DETAILED SURVEY, DESIGN AND COST ESTIMATION OF DISTRICT ROAD FROM BHUMESWOR MAHADEV MANDIR TO MICROSTAND (near *nec*)

Submitted by

Hari Lal Chaudhary (017-072)

Jagat Bista (017-051)

Jeeban Bomjan (017-071)

Prabesh Ojha (017-069)

Pratik Tiwari (017-070)

A Project report submitted in partial fulfillment of the

Requirements of Pokhara University for the Degree of Bachelor of Civil Engineering

Advisor

Asst. Prof. Binaya Shakya

DEPARTMENT OF CIVIL ENGINEERING

NEPAL ENGINEERING COLLEGE

(Affiliated to Pokhara University)

CHANGUNARAYAN, BHAKTAPUR, NEPAL

September, 2022

CERTIFICATE

This is to certify that the project entitled **"DETAILED SURVEY, DESIGN AND COST ESTIMATION OF DISTRICT ROAD FROM BHUMESWOR MAHADEV MANDIR TO MICROSTAND (near *nec*)"** submitted by (*Hari Lal Chaudhary (017-072), Jagat Bista (017-051), Jeeban Bomjan (017-071), Prabesh Ojha (017-069), Pratik Tiwari (017-070)*) have been examined by us and is accepted for the award of the degree of the **Bachelor of Civil Engineering by Pokhara University**.

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Er. Sagar Gautam
(External Examiner)

_____

Asst. Prof. Binaya Shakya
Department of Civil Engineering
(Advisor)

_____

Assoc Prof. Ajay Khadka
Head of Department of Civil Engineering
Nepal Engineering College
Changunarayan, Bhaktapur

ACKNOWLEDGEMENT

The following report entitled as **"Detailed survey, design and cost estimation of district road from Bhumeswor Mahadev mandir to microstand (near *nec*)"** has been prepared as part of project course of Civil Engineering.

First of all, we would like to thank Civil Department of **Nepal Engineering College, Changunarayan, Bhaktapur** for organizing the project on detailed engineering analysis of use of plastic waste in road construction. We would like to express our deep sense of gratitude to our respected teacher and project advisor **Asst. Prof. Binaya Shakya** for being connected with us instructing and guiding in co-operating the theoretical and the practical aspects making the project successful. His presence around the clock enthusiasm to help and guide us was remarkable.

Further we would like to thank **Asst. Prof. Ajay Khadka** (Head of Civil Engineering Department) for providing us necessary equipment during out project.

Hari Lal Chaudhary (017-072)

Jagat Bista (017-051)

Jeeban Bomjan (017-071)

Prabesh Ojha (017-069)

Pratik Tiwari (017-070)

ABSTRACT

The Detailed, survey, design and cost estimation of district road from Bhumeswor Mahadev mandir to microstand (near *nec*) was carried out for the project work. This proposed road was studied with various aspects such as technical, social, environmental and economical aspects and the technical standards and the guidelines of NRRS 2071 are followed for the road selection, feasibility study, detail survey, geometric design, drawing and pavement design of the road using plastic wastes.

Everyone is aware of the fact that humans are the most innovative creature. Their creativity and greed of getting more and more have helped them achieve the standard of life which they are living with. Development of the society they are living in is significantly dependent upon the word “Transportation”. Good transportation facilities itself plays the vital role for the overall development of the nation by raising the economic status of the people and development of a civilized society. The proposed road is 1.9080 km in length.

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SALIENT FEATURES OF THE PROJECT

1. **Name of the project:**

   Detailed survey, design and cost estimation of district road from Bhumeswor Mahadev mandir to microstand (near *nec*) Changunarayan, Bhaktapur

2. Project location:

2.1. Geographic location:

- **a. Province** : Bagmati Province
- **b. District** : Bhaktapur
- **c. Municipality** : Changunarayan Rural Municipality

2.2. Geographical Features:

- **a. Climate** : Subtropical
- **b. Soil Type** : Ordinary soil
- **c. Hydrology** : Precipitation controlled by monsoon
- **d. Meteorology** : Unevenly distributed precipitation controlled by monsoon
- **e. Terrain** : Hill

2.3. Classification:

- **a. Classification** : District Road

3. Length of road:

- **a. Length** : 1+908 km
- **b. Starting Point** : 0+000 Bhumeswor Mahadev Mandir
- **c. Ending Point** : 1+908 Microstand (near *nec*)

4. Geometrics:

- **a. Right of way** : 10 m either side of the road (20 meter)
- **b. Drain** : Trapezoidal drain as per site condition
- **c. Carriage way width:** 3.75 m
- **d. Design speed** : 25 kmph
- **e. Shoulder width** : 0.75 m
- **f. Super elevation** : Maximum 10%

g. Camber : 2.5%

h. Gradient : 0.5(minimum) to 12(maximum)

i. Radius : Minimum 22 m

j. Stopping Sight Distance: 48 m

5. Earthwork:

a. Earth work in Cutting : 3635.905 m^3

b. Earthwork in Filling **:**3927.485 m^3

6.Project Cost:

a. Total Cost : NRs 526,24,312.02

b. Cost per Km : NRs 275,74,372.93

ABBREVIATIONS USED

B	Breadth
BM	Bench Mark
BMS	Boulder Mixed Soil
CBR	California Bearing Ratio
CH	Chainage
CL	Centre Line
Cum	Cubic meter
Cvpd	Commercial Vehicles per day
DoLIDAR	Department of Local Infrastructure and Development of
DoR	Department of Road
H	Height
IP	Intersection Point
IRC	Indian Road Congress
Kmph	Kilometer per hour
L	Length
L-Section	Longitudinal Section
NRRS	Nepal Rural Road Standard
OSD	Overtaking Sight Distance
PCE	Passenger Car Equivalent
PCU	Passenger Car Unit
RL	Reduced Level
RoW	Right of Way
Sqm.	Square meter
SSD	Stopping Sight Distance
TBM	Temporary Bench Mark
VAT	Value Added Tax
X-Section	Cross-section
VDC	Village Development Committee
SRN	Strategic Road Network

CHAPTER 1
INTRODUCTION

1.1 Background of Nepal

Nepal is a landlocked country with mountainous regions and lies between India and China. Due to the rugged topography, the various means of transportation in our country such as railways, waterways, ropeways and airways are less suitable. The country lacks adequate transportation facilities and thus road transportation is best suited for the rural connectivity as well as overall development of most of the area in Nepal. While transport facilities do not create development, they are essential for development to start. The overarching goal of road development is to reduce the pervasive poverty. In a country like Nepal, where most of the population is living in rural area, road transportation plays a vital role. Market access of the agricultural products from rural areas, in time supply of medicine and daily required commodities, improvement of employment opportunities etc. are advantages of efficient transportation facilities. The poor condition of the road network affects the country's economic development. Therefore, it is crucial to maintain the rural road network, sustain its quality to contribute to development in major economic sectors, to ensure better living condition for the majority of national population.

In 2069 there were 6,683 rural roads with total length of 5,0943.647 km out of which 1,575.434 Km had been blacktopped, 14,601.921 Km had been graveled, 3,4766.293 had been earthen. The density of the road was 34.61 Km/sq.Km. The population influenced with the stated road connectivity was 1.91Km/1000 persons. (DoLI, 2069)

The History of Road development in Nepal is not very long. The Government of Nepal (GoN) has been giving high priority to the development of roads since the beginning of planned development programmed in 1956. With continued effort, the road length of the country which was only 376 Km in the 1950's is currently above 24,000 Km including District and Urban Roads. The length of road is also an indicator of development, industrialization and economic prosperity of a country. Over the last two decades, therefore, increasing emphasis is being accorded to the development of rural roads in the country. The local authorities, the DDCs in particular, are becoming more and more responsible for planning, development and management of rural roads. NGOs, INGOs and donor agencies are increasingly collaborating with the DDCs. From the government side DoLIDAR coordinates, facilitates, regulates and monitors the rural road development activities in the country simultaneously providing technical assistance to the DDCs.

1.2 The Project Background

The proposed road from Bhumeswor mandir to microstand (near *nec*), Changunarayan Bhaktapur was taken as project for the detail study and design. There is already existing earthen road for more than 70% of the total chainage and a small foot track in the remaining part, it needs greater improvement. This road is just about enough for medium sized vehicles. The Geometric design as well as gradient of the existing road is improper and much of the portion is not serviceable during heavy monsoon due to the presence of numerous cross flowing streams. Thus, construction of road with proper gradient and Geometric design has been found quite essential. Also paving of the road is also necessary because of the presence of numerous inhabitants and high flow of traffic. For the design of the proposed road project, Nepal Rural Road Standard (NRRS 2071 2nd revision 2071) has been used.

1.3 Study Area

1.3.1 Project Location

The project area is located in Changunarayan VDC which is situated to the North – West direction from Bhaktapur city. The proposed road connects Duwakot and Mulpani, Bhaktapur. The alignment runs through the Changunarayan based community.

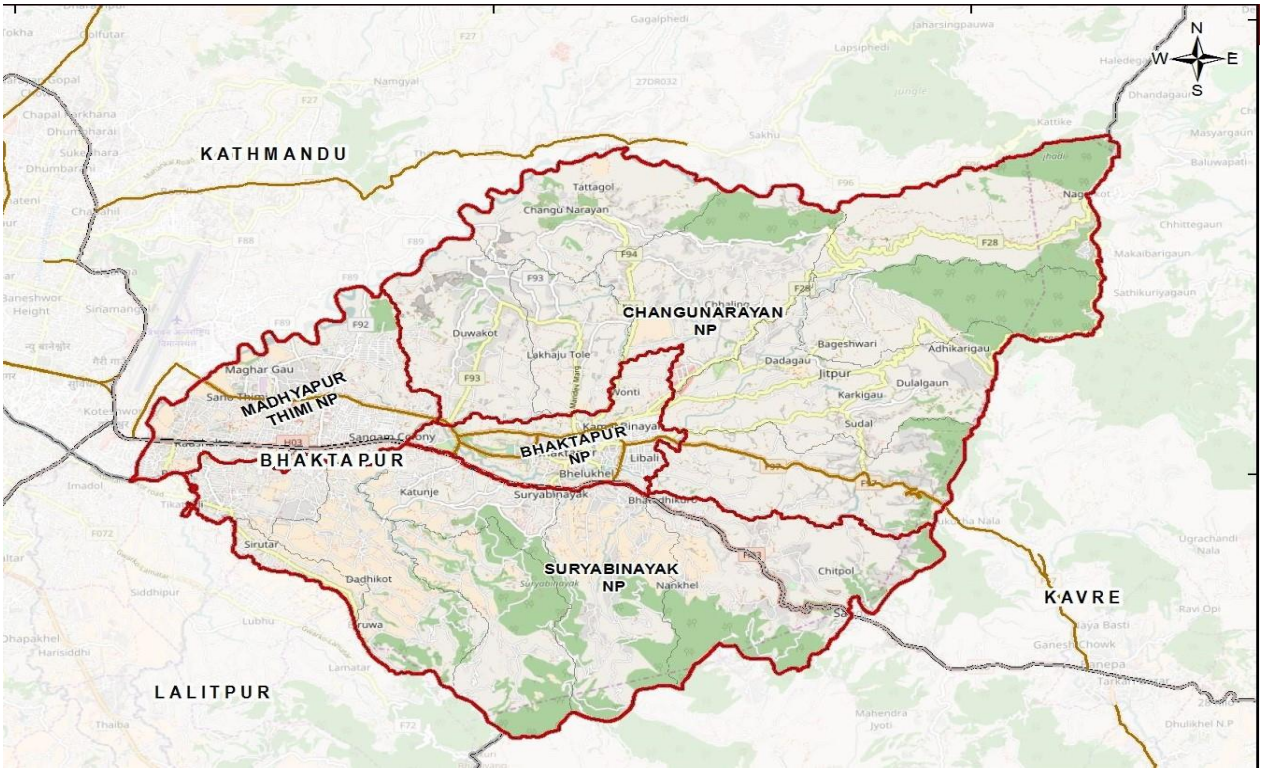


Figure 1: Map of Bhaktapur District

(Source: Google Map)

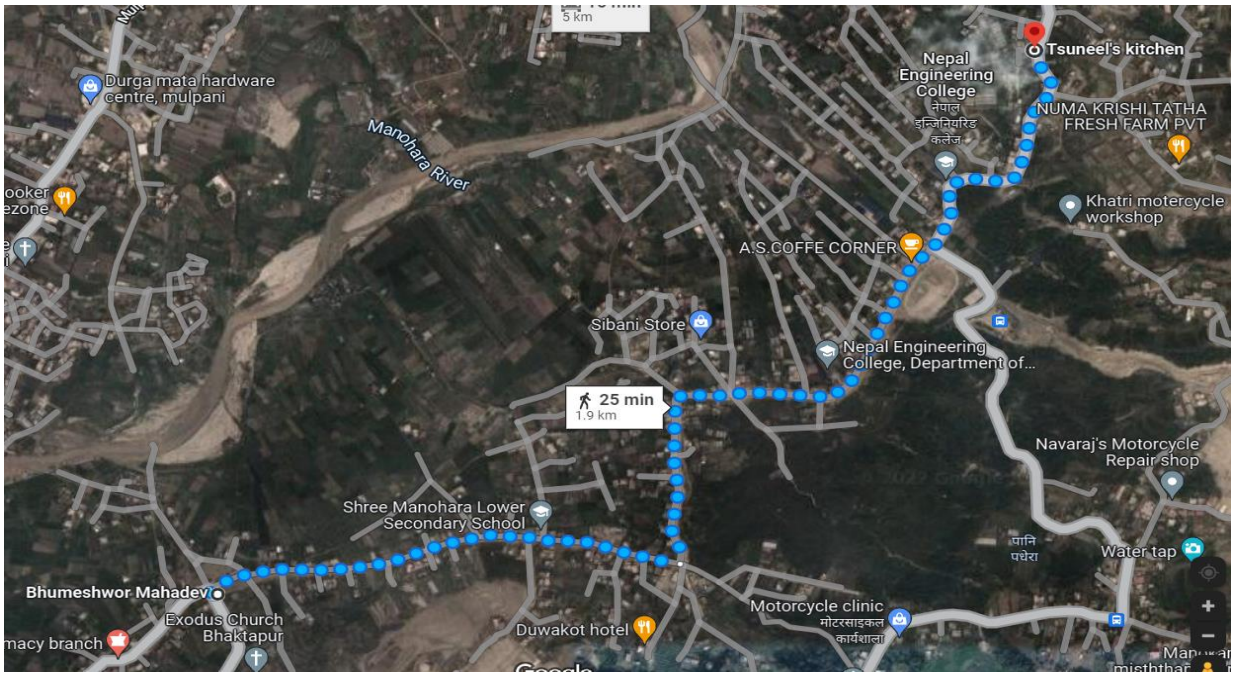


Figure 2: Road Alignment

(Source: Google Map)

1.3.2 Climate and Hydrology

The temperature of Changunarayan VDC is moderate. During summer, the maximum temperature ranges from 20 ^{o}C to 32 ^{o}C and during winter the minimum temperature ranges from 0^{o}C to 2^{o}C.

