 30m along the edge of carriageway tapered to 20m along the outer edge or at least of dimensions as specified in NRSS-2013		
16.	<b>Traffic Signs and Road Safety</b>	As detailed in the NRRS 2013		
17.	<b>Carriageway Width ( cross-drainage structures)</b>			
	Culvert	6.00	4.5	Distance between parapet walls
	Bridge	4.25	4.25	Distance between kerb on one side and footpath (min <sup>m</sup> 1.00m width) on the other side (see notes below)

18.	<b>Road side drains</b>	<p><b>Hill roads:</b> tick drain with masonry (1:4) back wall and 10cm thick M-15 grade concrete sloped bed throughout the road length as required</p> <p><b>Built up areas:</b> Type G drain specified in DoLIDAR Technical Guideline with adequate cover slabs for crossings.</p>	
<b>Surfacing Options</b>			
1.	<b>Gravel Surface</b>	15 cm thick in carriageway for both hill and terai roads.	<p><b>Hill roads :</b> 15cm gravel surfacing in carriageway to be extended in the hill side shoulder up to inner edge of the drain. Tapering gavel hard shoulder (15cm to 6cm) in the valley side with slope towards the valley.</p> <p><b>Terai Roads:</b> 1.00m wide tapering gavel hard shoulder (15cm to 6 cm) with slope towards the embankment on either side of the carriageway</p>

**Notes:**

- a) The standards are mainly adapted from Nepal Rural Road Standards (NRRS), 2013. However, in some cases separate standards are proposed where NRSS standards are found to be inadequate or missing.
- b) VPD - Vehicles per Day (VPD) as per definitions of NRRS, 2013.
- c) Main objective of the capping layer is to increase CBR of sub grade to at least 10%. Locally available suitable materials will be used for the capping layer.