



Appendix – A :

TERMS OF REFERENCE

for

Feasibility study of Roads

माधव

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**Appendix A : TERMS OF REFERENCE****1. OBJECTIVES**

- 1.1 To investigate the technical, economic and environmental feasibility of the following road, for which bids are presently invited, so that decision can be made regarding the appropriateness of proceeding with engineering design:

Name of road:

## **1 Dudharaksha 3-Mauravchowk-Balapur, Rupandehi Palpa Juthapani (Rupandehi district)**

District: Palpa, Rupandehi

Development Region: Western

- 1.2 To investigate minimum three alternative alignments in terms of socio-economic factors of the influence area, traffic, topography, geology, environmental aspects, soil and other related factors along the alignment with maps, sketches, wherever necessary;
- 1.3 To prepare order of magnitude of construction cost estimates for the alternative alignments based on a reconnaissance field survey and a study of construction costs;
- 1.4 To outline a realistic stage construction programmed for the project, this includes the investigation of alternative forms of standard of road construction with particular emphasis on material quality and availability, suitability for local conditions, and capital and maintenance costs;
- 1.5 To investigate the need for and likely cost of feeder roads if any.

**2. SCOPE OF WORK****2.1 General**

- 2.1.1 The consultant shall perform office works, field works and the analysis of the collected data, as required to attain the objectives in Section 1.
- 2.1.2 In performance of the services, the consultant shall co-operate fully with the Department of Roads. During the study, the consultant shall take into account Government of Nepal's policies and development plans in the transport and other sectors, particularly those directed toward the accelerated integrated development of the influence area with existing and proposed road network and the construction of secondary and tertiary roads.

In particular, the Consultant shall also take into consideration the policies and development plan of the corresponding local governments. It shall also consult the officials in the corresponding Division Road Offices of DOR, Zonal Offices of DOTM, District Administration Offices and other offices mentioned specifically elsewhere in the TOR. The prevailing material and labor rates of the concerned districts should be referred for any estimate to be made.

- 2.1.3 The Consultant should feel free to draw its own conclusions and make its own interpretation when compiling the reports and proposing recommendations. The Consultant shall be solely responsible for the analysis and interpretation of all data received the collection of additional data wherever necessary for the findings and recommendations contained in the reports.
- 2.1.4 The Consultant shall submit the list of references consulted and name of persons and officers visited or interviewed.

**2.2 Working Team**

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

- Highway/Transport engineer
- Engineering Geologist/ Geo-technical Engineer/Geologist
- Transport Economist/ Sociologist
- Environmentalist
- Hydrologist



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Note: **A proposal failing to include any of the above key personnel in the team will not be competent.**

- 2.3 Socio-economic studies of influence area with maps and sketches
- 2.3.1 Demographic picture:
  - (a) Influenced population/economic activity of influenced population
  - (b) Structure of population
  - (c) Nature of migration and outside influx etc.
- 2.3.2 Land use pattern:
  - (a) Wild life sanctuary
  - (b) Forest
  - (c) Production in influenced area and surplus in influenced area
  - (d) Settlement pattern etc.
- 2.3.3 Trade, Industry and Commerce (existing & planned):
  - (a) Local produces and other resources
  - (b) Export and import
  - (c) Major industries and cottage industries
  - (d) Market development
  - (e) Tourism potential etc.
  - (f) Major development works (hydro power project, irrigation project, other governmental/no-governmental development programs etc.)
- 2.3.4 Health (existing & planned):
  - (a) Hospital
  - (b) Health post
  - (c) Ayurvedic clinic etc.
- 2.3.5 Education (existing & planned):
  - (a) Primary schools
  - (b) Secondary schools
  - (c) High schools
  - (d) Colleges/institutions etc.
  - (e) Universities
- 2.3.6 Transport and communications network (existing & planned):
  - (a) Trail network and trail bridges
  - (b) Airport, STOL strips, helipad etc.
  - (c) Water transport
  - (d) Rope-ways
  - (e) Road network
  - (f) Telecommunication, postal service & other communication networks etc.
- 2.3.7 Administrative facilities:
  - (a) Government offices
  - (b) Co-operation offices
  - (c) Banks etc.
  - (d) Police station

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## 2.4 Geological studies with particular emphasis on alignment

To check geological & geomorphologic stability minimum natural hazard alignment, after conduction of walk over survey along all the alternate alignment.