1.3.3 Physical Infrastructure and Economy

Major income source of people in this area is agricultural products which are mushroom, cabbage, potato, tomato, maize etc. The area has gained importance for commercial vegetable cultivation in recent times. People are also involved in government and private services. There is absence of industrial infrastructures however educational institutions are present.

1.4 Statement of Problem

From the study of project area, the problems faced by the society can be listed as below

- Lack of transportation facilities to the rural people.
- Difficulties for export of crash crop and rural product to the market.
- Problem for higher education and health treatment due to lack of motor access.

1.5 Objective

The general objective of this project is to contribute for the development of Changunarayan VDC by connecting road network. The specific objective of project is:

- To carry out detail survey, design and cost-estimate of paved road from Bhumeswor Mahadev Mandir to microstand (near *nec*), Changunarayan Bhaktapur.

1.6 Significance of Study

The proposed road alignment has a total length of 1.850 Km. The project site can be accessed from Duwakot. Due to the present landscape of the area, it is required to have several earth retaining structures, pipe culverts, causeways etc. to maintain the standard road geometry as given by the Nepal Rural Road Standard (NRRS) 2071.The construction of this proposed road help to increase volume of trade and business at the proposed site by market access of the agricultural products and also supply of needed agricultural inputs. Simultaneously, increase in economical standard due to improvement in employment opportunities will create positive impact on the society.

The various significance of this project is:

- Road linking from Bhumeswor Mahadev Mandir to microstand (near *nec*) Changunarayan Bhaktapur with motor-able service.
- Explore the opportunities for tourism enhancement in the area.
- Enhance the use of locally available resources in terms of labor, materials, finance and improve access to services, market and trading centers.
- Generate direct and indirect employment opportunities in order to uplift the living standard of people.

1.7 Scope of the Work

The following are taken in the scope of work of proposed road project.

- Prepare the topographical map of the road corridor
- Detailed engineering survey of the alignment and its corridor
- Conduct hydrological studies for cross – drainage works and purpose the suitable cross drainage structures
- Choose economically feasible pavement type within the study corridor
- List the trees, house and other structures to be destroyed during the construction within road alignment
- Preparation of working drawings
- Prepare quantity and cost estimates
- Explore and recommend sources of basic construction materials.

1.8 Geology

Geology deals with the study of earth. Geomorphology is one of the branches of geology which deals with the characteristics of land and earth's surface phenomenon. The engineering geological study covers areas such as,

- Drainage flow and study
- Minor land slide areas
- Debris/mudflow sites
- Areas with high cuts and fill

CHAPTER 2
LITERATURE REVIEW

2.1 Importance of Road in Rural Development

A country cannot progress unless it has a good road network. It improves market intelligence while encouraging price equalization among different transport regions of the country. Since Nepal's economy is agrarian in character and the settlement pattern is rural oriented, rural roads constitute a critical element of the transport infrastructure. Road sector plays an important role in socio-economic development and regional integration in Nepal. The rural roads are essential to connect the rural areas with the cities or market centers. People in the rural areas need to travel long distances on a daily basis to access goods and services for domestic requirements and livelihoods. Thus, the absence of a proper means of transporting produces hindrance to district trades and economic development. The economic development is only possible when the rural economy gets developed. This is only possible when the rural people are able to access the daily requirements at cheaper cost and on timely basis. The specific importance of rural road is:

i. **National Integration:**
   Better roads contribute to the reduction of regional differences and to the building of national unity through integration, resulting from enhanced transport services.
ii. **Economic Growth:**
   Better road connectivity stimulates economic growth by reducing transportation costs and providing access to markets, thus facilitating agricultural growth by ensuring reliable delivery of inputs and timely marketing of production at reasonable cost.
iii. **Strategic Asset:**
   Better roads bolster Nepal's strategic geographical position as an essential transit corridor for its landlocked neighbors, facilitating their access to international markets.
iv. **Poverty Reduction and Social Development:**
   Roads provide access to VDC office, administrative and social support services, employment opportunities, schools, health care facilities and other social services.

2.2 Road classification

According to Nepal rural road standard -2071(2nd Revision) roads in our country are classified as follows:

District Road (Core Network) – An important road joining a VDC, HQ's office or nearest economic center to the district headquarter, via through either a neighboring district headquarter or Strategic Road Network.

District Road- Smaller roads not falling under District Road (Core Network) category are District Roads, including other Agriculture Road.

2.2.1 Road Standards

In context of Nepal, road is designed according to following standard:

i) Nepal Road Standards

Nepal Road Standard was introduced in 2027 B.S. (2nd Revised 2070 BS). It is used to design Strategic Road Network (SRN). National Highways and Feeder Roads come under SRN. It is followed by Department of Road.

ii) Nepal Rural Road Standards

The Nepal Rural Road Standards were introduced in 2055 B.S. and revised (second) in 2071 BS. It is used to design local level of Road Network. It is usually followed by user communities, DoLIDAR and its development partners. Since, the survey road falls under rural hill road, Nepal Rural Road Standard is used for literature purpose.

2.3 Hill Road

A hill road is one which passes through a terrain with a cross slope of 25% or more. A hilly or mountainous area is characterized by highly broken relief with widely differing elevations, steep slopes, deep gorges and great number of water courses. The geometric design of the highway deals with the dimensions and layout of visible features of the highway such as alignment, sight distance and intersections. The geometric of highway should be designed to provide optimum efficiency on traffic operations with reasonable cost. Selection of a suitable alignment in hilly region is a complex job when the valley pattern takes a radial form and where the valley converges into a knot of mountains due to the meeting of several mountains. A thorough knowledge of the geological formation of the area is essential to decide the road alignment as the process of road construction in mountains disturbs the natural stability conditions. Prevention of soil erosion and stabilization of hill slope has been major problem in the maintenance of hill road.

2.4 Design Consideration of Rural Road

2.4.1 Design Considerations

The design consideration of roads is based on many factors including design speed, functional classification, vehicular volume, types of vehicles, existing terrain and natural features, community impacts, environmental effects, cost considerations and the right of way needed for road development. Road design is accomplished with the consideration of following design criteria and guidelines:

i. **Design Capacity**: Design capacity shall provide the basis for determining the class of the rural road. For example, a road classified as 'B' on the basis of connectivity might be changed into a class 'A' road, if the volume of traffic is found to be higher.

ii. **Design Speed**: When the design speed is higher, the design standards should be of higher order which ensures the road safety, capacity, and comfort and decreases the user's operational expenditure but the choice of design speed is influenced by the class of road, traffic volume, available budget and the terrain.

iii. **Terrain**: The terrain through which the rural transport linkage passes directly influences the selection of geometric standards such as formation width, carriageway width, right of way, free board, radius of horizontal curves, gradient and intervals of passing zones.

iv. **Environment:** The factors such as aesthetics, landscaping, air pollution, noise pollution and other local conditions should be given due consideration in the design on road geometrics.

2.4.2 Socio-economic and Technical Consideration in Rural Roads

Improvement of "FWR-Fair Weather Road" to "AWR-All Weather Road" generally requires to be justified on socio-economic grounds. For this actually served population /households per kilometer must not be less than the threshold criteria. For AWRs proposed to be blacktopped (or bituminous seal coated) there must exist minimum of 50 vehicles per day as Annual Average Daily Traffic. Sustainability of rural roads may be assured only when local authorities take full responsibility of their development and maintenance. While designing different components of road, the design should be simple and low cost rather than complicated and costly design. More over the design should be based on availability of local materials and investment should remain within the reach of the local economy.

2.4.3 Environmental and Social Consideration in Rural Roads

I. Environmental Considerations

The basic intention of environmental consideration is to develop the best possible rural road in the given environmental settings by the use of environmentally sound and appropriate approaches, methods, standards and techniques maintaining environmental quality. Main environmental factors that need to be considered are forest and protected areas, landslides and erosion prone areas, flood and drainage problems, sites of historic, cultural, religious or archaeological significance, population centers and valued environmental features like wet land, lakes, drinking water source need to be protected while planning and developing the road network.

II. Social Considerations

The social consideration in road development is associated with promoting broader social development benefits and to discourage any social harms and dis-benefits from the road. Emphasized care should be given for not harming the poor, landless and vulnerable groups. Compensation should be provided for the loss of livelihood assets and employment opportunities.

2.5 Highway Alignment

The highway alignment may be defined as the position occupied by the center line of the road on the ground. The horizontal alignment includes the straight path, the horizontal deviations and curves. Changes in gradient and vertical curves are covered under vertical alignments of road. To determine the precise position of the layout of the road centerline from the design and drawing on ground during construction, it is essential to determine three coordinates of all points of the center line. Thus, highway alignment is located on the ground with the help of its two components. A new road should be aligned very carefully, as improper alignment will result in one or more of the following disadvantages:

1. Increase in construction cost
2. Increase in vehicle operation cost
3. Increase in maintenance cost
4. Increase in accident rates
5. When Road is constructed, it will be uneconomical to redesign and to realign the existing road and hence the road should be aligned carefully as far as possible.

2.5.1 Basic requirements of highway alignment

Short: It is desirable to have a shortest alignment between two terminal stations. Its shortest path due to obligatory points, such as gradient, mountain pass, structures, ditches, intermediate towns etc. So, obligatory points describe points through which the alignment should pass and should not pass.

Easy: The alignment should be such that it is easy to construct and maintain easy with minimum problems. In addition, the alignment should pass and should not pass.

Safe: The alignment should be safe enough for construction and maintenance from the viewpoint of stability of natural hill slopes, embankment and cut slopes and foundation of embankments. It should be safe for the traffic operation with safe geometric features.

Economical: If the total cost including initial cost, maintenance cost and vehicle operation cost is low the road alignment could be considered economical. The alignment should be such that it would offer maximum utility by serving maximum population and products is considered in selecting the alignment.

2.5.2 Factors Controlling Highway Alignment

While designing road alignment, the distance between two terminals should be straight and short as far as possible. However, it is not possible due to various reasons such as due to the physical and geometric conditions of the site. Similarly, there may be construction and maintenance problems along a route, which may otherwise be short and easy. A road, which is economical in the initial construction cost, need not necessarily be the most economical in the maintenance or in cost of vehicle operation. The various factors which control the highway alignment are listed as:

1) Obligatory points
2) Traffic
3) Geometric design
4) Economics
5) Other considerations

1) Obligatory points

a. Points through which the alignment should pass
b. Bridge site
c. Industrial area

d. Hill pass
e. Intermediate town
f. Points through which the alignment should not pass
g. Waterlogged area
h. Historical or archeological site
i. Restricted zone for defense / national security
j. Densely populated area
k. Very costly structures

2) Traffic

a. The alignment should suit traffic requirements. Origin and destination study should be carried out in the Area.

3) Geometric design

a. The geometric design of a highway deals with the dimensions and layout of visible features of the Highway such as such as gradients, radius of curve, sight distance, and super elevation etc. While aligning a new road, the gradient should be flat and less than design gradient.

4) Economy

a. The alignment should also be economical.

5) Others

- Various other factors such as drainage, hydrological factors, political considerations, monotony, Subsurface Water level, seepage flow and high flood level are to be keeping in view.
- Alignment along a hill side pass
- Connecting intermediate town
- Alignment avoiding an intermediate area
- Alignment to suit proper location of bridge
- For Hill Road special consideration needs, be given to such concerns as:

  Stability

  Drainage

  Geometric standards of hill roads

  Composition of traffic

2.6 Engineering Survey and its Stages

The engineering surveys are to be carried out before a Road alignment is finalized in Road project. The Surveys are completed in four stages, first three stages consider all possible alternate alignments keeping in view of the various requirement of road alignment. The fourth stage is meant for the detailed survey of the selected alignment.

The four stages of the engineering surveys are:

i. Map Study

By analyzing the topographical map of the area, we first extract several alternative routes of the road, so that further details of these may be studied later at the site. Usually, the topographical map of scale of 1:25000 provided by Department of Survey, Government of Nepal (GoN) is preferred in highway planning but for small stretch, such large-scale maps are not preferable.

ii. Reconnaissance

It is the second stage of surveying deciding the road location. The field survey parties inclusive of an advisor inspect a broad stretch of land along the proposed alternative routes of map in the field. All relevant details not available in the map were collected and noted down. Some of the details collected during reconnaissance are mentioned as follows:

- Ponds, marshy land, ridge, hills, permanent structures and other obstruction along the route, which are not available in the map study.
- Number and types of cross drainage structures, maximum flood level and natural ground water level along the probable routes.
- Soil type along the routes from field identification tests and observation of geological features.
- Sources of construction materials, water and location of stone quarries.

iii. Preliminary Survey

During Preliminary survey following tasks are performed:

- The Survey of the various alternate alignments proposed after the reconnaissance and to collect all necessary details of topography, drainage and soil.
- Comparison of different proposals in view of the requirements of a good alignment.
- Selected the best alignment from all considerations.

iv. Final Location and Detailed Survey

The alignment finalized after the preliminary surveys is first located on the field by establishing the centerline. Next detailed survey is carried out collecting the data necessary for the preparation of plans and construction details for the road Project. The key terms used in the course of detailed survey are as stated hereunder:

a) Plan

It is top view of project in a map. It consists of

i. Northing

ii. Location of IPs and BMs with reference

iii. The road centerline, formation width, side drain and right of way

b) Benchmark

It is a permanent point of reference whose elevations w.r.t some assumed datum is known.

c) Leveling

The objective of leveling is to find the elevations of given points w.r.t a given elevations or at a different elevations w.r.t a given or assumed datum. Leveling deals with measurements in a vertical plane. For the purpose of road construction, the profile leveling is carried out to determine the R.L of the centerline located with driven pegs. The leveling determines the alignment of the road. The leveling is taken at suitable intervals according to the site.

d) Composition of Traffic

The alignment of road passing from the shortest route is deviated due to the volume and composition of traffic. For road with intensive heavy vehicles and high volume of traffic alignment yielding minimum length of steep ascend/descend is much desirable than the shortest route distance.

Similarly, a road leading to a recreation spot, or tourist spot that might have predominant by light passenger car and a few buses, alignment may be chosen with higher slope. In addition, the origin and destination study should be carried out in the area and the desire lines be drawn showing the trend of traffic flow. The alignment should be chosen based on origin and destination study, traffic desire lines, flow pattern, future trends etc.

e) Geometric Features

Geometric design factors such as permissible limit of descending or ascending slopes, sight distance requirements, degree of curvature and bends, slope of camber, super elevation, and width of the road, extra widening and many other dimensional features of the road may also govern the final alignment of the road.

f) Economy

The appropriate alignment should also be economical. The economic analysis is done taking into account all the possible costs which includes construction cost, maintenance cost, vehicle operation cost, accident cost, travel time cost etc. The analysis should also include cost of environmental and social mitigation measures, land acquisition for construction and development of road. For road alignment to be economical, the sum of all road components should be as less as possible. The initial construction cost seems to be more initially but in reality, the vehicle operation cost and road user travel time cost is more. However, due to budget constraint sometimes – initial construction cost might be the governing factor and alignment selected accordingly even if the road yields highest maintenance cost and vehicle operation cost. The Initial cost of construction can be decreased if high embankments and deep cuttings are avoided and the alignment is chosen in a manner to balance the cutting and filling.

2.7 Geometric Design of Road

Geometric design of road deals with the dimensions and layout of visible features of road such as alignment, cross slope or camber, gradient, sight distance considerations, horizontal and vertical alignment details, intersection elements, width, turning radius, carriage way, kerb and road margins. The geometry of the road should be designed to provide optimum efficiency in traffic operations with maximum safety at reasonable cost and also should be consistent with its economy. Therefore, it is important to plan and design the geometric features of the road during the initial alignment itself taking into consideration the future growth of the traffic flow as well as the possibility of the road being upgraded to a higher category or to a higher design speed standard at a later stage.

2.7.1 Elements of Geometric Design

Geometric design of Road deals with following elements:

- Cross section elements
- Sight distance considerations
- Horizontal alignment details
- Vertical alignments details
- Intersection elements

2.7.2 Highway Cross-Section Elements

Cross-sections are run along transverse direction to the longitudinal profile and on other side for the purpose of lateral outline of the ground surface. They provide the data for estimating quantities of earthwork and for other purposes. The scale selected for plotting is equal on both the axes. Cross-sections are plotted for each element of curves. The cross-section consists of the following:

- Pavement surface
- Cross slope or camber
- Width of pavement or carriageway
- Kerbs
- Road margins
- Width of roadway
- Right of Way
- Formation width

A description of these cross-section elements is provided hereunder:

i. Pavement Surface

The pavement surface depends on the pavement type which is decided based on the availability of materials and funds, volume and composition of traffic, sub grade and climate conditions, constructions facilities and cost considerations. The important surface characteristics of the pavement are friction, pavement unevenness, Light reflecting characteristics and drainage of surface water.

ii. Cross Slope or Camber

Cross slope or camber is the slope provided to the road surface in transverse directions to drain off the rain water from the road surface. The required camber of a pavement depends on the type of pavement

surface and the amount of rainfall. Too steep cross slope is not desirable because of tilting of vehicles and discomfort in driving.

Types of camber are

a. Straight
b. Parabolic
c. Combined

The NRRS2071 has recommended of camber for the bitumen rural area to be 3%. The recommended values of camber in different types of roads are provided in table 2. In designing the proposed road, the standard value has been considered.

Table 1: Values of camber in different types of road surface (NRRS2071)

Camber	**Types of road surface**	**District Road Core Network**		**District Road**	
		Hill	**Terai**	**Hill**	**Terai**
Carriageway slope (%)	Earthen(existing)	5	5	5	5
	Gravel	4	4	4	4
	Bituminous Seal Coat	3	3	-	-

iii. Width of Pavement or Carriageway

The pavement or carriageway width depends on the width of traffic lane and number of lanes. The carriageway intended for one line of traffic movements may be called a traffic lane. The lane width is determined on the basis of the width of vehicle and the minimum side clearance which may be provided for safety.

Table 2: Width of carriageway for various classes of roads (NRRS2071)

		carriageway width (m)	Shoulder width (m)	Roadway width (m)
District Road Core Network	Hill	5.5 (if traffic> 400 vpd)	0.75	7
		3.75 (if traffic > 100 vpd)	0.75	5.25
		3 (if traffic < 100 vpd)	0.75	4.5
	Terai	5.5 (if traffic> 400 vpd)	1	7.5
		3.75 (if traffic > 100 vpd)	1.5	6.75
		3 (if traffic < 100 vpd)	1.5	6
District Road	Hill	3	0.5	4
	Terai	3	0.75	4.5

iv. Kerbs

Kerb indicates the boundary between the pavement and shoulder or sometimes islands or foot path or kerb parking space. Kerbs provide lateral confinement and stability to the granular base course and flexible pavements. Kerbs may be mainly divided into three groups based on their functions:

a. Low or mountable type kerb
b. Semi-barrier type kerb
c. Barrier type kerb

v. Road Margins

The various elements included in the road margins are shoulder, parking lane, frontage road, driveway, cycle track, footpath, guard rail and embankment slope as shown in fig no.1.

Roadway width

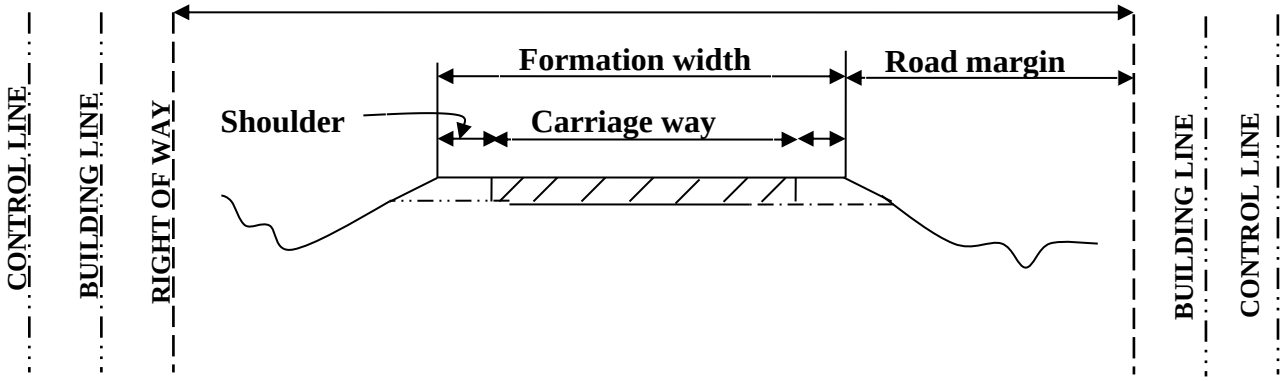


Figure 3: Road Margin in Embankment

vi. Width of Roadway

Width of roadway is the sum of widths of pavements or carriageway including separators, if any, and the shoulder excluding side drains.

vii. Right of Way

Right of way is the area of land acquired for the road, along its alignment. The width of this acquired land is known as land width and it depends on the importance of the road and possible future development. The NRRS2071 recommendation on the right of way for the different types of roads is provided in Table 4.

Table4: Right of Way (NRRS2071)

Types of Roads	RoW	Comment
District Road (Core Network)	20	10m RoW on either side from center line
District Road	15	7.5m RoW on either side from road center line

Formation width

It is finished width of earthwork in fill or cut.

2.7.3 Horizontal Alignment Details

Following elements are to be considered while the design of horizontal alignment:

i. Design Speed

It is the maximum speed allowed for the vehicles to move on the road. The design speed is the most important factor controlling the geometric design elements such as requirements of pavement surface characteristics, cross section elements of road, elements of horizontal alignment and element of vertical alignments. The NRRS 2071 recommendation for the design of district road is 20 Kmph. The adopted design speed is 20 Kmph for this project.

ii. **Horizontal Curve**

A horizontal curve is a curve in plan to provide change in direction to the central line of road. They are generally used on the highways where it is necessary to change the direction of motion. The simplest form of horizontal curve for roads is an arc of a circle, whose radius is chosen to suite the speed of traffic using the road or to fit geometrical constraints such as missing fixed objects or passing through a certain point.

Elements of horizontal curves are as follows:

- **Tangent Length (T):** The length between the beginning of the curve or end of the curve and the point of intersection is called the tangent length. It depends on the deflection angle and radius of the curve given by the relation $T=R \tan(\Delta/2)$.

- **Length of Curve (L):** The length of curve from the point of commencement to the point of tangency is called length of the curve. If the curve is designated by its degree of curvature, the length of the curve will depend upon the criteria used for the definition of the degree of curve given by relation $L= \pi R\Delta/180$.
- **Length of Chord (l):** It is the chord joining the point of curve with the point of tangent or point of curve itself.

- **Deflection Angle (Δ):** The angle between which a survey line makes with the prolongation of the proceeding line is called deflection angle. It is measured to the clockwise or anticlockwise from the prolongation of the previous line. Its value ranges from 0^o-180^o.

- **Radius of Curve(R):** For the certain speed of vehicle, the centrifugal force is dependent on the radius of the horizontal curve. To keep the centrifugal ratio within
low limit the radius of the curve should be kept correspondingly high. According to the NRRS 2071, the minimum radius to be adopted is 15 m.

- **Apex Distance (E):** It is the distance between the points of intersection to the middle of curve length. It also depends in the deflection angle and radius of the curve.

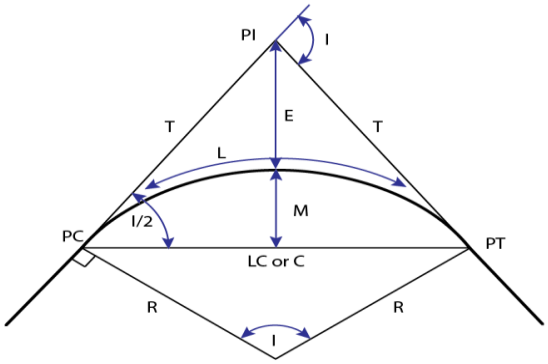


Figure 4: Horizontal Curve

- **Bearing of Line:** The bearing of line is the angle made by that line with respect to the magnetic north direction. It is also known as whole circle bearing (WCB).

Radius of Horizontal Curve

For the certain speed of vehicle, the centrifugal force is dependent on the radius of the horizontal curves. To keep the centrifugal ratio within a low limit, the radius of the curve should be kept correspondingly high. The centrifugal force which is counteracted by the super elevation and lateral friction is given by the relation,

$$e + f = \frac{v^2}{gR}$$

$0.07 + 0.15 = \frac{v^2}{gR}$ (Where e = 0.07 maximum allowable super elevation rate)

$0.22 = \frac{v^2}{gR}$ (f = 0.15 design coefficient of lateral friction)

If the design speed is decided for a highway, the minimum radius to be adopted can be found from the above relationship. Thus, the ruling minimum radius of the curve for ruling design speed v m/sec or V, Kmph is given by:

$$R_{ruling} = \frac{v^2}{(e+f)g}$$

Also, $R_{ruling} = \frac{V^2}{127(e+f)g}$

where, v and V = ruling design speeds in m/sec and Kmph respectively

e = rate of super-elevation

f = design value of transverse skid resistance or coefficient of friction taken as 0.15

g = acceleration due to gravity = 9.8 m/sec^2

a) Widening of Pavement on Horizontal Curve

Especially on horizontally curves, when they are not of very large radii, it is common to widen the pavement slightly more than the normal width. The widening introduces gradually, starting from the beginning of the transition curve or the tangent point progressively increased at the uniform rate, till the full value of designed widening is reached. Total widening 'We' is reached at the end of transition curve where full values of super elevation is provided.

Mechanical widening $(W_m) = \frac{nl^2}{2R}$

Psychological widening $(W_{ps}) = \frac{V}{9.5\sqrt{R}}$

Hence Total widening (W_e) = Mechanical widening + Psychological widening.

$= W_m + W_{ps}$

Where, n = number of traffic lanes.

l = Length of wheelbase of longest vehicle, m. The value of 1 is normally taken as 6.1 m or 6.0 m for commercial vehicle.

V = design speed, Kmph.

R = radius of horizontal curves.

Psychological widening is not considered for rural road.

b) **Super elevation**

To counteract the effect of centrifugal force and to reduce the tendency of the vehicle to overturn or skid, the outer edge of the pavement is raised with respect to the inner edge thus providing a transverse slope throughout the length of the curve. This transverse inclination to the pavement surface is known as super elevation or banking. Introducing super elevation permits a vehicle to travel through a curve more safely and at a higher speed than possible with a normal crown section. The NRRS recommendation for the super elevation where ice condition does not exist is 0.12, the maximum of 0.12 values has been adopted for designed purpose**.** The minimum super elevation to be provided on horizontal curve may be limited to the camber of the surface. There are two ways of attainment of super elevation which are:

(a) Elimination of crown of the cambered section

(b) Rotation of pavement to attain full super elevation.

Design criteria of super-elevation

Various steps in the design of the super elevation in practical are summarized as given below:

i. The super elevation for 75% of design speed (V Kmph) is calculated neglecting the friction.

$$e = \frac{(0.75v)^2}{gR}$$

$$e = \frac{V^2}{225R}$$

ii. If the calculated value of e is less than 1/15 or 0.07, then the value so obtained is provided. If the value of e exceeds 1/15 or 0.07 then provide the maximum super elevation equal to 1/15 and proceed with steps given below.

iii. Check the coefficient of the friction developed for the maximum value of e = 0.07 at the full value of the design speed.

$$f = \frac{v^2}{gR} - 0.07$$

$$f = \frac{V^2}{gR} - 0.07$$

If the value of f thus calculated is less than 0.15, the super elevation is safe for the design speed. If not, calculate the restricted speed from the above step.

As an alternative to step 3, the allowable speed (V_a, Kmph) at the curve is calculated by considering the design coefficient of lateral friction and the maximum super elevation

$$\text{e + f} = 0.067 + 0.15 = 0.217 = \frac{V_a^{\,2}}{127R}$$

Calculate the safe allowable speed.

$$V_a = \sqrt{2.156R}\text{ , m/sec.}$$

$$V_a = \sqrt{27.94R}\text{ , Kmph.}$$

If the allowable speed as calculate above higher than the design speed, then the designs is adequate and then provides a super elevation of 'e' equal to 0.07. If the allowable speed is less than the design speed then the speed is limited to the allowable speed V_a Kmph calculated above.

a) Transition Curve

Anon- circular curve introduced between a straight and a circular curve, is known as transition curve. The curvature of such curves varies from zero as its beginning to a definite value at its junction with the circular curve.

The function of transition curves in the horizontal alignment of the highway may be summed up into the following points:

i. To introduce gradually the centrifugal force between the tangent point and the beginning of the circular curve, avoiding a sudden jerk on the vehicle.
ii. To enable the driver, turn the steering gradually for his own comfort and security.
iii. To enable gradual introduction of the designed super-elevation and extra widening of pavement at the start of the circular curve.
iv. To improve the aesthetic appearance of the road

Calculation of the length of transition curve

The length of transition curve is designed to fulfill following three conditions

i. Rate of the change of centrifugal acceleration to be developed gradually.
ii. Rate of the introduction of the designed super-elevation to be at reasonable rate.
iii. Minimum length by IRC empirical formula.