### 2.4.1 Geomorphology

### 2.4.2 Geology

Data regarding the geological formation, type of rocks, its dip, strike, strata, seepage flow etc. may be observed so as to decide the stability of road and structure. Geological formation should be studied and engineering geological maps should be proposed. Identify risk areas and propose of mitigation measures.

### 2.4.3 Meteorology and hydrology

Drainage Structure and height of road embankment should be based on above data.

### 2.4.4 The alignment should be fixed considering the future power generation or irrigation structure possibility of the local rivers.

## 2.5 Engineering Studies of Alignment

### 2.5.1 Preliminary Alignment Survey

Use of GPS, level, meridian abney's level, altimeter, pedometer, geological compass etc. as essential.

- (a) For desk study, collection maps of its study area, contour map (not smaller than 1:50,000), political & geological map, hazard map, road network map, map of earthquake zoning, land use map, aerial photo (covering the catchments area of drainage system as far as possible), socio economical data of influence area and other relevant data, report (roads network study 1994, MRE, road standard, Standard specification, DOR publication etc.).
- (b) Prior to field visit, detailed desk study has to be made on the basis of study of top map (scale not less than 1:50,000 or larger map), aerial map and any other relevant document and information whatever is available. During desk study, all the alternate alignments between obligatory points have to be fixed. Determination of crow fly length/theoretical length/practical length between the obligatory points, by fixing controlling points between obligatory points and finding average grade between the controlling points (not exceeding the average grade of the road) has to be made. Suitable format for field work should be developed according to MRE recommendation. After field study, the changes (new settlement, river meandering, land slides, drainage name, district demarcation etc.) on the desk study as observed in the study area should be located in the map. Route alignment with name of districts & its chainage should be determined.
- (c) Survey work is to be carried out using GPS calibrated to Nepal National Grids. Height (RL) is to be determined from topographical map.
- (d) Alignment should be fixed with due consideration of the location of cross-drainage structures.
- (e) Alternate alignments should be chosen so as it may be comparable in consideration of total transport cost.
- (f) Take photograph of distinct features such as overall view, land slide area, other geologically hazardous area, river crossing, distinct soil type, road intersections, existing trails & bridges etc.
- (g) During field study, if desk study alignments are modified, the changes should be described in detail & it should be represented in the map.
- (h) Diskettes of data should be submitted (i.e. data of the alignment, plan & profile etc., if software is used).

### 2.5.2 Geometric characteristics & terrain classification

- (a) Road standards
- (b) Design standards

### 2.5.3 Salient features of pavement and structures proposed

### 2.5.4 Protection measures

- (a) Slope protection
- (b) Erosion control

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- (c) Soil conservation measures

#### 2.5.5 Additional special requirement (in case of specified urban road)

- The Consultant shall propose a suitable road width to incorporate motor able, non-motor able, pedestrian traffic/where ever necessary for foot paths on the basis of 20 years traffic forecast.
- The Consultant shall also propose a total width of land acquisition for road reserve to accommodate the designed road width (cross-section) and the right of way.
- The Consultant shall also propose the location of bus parks and taxi parks, areas to develop green belt and urban parks where ever possible along the alignment based on 20 years traffic forecast.
- The Consultant shall take special care to provide a proposal for extra width to accommodate non-motorized traffic like Bullock carts (in Terai area), Rickshaw and Bicycle.
- Consultant shall have to provide a provision for space to accommodate the services like Electricity, Telephone and Water Supply, Sewerage system on its right of way along with road line plantation. In addition to the above, the Consultant shall have to provide provisional location for the cross drainage for the urban Sewage system.
- There is a great chance of fast urbanization due to existence of this proposed road net work, Consultants are suggested to take more attention for the urban traffic type for the design of road width, pedestrian footpaths, green belts, bus/truck parks, bus lay-byes at appropriate intervals, taxi and Rickshaw stand (if required) along the proposed road alignment.
- The consultants are suggested to avoid selecting the alignment through the public settlement (village, school compound, and town), swampy land and try to utilize the existing motor able, tracks in the influence area as far as possible.
- The consultant shall have to identify the location of major intersections into proposed road net wok with adequate land reserve on the basis of 20 years traffic forecast.
- Future expansion & right of way suggestion should be mentioned.