Rate of the change of centrifugal acceleration (C)

$$C = \frac{v^3}{L_s R} \text{ (m/sec}^3\text{)}$$

The length of transition curve L_s

$$L_s = \frac{v^3}{CR}$$

Were,

L_s = length of transition curve, m

R = radius of the circular curve, m

C = allowable rate of change of centrifugal acceleration m / sec^3

$$C = \frac{80}{(75+V)} \text{ m/sec}^3 \; [0.5 < C < 0.08]$$

Rate of introduction of super elevation

$L_s = \frac{EN}{2} = \frac{eN}{2}(W + W_e)$; If outer edge is rotated about center line.

L_s= EN = eN (W +W_e); If pavement is rotated about the inner edge.

Where, L_s= Length of transition curve, m

e = rate of super elevation in %

E = e (W+W_e)

W_e = extra widening provided at the circular curve

N = 150 in plain rolling terrain

= 60 in hilly terrain

By empirical formula:

a) for plain and rolling terrain:

$$L_s = \frac{2.7V^2}{R}$$ V = Velocity in Kmph

b) for hilly and steep terrains

$$L_s = \frac{V^2}{R}$$ V = Velocity in Kmph

Grade Compensation on Horizontal Curves

When a sharp horizontal curve is to be introduced in a certain section of the road, which has already maximum permissible gradient, then the longitudinal gradient should be corrected and reduced to compensate the loss of tractive effort due to various reasons. Some of them are:

i. Increased rolling resistance.
ii. Increased grade resistance
iii. Increased air resistance

Due to the turning angle of vehicles, the curves resistance is developed at the horizontal curves. When there are horizontal curves in addition to the gradient, there will be increased resistance to traction due to both gradient and curves; it is necessary that in such cases, the total resistance due to grade and curve should not exceed the resistance due to the maximum value of gradient specified. For design

purpose, this maximum value may be taken as the ruling gradient and in some special cases as limiting gradient for the terrain. When the sharp horizontal curve is to be introduced on a road, which has already the maximum permissible gradient, the gradient should be decreased to compensate for the loss of tractive effort due to the curves.

This reduction in gradient at the horizontal curve is called grade compensation. This is calculated from the relation:

Grade compensation % = $\frac{30+R}{R}$, subject to a maximum value of $\frac{75}{R}$

Were,

R = Radius of circular curve, m

The grade compensation is not required for the curves flatter than 4% gradients.

2.7.4 Sight Distance

The clear distance visible ahead of a driver at horizontal and vertical curves and at intersections governs the safe movements of vehicles.

Three sight distance situations are considered in the design:

i. Stopping sight distance
ii. Safe overtaking or passing sight distance
iii. Safe sight distance for entering into controlled intersection

The standards for sight distance should satisfy the following three conditions:

- Driver travelling at the design speed has sufficient sight distance or length of road visible ahead to stop the vehicle, in case of any obstruction on the road ahead, without causing collision.
- Driver travelling at the design speed should be able to safely overtake the slower vehicles without causing obstruction or hazard to traffic from opposite direction at a certain interval.
- Driver entering an uncontrolled intersection has sufficient visibility to enable him/her to take control of his/her vehicle and to avoid collision with another vehicle.

i. Stopping Sight Distance (SSD)

The minimum sight distance available on a highway at any spot should be of sufficient length to stop a vehicle travelling at design speed safely without collision with any other obstruction.

The sight distance available on a road to a driver at any instance depends on

- Features of the road ahead
- Height of the driver's eye above the road surface
- Height of the object above the road surface.

Stopping distance = Lag distance + Braking distance

$$SD = vt + \frac{v^2}{2gf}$$

Where, v = speed of vehicle, m/s

f = design coefficient of friction (0.4-0.35 from 30-80 Kmph)

t = total reaction time of the driver in seconds

ii. Overtaking Sight Distance (OSD)

The minimum distance open to the vision of the driver of a vehicle intending to overtake slow vehicle ahead with safety against opposite direction vehicles is known as the overtaking sight distance or the safe passing sight distance available.

Some of the important factors on which the minimum overtaking sight distance required for the safe overtaking maneuver depends are:

- Speed of (a) overtaking vehicle (b) overtaken vehicles (c) the vehicle coming from opposite direction, if any.
- Distance between the overtaking and overtaken vehicles. The minimum spacing required depends on the speed.
- Skill and reaction time of the driver.
- Rate of acceleration of overtaking vehicle.
- Gradient of the road.

2.7.5 Vertical Alignment Details

While aligning a highway it must follow the general topography of the land. But the natural ground may be level only at some places and otherwise the ground may have slopes of varying magnitudes. Hence, the vertical profile of a road would have level stretches as well slopes or grades. In order to have smooth vehicle movements on the roads, the change in the grade should be smoothened by the vertical curves. Followings are important to be considered in vertical alignment:

i. Design of Vertical Curve

It is necessary to introduce vertical curve at the intersection of different grades to smoothen out the vertical profile because of changes in grade in the vertical alignment of highway and thus ease off the changes in gradients for the fast-moving vehicles. If not so, the drastic change in the rate of grade may subject a vehicle passing over it to an impact, which would be dangerous leading to the loss of property and lives. Hence, the vertical curve contributes to the safety, comfort and appearance.

ii. Types of Vertical Curve

a. Summit curve

b. Valley curve

a. Summit curve

The summit curve is introduced when an ascending gradient meets with descending gradient in the alignment. The maximum permissible gradient is taken as 12% and maximum average gradient is 8 % (NRRS2071). During the design, the minimum value of stopping sight distance is considered as 20m for the design speed 20 Km/hr. according to NRRS2071.

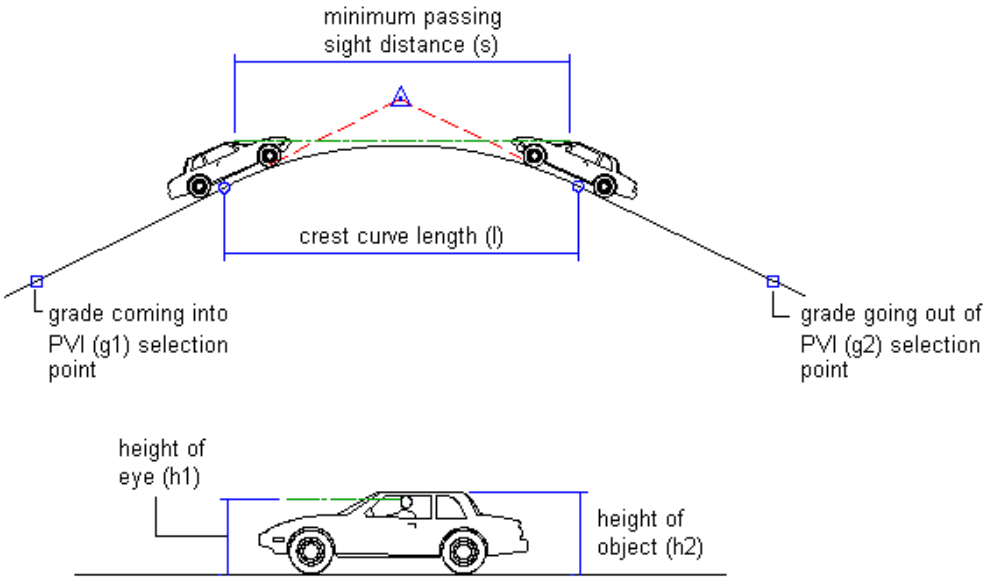


Figure 5: Summit Curve

a) When L> SSD

$$L = \frac{NS^2}{\left(\sqrt{2H} + \sqrt{2h}\right)^2}$$

Height of driver's eye (H) = 1.2m (above the pavement surface)

Height of object above the pavement surface (h)=0.15m

S = Stopping sight distance, (SSD), m

N = Algebraic difference of grade

b) When L < SSD

$$L = 2S - \frac{\left(\sqrt{2H} + \sqrt{2h}\right)^2}{N}$$

b. Valley curve

In the alignment, the valley curve is introduced when descending gradient meets with an ascending gradient. The length of valley transition curve is designed based on the two criteria: (i) the allowable rate of change of centrifugal acceleration (ii) the head light sight distance, and the higher of the two values is adopted. Usually, the second criterion of head light sight distance is higher and therefore governs the design. During design, sight distance is considered and according to NRRS2071, which consist that the headlight sight distance will be the stopping sight distance, minimum value of stopping sight distance is 20mand that the centrifugal acceleration will be of 0.6m/sec^2.

a) The length of transition curve L_s for comfort condition is given by equation,

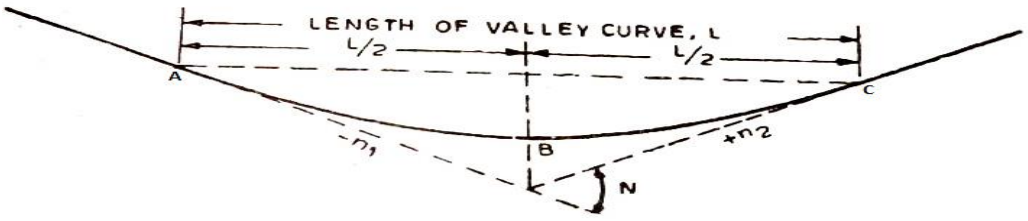


Figure 6: Valley curve

The valley curve is made fully transitional by providing two similar transition curves of equal length. Refer figure 3 where ABC is the valley curve of total length L and AB and BC are two equal transition curves each of length L_s=L/2, having minimum radius R at the common point B.

Length of valley curve $L = 2L_s = 2\left[\frac{Nv^3}{C}\right]^{\frac{1}{2}}$

N = deviation angle

L = Total length of valley curve

v = speed in m/s

C = allowable rate of change of centrifugal acceleration

V Kmph = $\left[\frac{v}{3.6}\right]$m/s

$L = 2\left[\frac{NV^3}{0.6x3.6^3}\right]^{\frac{1}{2}}$

$L = 0.38\ [NV^3]^{\frac{1}{2}}$

Minimum radius of valley curve for cubic parabola is given by $R = \frac{L_S}{N} = \frac{L}{2N}$

b) Length of valley curve for headlight sight distance.

i. L > SSD

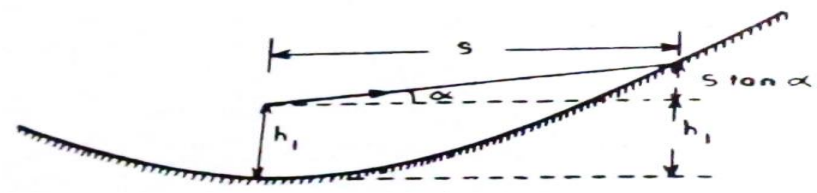


Figure 7: Head light sight distance when L>S

$$L = \frac{NS^2}{(2h_1 + 2S\tan\alpha)}$$

Where, L = length of summit curve,

S = stopping sight distance, (SSD), m

N = deviation angle

h_1 =Average height of head light = 0.75 m

α = Beam angle = 1^o

ii. L < SSD

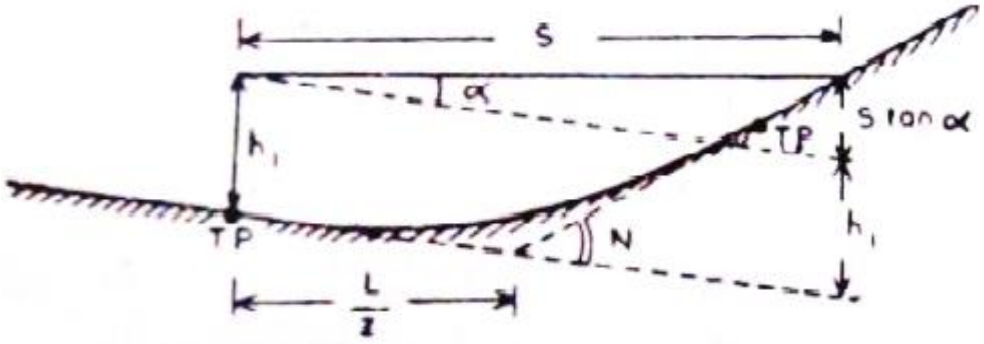


Figure 8: Head light sight distance when L < S

$$L = 2S - \frac{(2h + 2S\tan\alpha)}{N}$$

Substituting h=0.75 m and $\alpha = 1^0$when L<S

$$L = 2S - \frac{(1.5 + 0.035S)}{N}$$

iii. Gradient

Gradient is the rate of rise or fall along the length of the road with respect to the horizontal. It is expressed as a ratio of 1 in x. Sometimes it is also expressed as a percentage, n i.e., n in100.

Gradients are divided into following categories:

a. Ruling gradient
b. Limiting gradient
c. Exceptional gradient
d. Minimum gradient

2.7.6 Intersection Elements

Design of road intersection with facilities for safe and efficient traffic movement needs adequate knowledge of traffic engineering.

2.8 Highway Drainage

2.8.1 Introduction

Highway drainage is the process of removing and controlling excess surface and sub-soil water within the right of way. This includes interception and diversion of water from the road surface and sub-grade. Highway drainage is achieved by two methods as given below.

i.Surface drainage.

The surface water is to be collected and disposed of. The water is first collected in longitudinal drains, generally side drains and then the water is disposed of at the nearest stream, valley or water course. Cross drainage structures like culverts and small bridges may be necessary for the disposal of surface water from the road side drains.

ii. Sub surface drainage.

Sub-surface drainage involves removal of excess water from the sub soil. The aims of sub surface drainage are:

a. Lowering of water table.
b. Control of seepage flow.
c. Control of capillary rise.
d. Drainage of infiltration water.

2.8.2 Importance of Highway Drainage

Followings are the importance of highway drainage:

i. It maintains the bearing capacity of soil.
ii. It removes water from flowing or standing on the carriageway.
iii. It prevents from failure of pavement.
iv. It reduces necessity of maintenance cost.
v. It provides safety travel in place of freezing temperature.
vi. It prevents mud pumping pavement failure.

2.8.3 Side Drains

Side drains are meant for the drainage of the surface water these are provided on the both side of the road to drain off the surface water from the carriageway. The longitudinal slope
of drain is made parallel to the longitudinal slope of the alignment.

2.8.4 Design of Surface Drainage System

Design of surface drainage system involves:

i. Hydrologic analysis
ii. Hydraulic analysis

A. Hydrologic Analysis

The peak runoff is calculated by rational formula:

$Q=CIA/360$

Where, Q= Runoff in m^3/s

A= Area of catchment in hectare

C=Runoff coefficient

I= Rainfall intensity, mm/hr.

B. Hydraulic Analysis

Once the design discharge is determined the hydraulic analysis is done. The side drains are designed based on principle of open channel flow. Longitudinal slope of channels, which is parallel to the road profile, is selected. The type of lining from which value of 'n' and permissible 'V 'is obtained is selected.

Then,

$Q=A \times V$

$Q=A \times (R^{2/3} \times S^{1/2})/n$ (1)

For the rectangular section, select economical section as,

$R=D/2$, $B=2 \times D$

Solve equation (1) to get B and D

Calculate V by

$V= (R^{2/3} \times S^{1/2})/n$ for the design section which should be within the permissible limit otherwise change lining material and redesign the section.

Where,

V=velocity of flow, m/sec

N= Manning's roughness coefficient

A=Area, m^2

P=wetted perimeter, m

R=Hydraulic radius =A/P, m

S=Longitudinal bed slope of channel

2.8.5 Cross-Drainage Structure

There are number of cross drainage structure is to be constructed in order to drain off the water from the side drain.one of the important cross drainage structure in the road aliment is culvert.

2.8.5.1 Culvert

A culvert is a closed conduit placed under the embankment to carry water across the roadway. Culvert is preferred than a minor bridge because it is hydraulically more efficient. According to Nepal Road Standard 2027; bridge structure of span less than 6 m is termed as culverts.

Followings are important types of culverts:

Slab Culvert: A slab is placed over abutments made of masonry, sometimes called box culverts if the span is below two meters.

Pipe Culvert: Pipe of minimum diameter 60 cm and made of steel or pre-cast RCC is used when the discharge is low. But, pipe culverts of diameter 75 cm, 90 cm, 120 cm are available in the market.

Causeway

These are structures provided with hill road which allows to drain off water flowing over the road surface to the lower level safely. Generally, for stability and durability consideration RCC cause ways are used rather than dry stone cause ways.

2.9 Retaining Structure

2.9.1 Introduction

Retaining wall is that type of wall, which is used to retain the vertical mass of soil. The primary function of retaining wall is to resist the lateral thrust of a mass of earth on one side and sometime the pressure of subsoil, water and in many cases the wall may also be required to support vertical loads form a structure above call surcharge.

Functional Requirements of Retaining Structures:

Retaining structures must specially satisfy the important requirements as below:

i. Strength and stability
ii. Durability

The retaining structures must not

i. Slide
ii. Overturn
iii. Overstress the materials of which the structures are constructed
iv. Overstress the soils in which the wall rest

2.9.2 Types of Retaining Walls

i. Cantilever retaining walls
ii. Mass retaining walls (Gravity retaining walls)

Considerations of following elements are important in the design of retaining wall:

i. **Active Earth Pressure:** Lateral pressure, which tends to move or overturn the wall at all, times and this is result of the earth wedge being retained together with any hydrostatic pressure caused by the pressure of ground water.

ii. **Passive Earth Pressure:** Reactionary pressure that builds up to resist any forward movement will comprise the soil in front and relation to counteract this movement.

iii. **Angle of Repose:** It is the natural slope taken by any soil and it is given in terms of the angle to the horizontal base line. Angle of repose varies from 45 degree to 0 degree for wet clay but for most of soil angle of repose is nearly about 30 degrees.

iv. **Wedge of Soil:** It is the mass of soil resting on the upper plane of the angle of repose.

v. **Surcharge Load:** The part of the material or load supported by a retaining wall at a level above the top level of the wall may be by virtue of its nature of position

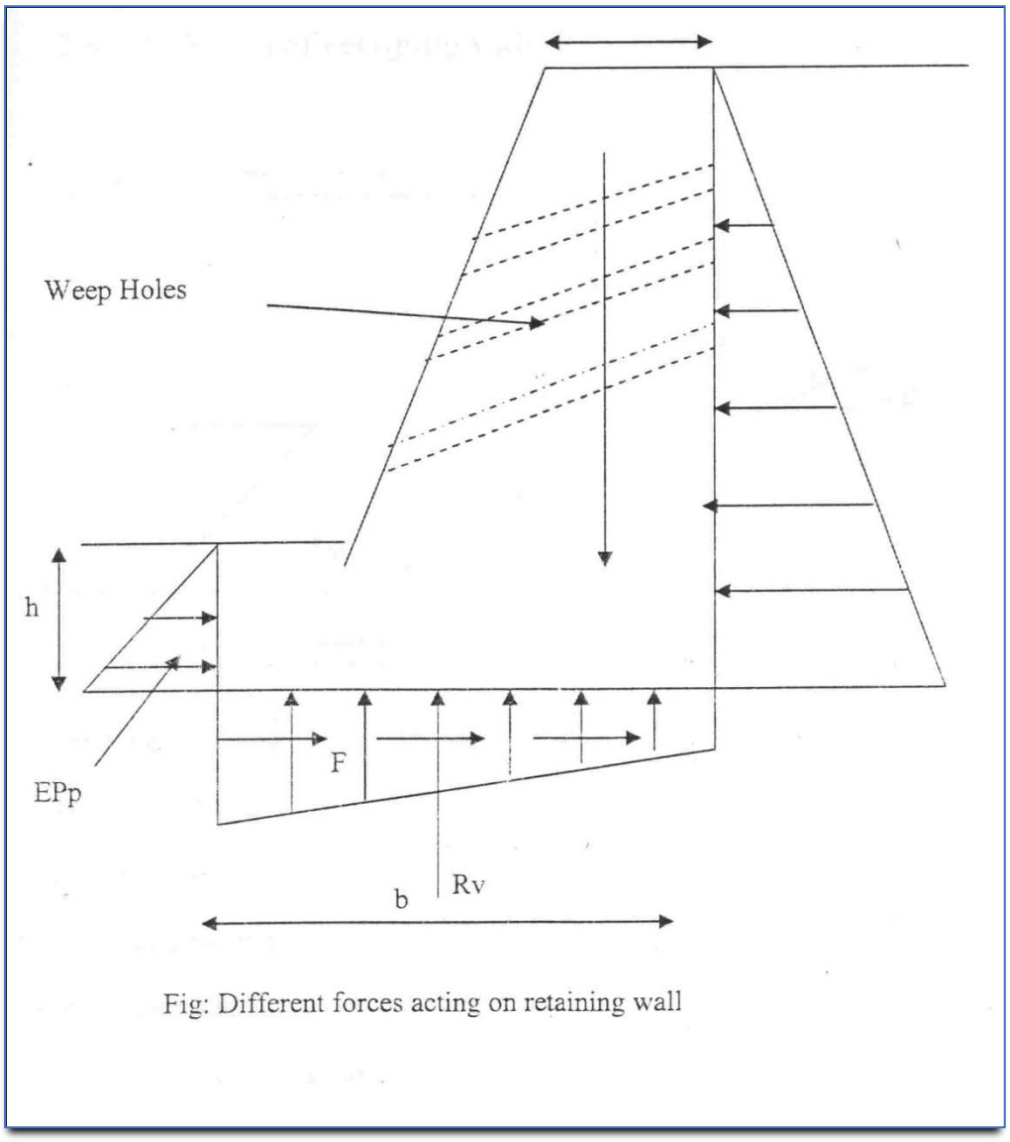


Fig: Different forces acting on retaining wall

Figure 9: Different Forces acting on Retaining Wall

2.9.3 Survey Information and Design Consideration for Retaining Walls

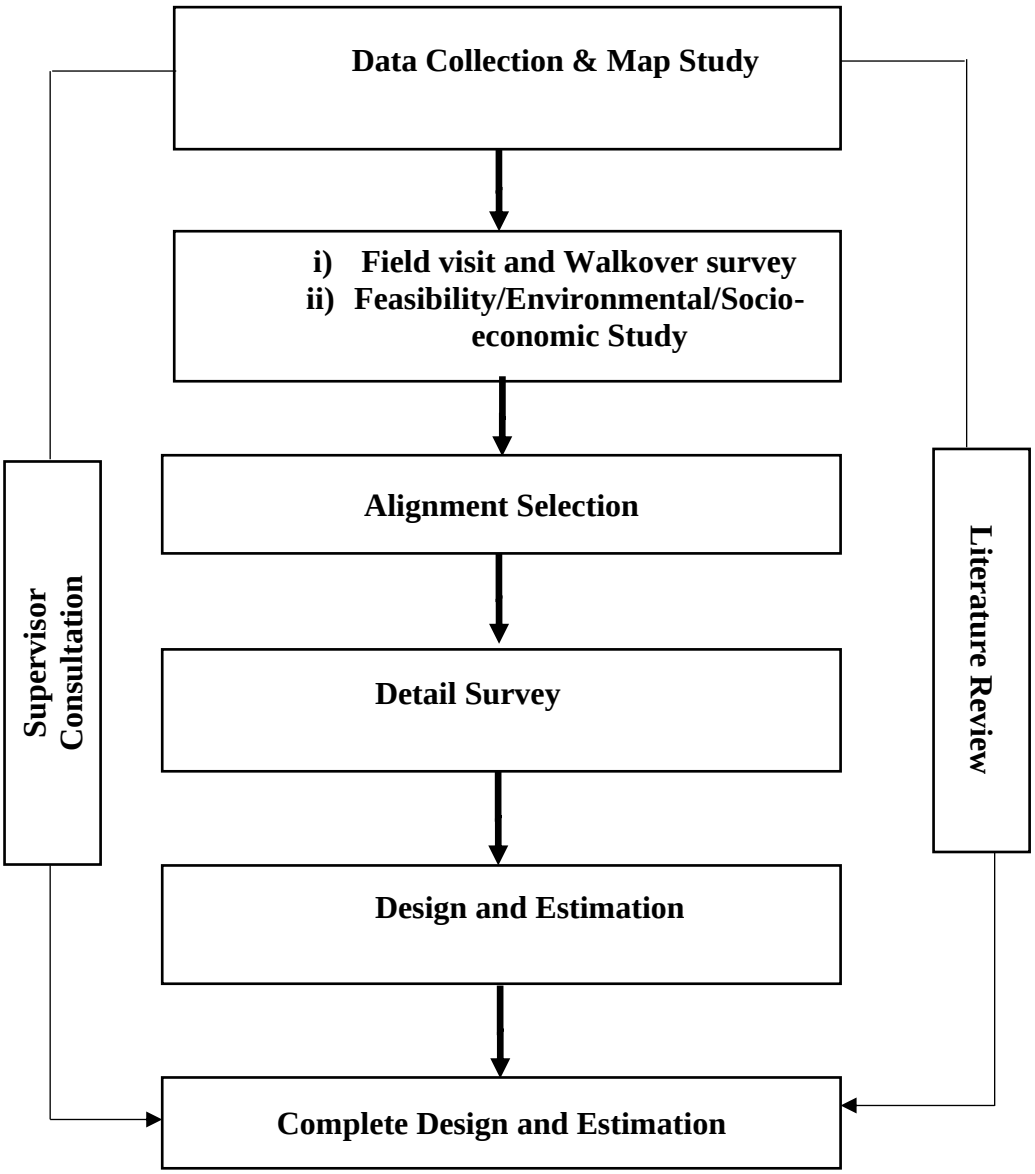
Retaining walls help to support mountainside slopes, or support the road or slope segments from the valley side. They are designed to stop an active earth pressure. Toe walls are normally considered to be a type of retaining wall found are the base of a slope or segment of slope which have the outer slope 1 in 10 and bed slope is 1 in 4.

Practical Features:

- Use dry masonry in every case where it is applicable (see special features of dry masonry walls below). Only use other types of walls when you are certain you need greater strength and can justify the additional cost.
- The top width of the retaining wall should not be less that 60cm for stone masonry
- The back should be left rough or built-in steps to increase friction between the wall and the backing.
- The backfill should be deposited in 10 cm to 15 cm layers with moderate compaction sloping downward from the wall to reduce lateral pressure, after the wall has attained sufficient strength.
- The foundation should be taken deep enough to safeguard against weather and should be at least h/10 +30 cm below the ground level.
- The projection of any footing course should not exceed half the depth of course
- Careful design and supervision of foundations are of paramount importance
- While excavating foundations, remove debris to a safe location. Do not allow to be thrown down the slope.
- In most locations, solving the drainage problem is a major difficulty. Therefore, consideration should always be given to using the best drained of structures. Once the construction is complete ensure that the slopes around the structure are tidied up and treated using appropriate bioengineering measure. All surplus debris must be removed, or it will encourage the development of erosion.

CHAPTER 3
METHODOLOGY

The typical flowchart diagram of the methodology which will be carried out are as follows.



3.1. Data Collection

3.1.1. Desk study

Documents, drawing maps, design standard for the detail design of the road were collected. Following activities were carried out during desk study.

a. Map and the paper document related with the site were studied.

b. The design standards, norms were collected during the desk study.

c. NRRS 2nd revision 2071 has been studied and referred for adoption of design standard and specification.

3.1.2. Identification and selection of road

After thorough review of the different site by field visit, Bhumeswor Mandir to Microstand, Manohara road was selected as final project site. The route was selected because we found this site as best possible site to learn hill road survey and design.

3.2. Design and Survey works

3.2.1. Field survey

The survey included survey throughout the road alignment, hydrological study geological study as well as structure that must be constructed along the road alignment. The major works on the field's survey are:

a. Reconnaissance

It was the first stage of the survey for the road alignment. During reconnaissance we proposed

i. The type of the cross drainage and their location.

ii. Location of the Gabion retaining wall, retaining structures along the road.

iii. Bio-engineering methods application area.

b. Detail survey

The list of equipment's that were used in surveying work can be mentioned as follows:

- Total station
- Measuring tape
- Plumb bob
- Level
- Staff
- Ranging rods and arrows
- Hammer

- Wooden pegs
- GPS device
- Compass

First of all, we fixed the station point at the ground. Then total station was placed on the station point and the coordinate of Northing (N), Easting (E) and Elevation (Z) was set. For the Horizontal angle in Total Station the North point was set as zero. And reading was taken on the center line of the road at the interval of 20m.The ground points data were also recorded. A Gabion retaining wall, Hume pipe were proposed in different locations which are shown in ANNEX- DETAILED ESTIMATE. These various structures are shown on the detailed drawings. The soil type was identified on the field by the quantity of gravel present in the soil and the soil was mixed with boulders so the soil is boulder mixed soil (BMS). Detailed survey was done with the rough drawing and recording the required data throughout the road alignment.

3.3 Engineering Design

The geometric parameters were adopted following the NRRS (2071) guidelines and chosen on the basis of comfort, safety and minimal construction and maintenance cost after finalizing the road classification. The vertical alignment was designed to obtain an optimum balance of cut and fill (earth work) while minimizing the optimum embankment filling in the plain and rolling terrain insuring its stability. The locations of key points of vertical alignment such as beginning of curve, middle of curve, and end of curve, highest and lowest points was fully defined with respect to the designed points of vertical intersection. Cross-sectional parameters such as extra widening, super-elevation, and camber was provided according to NRRS (2071). Adequate provisions for retaining wall, gabion wall, cross and side drains was made to ensure safety of road.