#### 2.6 Traffic Studies

To determine the type and volume of future traffic for the proposed roads, the consultant shall analyze all existing statistical data affecting traffic within influence area. The consultant shall carry out traffic counts and origin/destination surveys or any other surveys as necessary to determine the nature of traffic and the present volume of goods, animal and pedestrian movements (motorized as well as non-motorized traffic) within the influence area. Traffic data should be co-related to the influenced population (or economically active population) and production (surplus or deficit in agriculture/industry etc.)

Threshold traffic value for construction and upgrading of the road, for the reduction of total transport cost, judgment should be applied considering all possible method like stage construction (according to appendix III of design standard of feeder road)

In broad terms, the consultant should also identify, describe and quantify existing and probable future traffic generating sources, based on the probable future development of the influence area on relevant factors, such as;

- Population growth and changes in population distribution.
- Regional economic growth.
- Development of agriculture, forestry, mineral and other resources.
- Anticipated domestic trade in agriculture and non-agriculture commodities. A second traffic forecast should be made assuming that an appropriate accelerated development program within the zone of influence is undertaken by the Government.

#### 2.7 Studies on availability of construction materials and access road

- Rock, Boulders for use as road aggregates for road and other structures
- Sand
- Gravel

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- (a) Possible impact on Ecology, Environment and Geo-system in the vicinity of the alignment due to construction of the proposed road.
- (b) Disturbance to the geo-system and possibility for triggering the landslide and other instabilities.
- (c) Deforestation.
- (d) Grazing, farming and possible encroachments.
- (e) Any other social and environmental factors which affect the quality of life in the influence area.
- (f) Positive & negative impact on the area due to the project.
- (g) Identify and recommend mitigation methods to be incorporated in detailed design stage.

- (a) People's Participation
- (b) Labor intensive method
- (c) Capital intensive method
- (d) Appropriate technology of construction

### 2.10.1 Legal Aspect of Land Acquisition

### 2.10.3 Displacement and Rehabilitation of People

#### 2.10.4 Compensation etc.

### 3.1 Construction

Each alternative alignment should be included in the cost estimate. If necessary the cost of a feeder road system which will be necessary to connect existing population concentrations and develop the economic potential of the region, preliminary cost estimate may be based on typical construction cost of road, highway and bridge etc. recently constructed by the Department of Roads but should take into account recent increases in the cost of construction, materials and labor prevalent in the districts. Cost estimate for stage construction should be considered possibility starting with a low cost solution with initially a dry season road. Estimate of the local and foreign cost components, if applicable should also be made.

The cost of maintenance of road for design period should also be considered. The Consultant shall have to analyze and suggest the sources of income and the possibilities in which funds for the maintenance could be mobilized viz.: from local levels, toll taxes, vehicle registration fees or fines and transport equipment and spare parts taxes or through Road Board.

Cost of vehicle operating cost, accident cost etc. shall be included in existing & proposed conditions. Vehicle operating cost of the proposed road shall be mentioned in terms of roughness verses required pavement cost, which is dominating cost of vehicle operation.

Comparison has to be made between different alignments taking into consideration of construction, maintenance, road user costs and other costs into consideration. While recommending the most feasible alignment in terms of construction cost, comparison has to be made with the operating cost as well as to determine the period during which the extra construction cost will be compensated. The

feasible alignment  
as well as to determine



ranking of alternatives should be as recommendations given in manual of mountain risk engineering (MRE).



#### 4. ECONOMIC ANALYSIS

4.1 Economic projections within the zone of influence of the various alternatives should be made assuming at least three basic settings:

- The proposed road project is not undertaken and that existing trends continue and that the proposed Government of Nepal's Development plans are carried out;
- The proposed road project is undertaken and that existing trends continue and Government of Nepal's plans are carried out;
- the proposed road project is undertaken and that appropriate accelerated development programmed, particularly for agriculture and forestry, setting of new industries, converting City into Metro City and establishment of dry port are undertaken in case of urban roads.