Road Design Software (Smart-Road) was used for the computation of field data which also facilitate in the preparation of various drawings and design such as:

- Plan of Survey alignment showing the key structures within road corridor.
- Horizontal and Vertical alignments showing all design parameters with the conformity of road design standards.
- Cross-sections at given interval including retaining structures, drainage type as recommended.
- Computation of cut-fill quantity to access the estimation of earth work.

3.4 Engineering Drawings

The drawings were prepared using AutoCAD and Road Design Software. For the implementation of detail design works of the project following drawings are produced:

- Plan in 1:1000 scale containing alignment, curve data and indicating surrounding features in the Road corridor.
- Profile at 1:200 scale indicating existing ground situations, proposed designs and indicating length and type of drains.
- Cross-sections incorporating structures at 1:200 scale at all centerline pegs with existing ground situations, proposed designs and data such as existing ground level, area of cut, area of fill, soil type and drain type etc.

3.5 Software used

Smart Road software is one of the best tools for plotting the cross-section at required intervals, plan and profile of the proposed alignment of the road. This software is very easy for operation. Output of this software is obtained in auto CAD. It is very popular software for designing the roads.

The data obtained from surveying by Total station used in the Smart Road software. Then, this software gives the output for the longitudinal profile of existing ground and from this profile, alignment can be fixed with respect to the average maximum gradient considering the balance of cut/fill volume.

After entering co-ordinates, type of drain, side slope of drain, right of way, shoulder width, carriageway width, type of soil, cross-section interval, scale of drawing, the output can be achieved in required format of cross section, plan and profile in auto CAD. This software gives the quantities required for various structures like gabion retaining wall, gabion breast wall. It also gives the data for horizontal curve and vertical curve in excel sheets. Cross section, plan and profile of road alignment from auto CAD can be plotted easily.

3.6 Report

Final report and drawings including salient features and all findings from detailed design and survey was prepared.

CHAPTER 4
DESIGN AND CALCULATIONS

4.1 Geometric Design

4.1.1 Horizontal Curve

For minimum radius of horizontal curve,we have the formula,

$R = V^2 / (127(e + f))$

Where,

e= super elevation=0.07

f=lateral coefficient of friction between the road surface and tires=0.15

V=speed of vehicles in Kmph=25 Kmph

This gives R=22m

From NRRS 2071,

Minimum radius of horizontal curve(R) =12.5m

So, we provide minimum radius of horizontal curve (R) =22m

Curve Design at IP2:

$\Delta = 78.15^0$

R =25 m

Tangent length = R*tan (Δ/2)

= 25*tan(78.15/2)

=20.29 m

Length of curve (L) = $\pi R\Delta/180$

=3.14*25*78.15/180

=34.1 m

Vertical curve design at IP8 :

SSD = 48 m

n_1 = 3.03 %

n_2 = -3.06 %

Then

N = 3.03 –(-3.06)

= 6.09 %

Assume L<S, L= 2S-4.4/N

=2*48- 4.4/6.09

= 23.75 m <SSD (OK)

4.1.2 Super elevation Design

The super elevation for 75 percent of design may be calculated by neglecting the friction.
From NRRS 2071,
e=super elevation =0.07

f=lateral coefficient of friction between the road and tires=0.15

For checking super elevation,

$e= (0.75v^2)/ (127R)$

$e= (0.75*25)^2 / (127*25)$

e=0.11>0.07

So $f= v^2/127R-e$

f=0.12<0.15(safe)
So, we provide maximum super elevation (e) =7% and lateral coefficient of friction =0.12

4.1.3 Extra Widening of curves

For single lane road, psychological widening is not provided and the space required for

mechanical widening is fulfilled by shoulder

Total extra widening $=nL^2/2R$

Where, L=length of wheel base=6.1

V=design speed (Kmph) =25 Kmph

n=number of lanes=1

R=design radius in meters=22m

Therefore, extra widening of curves=0.84m

4.1.4 Stopping sight distance

S=reaction distance + braking distance

$SSD = 0.278vt + v^2/(254f)$

v=design speed in Kmph=25kmph

t=reaction time of driver in sec=2.5sec

f=coefficient of friction between tire and road surface=0.4

Above values give SSD=24m

Provide SSD= 48m

4.2 Hydraulic Design

4.2.1 Design of Side Drain

The peak run off is calculated by rational formula in which,

$Q = CIA / 360$

Where,

Q = Runoff in m^3/s

A = Area of the catchment = 75 ha (from Google earth)

C= Impermeability factor = 0.45

I = Rainfall intensity = 5 mm/hr.

Thus

$Q= (0.45*5*75)/360=0.468\ m^3$

Now,

V = Permissible velocity of flow=1.5m/s

n = manning's roughness coefficient = 0.015

A = area of drain

P = wetted perimeter

R = hydraulic radius =A/P

Now

$A = \frac{Q}{V}$

$= \frac{0.468}{1.5}$

$= 0.312\ m^2$

Assume B= 0.6 m

Solving,

$A= (B \times D) + \frac{1}{2} \times D \times mD$

$0.312 = BD + 1/2 * D^2 * 0.2$ (assume m=0.2)

Or, D = 0.486 m

Adopt, D = 0.5 m

Slope of Drain

$S^{1/2} = v * n / R^{2/3}$

A/P = (0.312/(0.5+0.6+0.51) = 0.194 m

Or, $S^{1/2} = \frac{1.5 \times 0.015}{(0.194)^{2/3}}$

Or, $S = 4.5 \times 10^{-3}$

= 1 in 222.22

Therefore, Longitudinal Slope, S = 1 in 225 is provided.

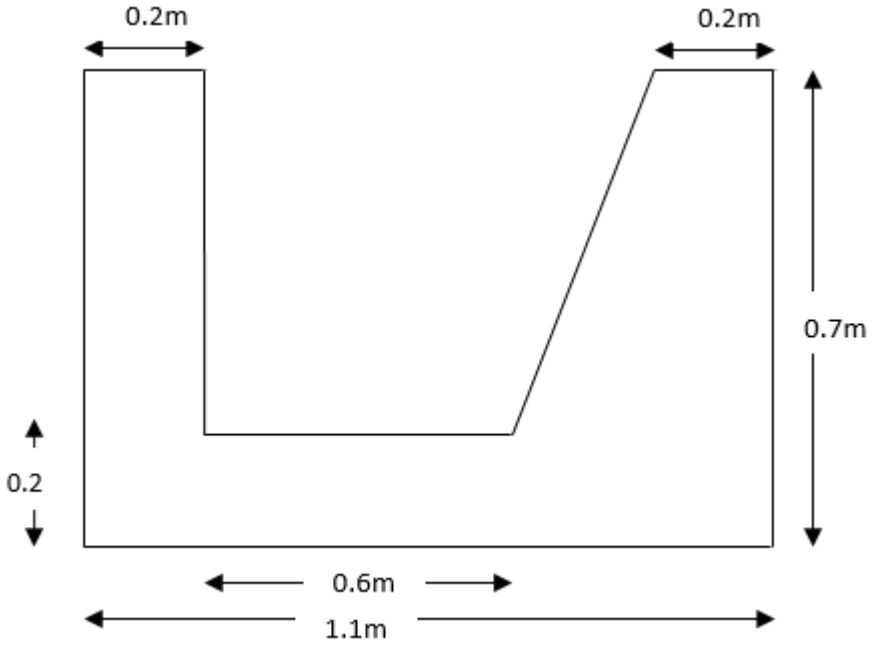


Figure 10: Typical Drawing of Drain

4.2.2 Design of Hume Pipe

For Small seasonal stream pipe culvert of sufficient dia. To be provided for safe crossing.

The design of the pipe culvert, s=7%

Manning's Coefficient is assumed

$Q=A\times V$

Velocity (V) = $\frac{1}{n}R^{2/3}S^{1/2}$

$Q=\frac{\pi d^2}{4}\times \frac{1}{n}R^{2/3}S^{1/2}$

For most economical section

R=0.29D

Where,

Q=discharge=0.2029m^3/s

(For, A'=31.32 ha)

A=area of pipe

Diameter is calculated on the basis of trial and error method.

Check for velocity,

If calculated velocity<permissible velocity, velocity is adopted for calculation.

Hume pipe of dia. 0.6m is adopted.

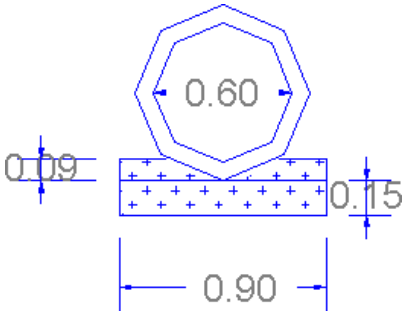


Figure 12: Hume Pipe

4.2.3 Causeway Design

Since the design discharge for Causeway design is very low i.e. Q= 0.08 m^3 /s (For A=10hac, C=0.55), a simple type of causeway is provided having base slab 3m, and side slab of 3m span at slope 1:10 on both sides. Slab thickness is adopted as 25cm (250mm). Longitudinal slope of Causeway is 7%.

4.3 Retaining Wall Design

Sample calculation,

Since the back of the wall is inclined, Rankine's equation for determining the active pressure will have to be used. Hence, use equation

$$Ka=\cos\beta((\cos\beta-\sqrt{(\cos\beta)^2-(cos\emptyset)^2})/(\cos\beta-\sqrt{(\cos\beta)^2-(cos\emptyset)^2}))$$

Here,

β = Angle of backfill slope

Ø = Angle of shearing resistance of the soil

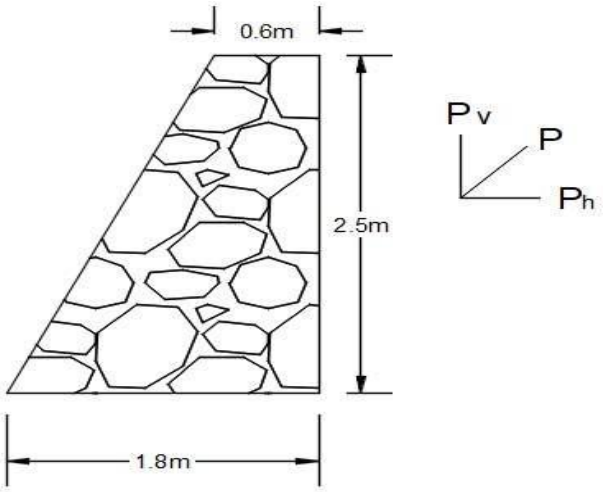


Figure 13: Retaining Wall

Here,

Back fill provided is 2.5:1 (H:V)

Therefore, $\beta= \tan^{-1}(\frac{1}{2.5})=21.8^0$

Assume the coefficient of friction at the base of the wall is 0.6

Angle of shearing resistance of soil for clay is (25-30)

Therefore, take $Ø=28^0$

From above equation we get,

$K_a=0.489$

Now, using equation, we get active pressure

$P_a=\frac{1}{2}K_a \Gamma H^2= \frac{1}{2}(0.489\times20\times2.5^2)=30.56KN/m$

The total pressure acts inclined to the normal.

Horizontal Components of pressure

$P_h = P_a \cos 25.64°$

$= 30.56 \times \cos 25.64$

$= 27.55 KN/m$

Vertical component,

$P_v = P_a \sin 25.64°$

$= 30.56 \times \sin 25.64°$

$= 13.22 KN/m$

Table 4: Computation of Forces and Moment

Sn	Description	Forces(Kn/M)		Lever Arm	Moments About Toe (KnM/M)	
		Vertical	Horizontal		Clockwise	Anticlockwise
1	W1=0.6×2.5×24	36		1.5	54	
2	W2=0.5×1.2×2.5×24	36		0.8	28.8	
3	P_v	13.22		0.8	10.576	
4	P_h		27.55	0.833		22.94
	$\sum$	**85.22**	**27.55**		**93.376**	**22.94**

i) FOS against sliding $= \frac{Resisting\ Forces}{Sliding\ Forces}$

$= \frac{\mu \sum V}{\sum H}$

$= 0.6 \times \frac{85.22}{27.55}$

$= 1.85 > 1.5$ (Safe)

ii) FOS against overturning $= \frac{Resisting\ Moment}{Oveturning\ Moment}$

$= \sum \frac{Mr}{Mo}$

$$= \frac{93.376}{22.94}$$

= 4.04>2 (Safe)

4.4 Traffic Volume Study

Location: Near to Electrical Block (*nec*)

Observed Month= March

Time: 10:30 AM to 11:30 AM

Table 5: Traffic volume data

Type of vehicle	No. of vehicle per hour(a)	No. of projected vehicle per day(a*10)	Equivalency factor	Converted no. of vehicle or PCU
Motorcycle	90	900	0.5	450
Bus	5	50	3	150
Car	8	80	1	80
Truck (Mini)	4	40	1.5	60
Van	3	30	1	30
Total		**1100**		**770**

Note: As the data was only taken for sample observation, peak hour was chosen and due to unavailability of sufficient time to take full day data. So this peak data is projected to get daily traffic data for design basis. In order to get vehicle per day (full day data) 10 hour is assumed for projection.

4.5 CBR Test:

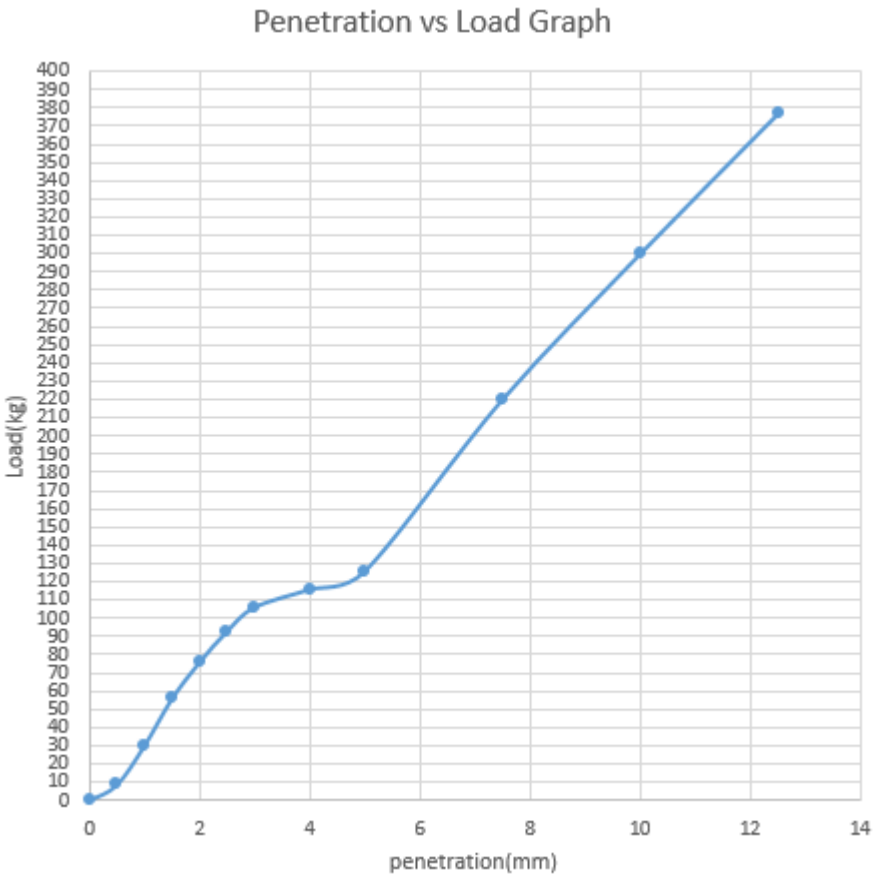
- CBR test is used to evaluate the subgrade strength of road and pavements.
- It is used to determine thickness of pavement.

Table 6: CBR test(sample 1)

Penetration (mm)	Reading Division	Loading Kg
0	0	0
0.5	25	8.5
1	88	29.92
1.5	164	55.76
2	223	75.82
2.5	273	92.82
3	312	106.08
4	341	115.94
5	370	125.80
7.5	647	219.98
10	882	299.88
12.5	110	376.72

Standard values on crushed stone aggregates for specified penetration values:-

Penetration, mm	Standard load, Kg
2.5	1370
5	2055



Graph 1: Load-Penetration Curve in CBR Test (Sample 1)

Sample 1,

$$\text{CBR at 2.5 mm} = \frac{Load\ required\ to\ penetrate\ 2.5\ mm\ for\ given\ specimen}{Load\ Carried\ by\ standard\ specimen\ for\ 2.5\ mm\ penetration} * 100$$

$$= \frac{Load\ at\ 2.5\ mm}{1370} * 100$$

$$= \frac{92.82}{1370} * 100$$

$$= 6.775\ \%$$

$$\text{CBR at 5 mm} = \frac{Load\ at\ 5\ mm}{2055} * 100\%$$

$$= \frac{125.8}{2055} * 100\% = 6.2\%$$

4.6 Pavement Design

Subgrade CBR obtained from lab = 6.77%

So, Adopting, subgrade CBR as 6%.

PCU = 770 PCU

n =10

Traffic growth rate = 8%

$N = 365*((1+r)^n-1)/r)*VDF*LDF$

$=365*770((1+0.08)^{10}-1)/r)*1.5*1$

$=6.10*10^6$ esal

Here Traffic class is T6 and subgrade strength class is S3.

From chart,

Thickness of surface course = 50 mm

Thickness of base course = 225 mm

Thickness of sub-base course = 350 mm

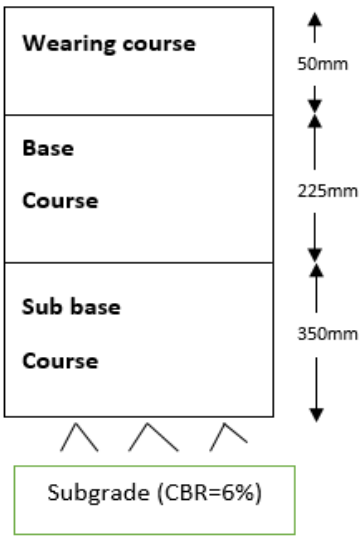


Figure 15: Pavement Structure

CHAPTER 5
BIOENGINEERING

A detailed environmental assessment of the project area was undertaken comprising of the physical, cultural and ecological environment. In this context, the physical environment refers to meteorological elements, topography, soil, geology, land use pattern along the corridor, surface water resources and ground water resources, ambient air quality and noise. The cultural environment comprises schools, colleges, temples etc. Forests and the associated wildlife along with the trees along the corridor constitute the ecological environment. The findings are outlined in the ensuing section.

5.1. Bioengineering works

5.1.1. Introduction

Bioengineering systems work by fulfilling the engineering functions required for the protection and stabilization of slopes. It is not a substitute for civil engineering even though it offers a set of tools to complement those already available in solving a range of shallow slope problems.

Bioengineering plays one or more roles of catching debris, armoring the surface, reinforcing the soil, anchoring the surface layer, supporting the slope or draining the material.

Bioengineering serves two distinct roles providing additional techniques for stabilizing shallow failures and controlling erosion and enhancing civil engineering structures by protecting them and maximizing their effectiveness.

In the context of Nepal, Bioengineering plays an important role because of the conditions like the active geomorphology, steep slopes in mountains, intense rainfall, restricted economy, etc. So, Bio-engineering should be used more widely in Nepal on account of the extreme terrain conditions and the need for extensive low-cost techniques for protecting slopes and stabilizing shallow-seated failures.

5.1.2. Combined Effect of Civil and Bio-Engineering Structures

Due to integration of bioengineering with the road construction projects it stabilize the slope with minimum number of structure and small size of them which ultimately minimizing the cost of construction.

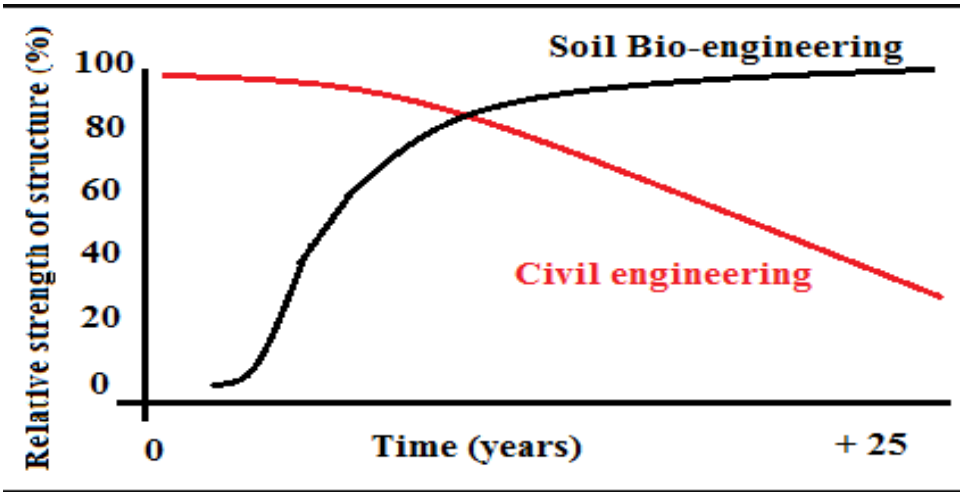


Figure 16: Life span of small civil engineering and vegetative structures

5.1.3. Importance of Bio-Engineering

Without the knowledge of bioengineering, a road engineer cannot be perfect. Every road engineer must have to knowledge about slope stabilization, choice of suitable plants according to altitude and environmental condition for plantation on both sides of road and idea makes the road beautiful. Bioengineering Works as Road Side Development

Roadside development deals with the development of aesthetic and other amenities of road and the right of way. Proper planning is needed for roadside development right from the stage of survey and during construction. For this, we propose following points.

- Wide right of way
- Consistent alignment
- Flint side slope in embankment and cutting
- Planting of trees along the roadside and proper maintenance
- Turfing on side slopes

Afforestation along the roadside or the arboriculture is one of the very important aspects in roadside development. Trees are proposed to plant on both sides of the road to enhance road in the following ways.

- It helps to improve road landscape from aesthetic point of view. Greenery along theroad apparently makes the road beautiful and attractive.
- It provides shade and a highly cool feeling
- It intercepts the annoying sound of vehicles.

Both forest resources and land for agriculture become economically important with access. Under such conditions threat of extinction of vegetation become imminent. Roadside land provides an excellent habitat for the conservation of such species. The management or the conservation of plantations on the roadside is relatively easy and more effective to control.

Representative of all the endangered or threatened life forms such as trees shrubs and herbs can be conserved in this fashion. In this process priority should be given to those plants that are most need. Roadside plantation can also enhance the scope of bee keeping and increase the possibility of farmers to earn additional income from honey. This also increases the crop production through pollination.

Proper planning in plantation would avoid wastage due to deterioration trees. It is necessary to frame a plan where trees are carefully examined and dead trees are discarded. Additional trees are planted as part of renovation. Trees are planted at an interval of 12m longitudinally. List of species to be used are proposed as follows.

A. Trees
   1. Bamboo
   2. Khannue

B. Shrubs
   1. Nigalo
   2. Assuro

C. Grass
   1. Amliso
   2. Khar
   3. Narkat
   4. Babiyo

5.2. Environmental Impact Assessment Observation

Any development activities have its own advantages and disadvantages. The major activity in road construction is cutting of stabilized land slope. Earthwork excavation through blasting can disturb the stabilized mass. Balance volume of soil, which is supported by itself under gravity. Hence, the major environmental impact of road construction is destabilization of stable slope in general following is the main environmental effect may result during the construction of road.

1. Deforestation
2. Air pollution
3. Mass movement of Soil

For prevention on the environmental impact following measures will be adopted during construction.

1. While selecting road alignment selection in such a way that uncultivated land was used by road.
2. Cut/fill volume should be minimum to reduce erosion soil dump area requirement and changed in landscape protection the susceptible surface affected by erosion at construction side.
3. Implementation forestry conservation and development program
4. Limitation on use of fuel wood and prohibition of unauthorized falling of trees and use of open fire during construction
5. In the entire cut slope major, minor, good water management is required, which is the main cause of land unsuitability of the region.
The alignment mostly following the existing track so the environmental impact is within the manageable limit.

CHAPTER 6
PROJECT COST

6.1. Cost Estimation

6.1.1 Project Cost

Project cost was obtained based on Rate Analysis norms and basic district rate of Bhaktapur district. The project cost has been classified as

1. Net project Cost
2. Gross project cost

Net project cost includes the contractor's overhead and contract tax whereas the gross project cost is inclusive of provisional sum @4%, contingencies @ 5% and VAT@13%.

Basic unit rates of labor, material and equipment are adopted as per district rate of Bhaktapur.

6.2 Details of Measurements

6.2.1 Earth Work

The earthwork in cutting and filling was derived in cubic meters from average area method. This is given by the combine computation of design line, summit curve and valley curve.

6.2.2 Side Drainage and Cross Drainage

The quantity of side drain was determined by taking sectional area for each type of side drain and multiplying it by the length of the corresponding side drain.

6.2.3 Retaining Structures Earthwork

Earthwork in retaining structure is computed from the cross-section diagram. Cross-section diagram shows depth of earth work required for the structures.

6.3 Analysis of rate

6.3.1 Quantity Estimate

Quantity estimate of different items are provided in Appendix-1 which provides the estimate quantities of different items of work for the road alignment.

6.3.2 Manpower Estimate

The necessary number of skilled and unskilled manpower is estimated for different kinds of road construction jobs according to norms and quality of works included in rate analysis.

6.3.3 Availability of Materials

Besides the locally available construction materials, other imported materials are also necessary for other jobs like slope protection works, cross-drainage structures.

6.3.4 Availability of Manpower

It has been realized that the skilled and unskilled manpower is adequately available in Bhaktapur district.

CHAPTER 7
CONCLUSIONAND RECOMMENDATION

7.1. Conclusion

This report contains all the technical and theoretical aspects and the geometric standards that are required for the construction and that follow the standard norms of Nepal of the before mentioned road. Observing the current road construction, it has various problems for the vehicle due to the construction in the road. The various problems are due to the excessive gradient, inadequate geometric standards, improper drainage structures and the lack of retaining structures.

The maximum gradient was fixed up to 12%due to the topography of the location and due to the social constraints of the locality and in this project exceptional gradient was avoided while selecting road alignment.

The total volume of cutting is 3635.905 m^3 and total volume of filling is 3927.485 m^3. The total cost of the project having a length of 1+908 Km is estimated to be NRs. 526,24,312.02. The total cost per Km is NRs. 2,7574372.93.

7.2. Recommendation

- Due considerations should be taken during the construction phase in order to minimize disturbances to the naturally stable slopes.
- Introduction of small scale Civil Engineering structure with conjunction of bio engineering should be preferred and land preparation for this purpose should be done from the very beginning of the project i.e. from the first phase of the project.
- Due to variance in cutting and filling volume, two optimum sites for the deposition of the soil must be explored within the area by visiting the site of the road construction and thus deposition of the soil must be done.
- For quality and long life of road, it is strongly recommended that the road should be frequently maintained after construction. This will not only maintain the beauty, quality and life of road, but also the economy.

Limitations

- This report covers survey and design work of rural hill road only.
- Design of pavement in the road is not carried out due to limited scope of our project.
- The maintenance works are not included in this report.
- Designing on retaining wall is based on simple considerations.
- Rainfall intensity is assumed while calculating drainage discharge due to lack of availability exact data for project area.