4.2 The economic analysis for the three setting of alternative alignments and phasing of recommended construction program shall include the following:

- Estimated future transport cost saving including vehicular and porters and pack animals, where appropriate;
- Estimates of other economic benefits, such as increase in the net value of agriculture and forestry production, the future trends in road maintenance, time saving, reduction in road accidents and other developments and social benefits such as industrial expansion, improvement in existing facilities with regard to communication, recreation and education. The Consultant should broadly identify constraints, and where possible, quantify resources required other than the road investment;
- A comparison of the expected cost of construction and maintenance with the benefits estimate in (a) and (b) indicating a benefit-cost ratio;
- Evaluation of the sensitivity of the rates of return to possible variations in the main factors used in the economic evaluation;
- On the basis of the study of alternative solutions, the Consultant shall recommend the optimum economic program for the construction of proposed roads.
- Above all, the consultant should clearly specify whether the proposed road project should be undertaken by DoR (i.e. the road is a part of highway or a feeder road) or by the local agencies i.e. the proposed road is district level or local road.**

#### 5. CONSULTANT'S REPORTING OBLIGATIONS

5.1 The whole work should be completed within time frame as mentioned below:

S. No.	Particulars	Time required	
		up to 50 KM	> 50 KM
1	Desk study	1.5 weeks	2 weeks
2	Field works	2 weeks	3.5 weeks
3	Draft report preparation	2.5 weeks	3.0 weeks
4	Final report submission	1 week	1.5 weeks
	Total time from the date of signing the agreement	7 weeks	10 weeks

Note: Length of alignment in above table is the estimated length derived from map study.

Provide work schedule in the form of a bar chart as follows:

S. No.	Particulars	Total weeks	Weekly activity												
			1	2	3	4	5	6	7	8	9	10	11	12	13
1	Desk study														
2	Desk study report														

*(Signature)*

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- (5) Tourism Potential
- 2.2.5 Health
- 2.2.6 Education
- 2.2.7 Transport and Communication Network
- 2.2.8 Administrative Facilities
- 2.3 Geology
- 2.3.1 Geomorphology
- 2.3.2 Local Geology
- 2.3.3 Hydrology and Meteorology
- 2.3.4 Hydraulics
- 2.3.5 Hazard/Risk assessment of the alternatives
- 2.4 Protection Measures
- 2.4.1 Slope Protection
- 2.4.2 Erosion Control
- 2.4.3 Soil Conservation Measures
- 2.4.4 River Training Works
- 2.5 Traffic Data
- 2.5.1 Existing roads/tracks/bridges (foot bridge also), traffic count & its reliability for analysis.
- 2.5.2 Adjustment of traffic data in comparison of given influence population & surplus of the production.
- 2.5.3 Passenger car unit & traffic forecast
- 2.6 Materials Availability Data
- 2.7 Environmental Data
- 2.8 People's participation in Road Construction
- 2.9 Property Acquisition
- 2.10 Engineering Study
- 2.10.1 Category of road & norms of road/geometric characteristic of road
- 2.10.2 Fixing of control points, crow fly length, theoretical/practical length of alternatives
- 2.10.3 Alignment study during the desk study
- 2.10.4 Adjustment of alternatives after field study (giving the field data)
- 2.10.5 Engineering comparison of the alternatives
- 2.10.6 Structures/pavements of the road
- 3. ECONOMIC ANALYSIS
- 3.1 Construction cost
- 3.2 Maintenance cost
- 3.3 Road user costs (accident cost & VOC)
- 3.4 Net and gross costs
- 3.5 Benefit analysis
- 3.6 Cost-benefit Ratio
- 3.7 Economic internal rate of return
- 4. CONCLUSIONS
- 4.1 Methodology & factors affecting the ranking of the alternatives.
- 4.2 Ranking of alternatives
- 4.3 Discussions
- 4.4 Conclusion
- 4.4.1 General conclusions
- 4.4.2 Specific conclusions
- 4.4.3 Recommended alignment
- 4.4.4 Feasibility for DoR undertaking
- 4.5 Final recommendations

## REFERENCES

ANNEX: Team details / used equipment / software /spread sheets (if any)

## Information to be included in the SALIENT FEATURES:

- A. Name of project:
- B. Location:
- B.1 Geographic Location (name of the district & chainage of the recommended alignment)

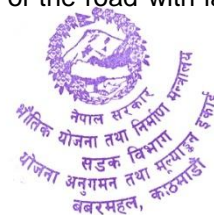


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- B.2 Starting point & end point of the alignment (obligatory points of the road with latitude /longitude and name of place)
- B.3 Geographical feature
- B.4 Terrain
- B.5 Climate
- B.6 Geology
- B.7 Hydrology
- B.8 Meteorology



C. CLASSIFICATION OF ROAD

- C.1 Classification
- C.2 Surface
- C.3 Suggested longitudinal grade

D. CONNECTION WITH ROAD NETWORK

E. ALIGNMENT DETAILS

E.1 Previously surveyed alignment

Consultant's Name & Date	Alignment -1		Alignment -2		Alignment -3	
	Route	Length (km)	Route	Length (km)	Route	Length (km)
Name of district						
Chainage (from - to)						

E.2 Present survey  
(giving the recommended alignments)

Consultant's Name & Date	Alignment -1		Alignment -2		Alignment -3	
	Route	Length (km)	Route	Length (km)	Route	Length (km)
Name of district						
Chainage (from - to)						

F. STRUCTURES

(giving the recommended alignment)

S No	Structures	Alignment -1	Alignment -2	Alignment -3
F.1	Culverts			
F.1.1	Slab Culverts			
F.1.1.1	Span			
F.1.1.2	Number			
F.1.2	Pipe Culverts			
F.1.2.1	Diameter			
F.1.2.2	Number			
F.1.3	Drifts			
F.1.3.1	Type			
F.1.3.2	Number			
F.2	Bridges			
F.2.1	Minor Bridges			
F.2.1.1	Span			
F.2.1.2	Number			
F.2.2	Medium Bridges			
F.2.2.1	Span			
F.2.2.2	Number			
F.2.3	Major Bridges			
F.2.3.1	Span			
F.2.3.2	Number			
F.3	Retaining Structures			
F.3.1	Gabion Wall			
F.3.1.1	Height Range			
F.3.1.2	Thickness Range			
F.3.1.3	Length			
F.3.2	Stone Masonry			

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F.3.2.1	Height Range		
F.3.2.2	Thickness Range		
F.3.2.3	Length		

## G. CROSS-SECTION

- (1) Right of way
- (2) Formation width
- (3) Carriage way width
- (4) Shoulder width
- (5) Side drain (top width)

## H. PAVEMENT

## H.1 Sub-base:

- (1) Materials
- (2) Thickness

## H.2 Base

- (1) Materials
- (2) Thickness

## H.3 Surface :

- (1) Type
- (2) Thickness

## H.4 Sealing :

- (1) Type
- (2) Thickness

## I. TOTAL TRANSPORT COST

(state the recommended alignment)

S No	Particulars	Alignment-1	Alignment-2	Alignment-3
I.1	Study & research cost			
I.2	Property acquisition cost			
I.3	Construction cost			
I.3.1	Earthwork			
I.3.1.1	Cutting			
I.3.1.3	Filling			
I.3.2	Pavement			
I.3.2.1	Sub-base			
I.3.2.2	Base			
I.3.2.3	Surface			
I.3.3	Structures			
I.3.3.1	Culverts			
I.3.3.2	Bridges			
I.3.3.3	Retaining structures			
I.3.3.4	Side drains			
I.3.4	Other work (site clearance /road safety, etc.)			
I.4	Maintenance cost			
I.5	Road user cost			
I.5.1	Accident cost			
I.5.2	Vehicle operating cost			
Total NRS				

## J. ECONOMIC ANALYSIS

(state the recommended alignment)

S No	Particulars	Alignment -1	Alignment -2	Alignment -3
J.1	Net Cost			
J.1.1	Total			
J.1.2	Rate per Km			
J.2	Gross Cost			
J.2.1	Total			
J.2.2	Rate per Km			

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J.3	Benefit		
J.4	Cost-benefit ratio		
J.5	Internal rate of return		

## K. RECOMMENDED ALIGNMENT

K.1 Alignment Number

K.2 Reasons

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