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ANNEXES

ANNEX 1
SURVEY DATA

SURVEY DATA

S.N.	Easting	Northing	RL	Remarks
1	342806.8	3065542.377	1285.786	IS1
2	342806.8	3065545.377	1285.786	BS1
3	342810.5	3065541.043	1285.675	RRC
4	342816.2	3065542.039	1285.85	RRC
5	342824.1	3065543.427	1286.027	RRC
6	342833.1	3065545.08	1286.221	RRC
7	342840.7	3065544.761	1286.315	RRC
8	342850.2	3065543.9	1286.53	RRC
9	342857.5	3065543.096	1286.704	RRC
10	342866.7	3065543.141	1286.804	RRC
11	342874	3065543.229	1286.812	RRC
12	342886.5	3065543.458	1287.008	RRC
13	342894	3065543.362	1287.138	RRC
14	342903	3065544.088	1287.294	RRC
15	342911.5	3065544.13	1287.318	RRC
16	342921.9	3065545.291	1287.509	RRC
17	342932.1	3065545.982	1287.655	RRC
18	342942.4	3065547.031	1287.662	RRC
19	342950.1	3065547.838	1287.995	RRC
20	342959.9	3065549.481	1288.189	RRC
21	342969	3065550.242	1288.373	RRC
22	342980.3	3065551.776	1288.499	RRC
23	342989.5	3065551.073	1289.062	RRD
24	342941.5	3065544.216	1288.01	RRD
25	342945.2	3065544.54	1288.09	RRD
26	342936.8	3065543.511	1287.869	RRD
27	342929.5	3065542.836	1287.702	RRD
28	342911.6	3065541.968	1287.46	RRD
29	342904.4	3065542.229	1287.381	RRD
30	342891.2	3065542.149	1287.17	RRD
31	342873.5	3065541.398	1287.101	RRD
32	342861.4	3065540.7	1287.003	RRD
33	342859	3065540.812	1286.944	RRD
34	342855.3	3065541.286	1286.87	RRD
35	342847.7	3065542.108	1286.708	RRD
36	342839.6	3065542.736	1286.521	RRD
37	342833.4	3065542.808	1286.397	RRD
38	342823.8	3065541.344	1286.216	RRD
39	342817.7	3065540.14	1286.145	RRD
40	342814.2	3065539.455	1286.034	RRD
41	342808.8	3065538.494	1285.973	RRD
42	342806.3	3065548.64	1285.81	CL
43	342814.7	3065549.629	1285.9	CL
44	342824.9	3065549.994	1286.063	CL
45	342839.1	3065550.801	1286.217	CL
46	342848.7	3065549.999	1286.376	CL
47	342864.5	3065548.028	1286.642	CL
48	342872.3	3065547.874	1286.839	CL
49	342864.5	3065548.038	1286.647	CL
50	342872.4	3065547.799	1286.855	CL

51	342886.4	3065547.403	1286.887	CL
52	342897.6	3065548.678	1287.186	CL
53	342911.1	3065551.303	1287.4	CL
54	342929.1	3065552.997	1287.705	CL
55	342945.7	3065553.353	1287.987	CL
56	342965.2	3065554.937	1288.364	CL
57	342867	3065554.96	1286.656	LRC
58	342858.4	3065555.902	1286.35	LRC
59	342847.4	3065555.701	1286.4	LRC
60	342836.9	3065555.434	1286.245	LRC
61	342828.4	3065555.283	1286.19	LRC
62	342821.4	3065555.221	1286.065	LRC
63	342814.7	3065554.473	1285.991	LRC
64	342807.4	3065554.428	1285.783	LRC
65	342975.4	3065559.322	1288.513	IS2
66	342963.6	3065560.512	1288.019	LRC
67	342955.6	3065560.096	1287.82	LRC
68	342891.7	3065555.976	1286.779	LRC
69	342944.5	3065559.413	1287.561	LRC
70	342904.3	3065556.327	1286.84	LRC
71	342930.5	3065559.29	1287.377	LRC
72	342915.5	3065557.2	1287.064	LRC
73	342922.3	3065559.107	1287.275	LRC
74	342977	3065562.046	1288.354	LRC
75	342984.5	3065564.204	1288.352	LRC
76	342993.9	3065567.324	1288.62	LRC
77	343001.3	3065569.485	1288.708	LRC
78	343015	3065573.192	1289.009	LRC
79	343024.5	3065575.59	1289.074	LRC
80	343037	3065579.193	1289.137	LRC
81	343045.8	3065582.052	1289.159	LRC
82	343060	3065585.855	1289.463	LRC
83	343068.9	3065587.566	1289.628	LRC
84	343077.7	3065589.112	1289.806	LRC
85	343087.6	3065590.779	1289.893	LRC
86	343095.8	3065592.51	1289.836	LRC
87	343104.6	3065593.192	1290.063	LRC
88	343115.1	3065594.28	1290.312	LRC
89	343122.4	3065594.55	1290.425	LRC
90	343130.2	3065594.2	1290.405	LRC
91	343138.7	3065594.028	1290.564	LRC
92	343148.8	3065593.198	1290.712	LRC
93	343157.6	3065592.132	1290.864	LRC
94	343139.5	3065588.675	1290.482	CL
95	343131.2	3065589.381	1290.433	CL
96	343119.2	3065588.287	1290.428	CL
97	343110.1	3065587.951	1290.216	CL
98	343100.6	3065586.398	1290.131	CL
99	343088.9	3065585.018	1289.977	CL
100	343083.2	3065583.914	1289.917	CL
101	343073.4	3065581.922	1289.75	CL
102	343066.3	3065580.678	1289.601	CL
103	343050.9	3065577.631	1289.257	CL

104	343029	3065570.208	1288.998	CL
105	343013.7	3065566.121	1288.811	CL
106	342997.2	3065561.507	1288.552	CL
107	342982.4	3065557.133	1288.23	CL
108	342974.6	3065555.311	1288.103	CL
109	342998.9	3065555.076	1288.522	RRC
110	343010.1	3065559.121	1288.873	RRC
111	343021	3065563.077	1288.698	RRC
112	343028.3	3065565.769	1288.881	RRC
113	343040.8	3065568.588	1289.098	RRC
114	343049.7	3065571.431	1289.225	RRC
115	343061.8	3065574.385	1289.455	RRC
116	343072.4	3065576.64	1289.392	RRC
117	343086.5	3065579.099	1289.674	RRC
118	343096.5	3065580.866	1289.845	RRC
119	343108.1	3065580.996	1290.046	RRC
120	343118.9	3065582.088	1290.009	RRC
121	343079.3	3065575.548	1289.92	RDC
122	343090.9	3065577.465	1289.908	RDC
123	343060.1	3065571.156	1289.423	RDC
124	343048.7	3065568.845	1289.397	RDC
125	343020.2	3065560.15	1289.199	RDC
126	343005.4	3065555.141	1288.961	RDC
127	342992.1	3065551.374	1288.698	RDC
128	343012	3065551.024	1289.892	HC
129	343021.3	3065554.612	1289.786	HC
130	343023.5	3065556.483	1289.465	HC
131	343033.9	3065559.513	1289.488	HC
132	343163.4	3065589.559	1290.75	IS3
133	343131.3	3065581.784	1290.3	RRC
134	343141.8	3065581.468	1290.348	RRC
135	343149.4	3065580.828	1290.434	RRC
136	343155	3065579.969	1290.547	RRC
137	343163.3	3065577.612	1290.745	RRC
138	343172.4	3065574.878	1290.946	RRC
139	343181.1	3065572.799	1291.073	RRC
140	343187.6	3065572.139	1291.222	RRC
141	343195.6	3065571.644	1291.996	RRC
142	343214.7	3065571.129	1291.738	RRC
143	343228.6	3065566.221	1292.19	RRC
144	343236.7	3065563.103	1292.385	RRC
145	343245.4	3065561.979	1292.673	RRC
146	343256	3065560.559	1293.193	RRC
147	343266.6	3065561.008	1293.163	RRC
148	343270.4	3065561.01	1293.576	RRC
149	343278.1	3065560.956	1293.755	RRC
150	343284.9	3065560.015	1293.904	RRC
151	343290.7	3065557.851	1294.036	RRC
152	343300.1	3065554.776	1293.989	RRC
153	343283.6	3065558.158	1294.067	RDC
154	343273.6	3065558.82	1293.701	RDC
155	343266.5	3065558.577	1293.458	RDC
156	343252.7	3065558.83	1293.081	RDC

157	343245.2	3065559.813	1292.927	RDC
158	343233.5	3065560.224	1293.109	RDC
159	343195.2	3065568.612	1292.569	RDC
160	343188.1	3065567.558	1291.526	RDC
161	343182.4	3065569.675	1291.283	RDC
162	343171.4	3065572.649	1290.943	RDC
163	343159.3	3065576.213	1290.861	RDC
164	343148.8	3065578.746	1290.368	RDC
165	343140.3	3065579.364	1290.3	RDC
166	343129	3065579.766	1290.251	RDC
167	343121.2	3065579.497	1290.203	RDC
168	343188.9	3065571.791	1291.908	CUL
169	343195	3065571.298	1292.062	CUL
170	343194.7	3065566.627	1292.287	CUL
171	343188.6	3065567.717	1292.028	CUL
172	343186.1	3065565.307	1292.818	HC
173	343179.4	3065565.732	1292.522	HC
174	343179.1	3065590.85	1290.988	HC
175	343168.5	3065592.186	1290.831	HC
176	343139.5	3065594.048	1290.574	LRC
177	343154.8	3065592.426	1290.815	LRC
178	343171.4	3065589.096	1291.012	LRC
179	343179.6	3065586.4	1291.108	LRC
180	343191.8	3065584.053	1291.125	LRC
181	343202	3065582.497	1291.314	LRC
182	343218.3	3065578.954	1291.508	LRC
183	343227.7	3065577.298	1291.839	LRC
184	343239.9	3065574.859	1292.453	LRC
185	343239.7	3065569.244	1292.498	CL
186	343228.1	3065571.82	1292.008	CL
187	343213	3065575.64	1291.581	CL
188	343199.6	3065578.135	1291.352	CL
189	343179.1	3065579.753	1291.008	CL
190	343163.4	3065584.441	1290.641	CL
191	343151	3065587.02	1290.547	CL
192	343140.1	3065588.752	1290.459	CL
193	343260.4	3065568.331	1293.279	CL
194	343269.6	3065567.408	1293.494	CL
195	343280.6	3065565.248	1293.537	CL
196	343290.1	3065562.366	1293.734	CL
197	343302.8	3065556.757	1294.102	CL
198	343313.4	3065552.274	1294.34	CL
199	343329	3065550.482	1294.785	IS4
200	343314.1	3065560.449	1294.295	LRC
201	343307	3065563.268	1294.191	LRC
202	343300.9	3065566.788	1294.173	LRC
203	343300.9	3065566.802	1294.17	LRC
204	343300.9	3065566.79	1294.17	LRC
205	343293.5	3065569.478	1294.143	LRC
206	343286.2	3065571.575	1293.973	LRC
207	343279.2	3065573.312	1293.781	LRC
208	343271.7	3065574.05	1293.47	LRC
209	343261.9	3065575.05	1293.331	LRC

210	343254.3	3065575.752	1293.025	LRC
211	343244.2	3065576.436	1292.626	LRC
212	343235.7	3065576.683	1292.377	LRC
213	343304	3065551.032	1294.257	RRC
214	343314.7	3065545.198	1294.601	RRC
215	343337.4	3065537.409	1295.211	RRC
216	343342.9	3065534.916	1295.437	RRC
217	343352.1	3065532.914	1295.372	RRC
218	343358.8	3065532.023	1295.648	RRC
219	343369.5	3065529.145	1295.958	RRC
220	343375.7	3065526.468	1296.314	RRC
221	343386.7	3065521.393	1296.788	RRC
222	343394.1	3065518.331	1297.496	RRC
223	343402.2	3065516.294	1297.541	RRC
224	343405.9	3065515.422	1298.047	RRC
225	343410.6	3065514.638	1298.027	RRC
226	343413.9	3065514.838	1298.115	RRC
227	343416.9	3065522.887	1298.216	RRC
228	343415.7	3065518.379	1298.44	RRC
229	343417.8	3065521.23	1298.24	RRC
230	343417	3065525.768	1297.973	RRC
231	343417.2	3065535.018	1297.301	RRC
232	343416.6	3065528.152	1297.602	RRC
233	343417.1	3065544.176	1297.04	RRC
234	343409.9	3065545.732	1297.056	LRC
235	343409.7	3065540.408	1297.135	LRC
236	343409.1	3065536.708	1297.259	LRC
237	343407.5	3065529.414	1297.505	LRC
238	343407.3	3065528.287	1297.552	LRC
239	343406.7	3065526.844	1297.622	LRC
240	343406.2	3065526.087	1297.676	LRC
241	343403.2	3065525.457	1297.533	LRC
242	343399.7	3065526.675	1297.399	LRC
243	343391	3065530.095	1296.863	LRC
244	343377.9	3065535.751	1296.3	LRC
245	343362.4	3065540.441	1295.621	LRC
246	343351.6	3065544.433	1295.465	LRC
247	343341.7	3065547.269	1295.255	LRC
248	343331.5	3065551.066	1294.909	LRC
249	343288.8	3065557.307	1294.039	RDC
250	343296.4	3065553.227	1294.279	RDC
251	343301.7	3065550.431	1294.276	RDC
252	343306.6	3065547.461	1294.41	RDC
253	343325.5	3065538.649	1295.166	RDC
254	343330.3	3065537.357	1295.251	RDC
255	343334.8	3065536.328	1295.205	RDC
256	343341.2	3065533.555	1295.391	RDC
257	343346.7	3065532.064	1295.417	RDC
258	343352.4	3065530.966	1295.558	RDC
259	343361.4	3065530.431	1295.819	RDC
260	343368.1	3065528.195	1296.25	RDC
261	343379.8	3065522.755	1296.693	RDC
262	343385.7	3065519.773	1296.889	RDC

263	343391.7	3065516.992	1297.569	RDC
264	343398.8	3065514.945	1297.604	RDC
265	343406.6	3065511.444	1297.708	RDC
266	343413	3065541.728	1296.827	CL
267	343413.6	3065535.707	1297.085	CL
268	343412.6	3065547.505	1296.613	CL
269	343412.2	3065529.318	1297.379	CL
270	343411.5	3065527.366	1297.586	CL
271	343411.7	3065524.931	1297.822	CL
272	343409.7	3065523.326	1297.921	CL
273	343408.4	3065520.95	1297.998	CL
274	343404.7	3065520.821	1297.767	CL
275	343398.7	3065521.445	1297.39	CL
276	343391.7	3065524.046	1296.983	CL
277	343385.8	3065527.237	1296.635	CL
278	343372.3	3065532.396	1296.056	CL
279	343360.2	3065536.43	1295.626	CL
280	343349.5	3065538.767	1295.34	CL
281	343336.9	3065542.354	1294.869	CL
282	343326.6	3065545.352	1294.728	CL
283	343314.8	3065550.881	1294.414	CL
284	343308.2	3065555.47	1294.211	CL
285	343405.7	3065556.116	1296.197	IS5
286	343407.2	3065549.643	1296.594	LRC
287	343400.7	3065561.624	1296.082	LRC
288	343398.1	3065566.855	1295.621	LRC
289	343397.6	3065573.914	1295.586	LRC
290	343397.1	3065578.294	1295.251	LRC
291	343396.7	3065581.756	1295.083	LRC
292	343397.1	3065588.137	1294.874	LRC
293	343398.6	3065595.708	1294.653	LRC
294	343401	3065602.092	1294.53	LRC
295	343402.7	3065607.975	1294.169	LRC
296	343405.2	3065615.376	1294.147	LRC
297	343406.8	3065619.34	1293.966	LRC
298	343408.7	3065623.979	1293.529	LRC
299	343410.7	3065630.807	1293.453	LRC
300	343411.6	3065636.434	1293.252	LRC
301	343412.3	3065642.53	1293.012	LRC
302	343412.8	3065650.195	1292.739	LRC
303	343412.1	3065657.53	1292.588	LRC
304	343410.7	3065664.009	1292.238	LRC
305	343409	3065669.736	1292.007	LRC
306	343408.9	3065676.928	1291.81	LRC
307	343408.8	3065683.632	1291.483	LRC
308	343409.3	3065692.649	1291.32	LRC
309	343414.3	3065710.644	1290.82	CL
310	343414	3065705.061	1290.87	CL
311	343414.9	3065699.044	1290.984	CL
312	343414.4	3065691.669	1291.207	CL
313	343414.7	3065682.784	1291.551	CL
314	343414.4	3065677.343	1291.722	CL
315	343416.8	3065668.745	1291.925	CL

316	343417.6	3065661.84	1292.056	CL
317	343418.1	3065653.646	1292.446	CL
318	343418.9	3065648.252	1292.618	CL
319	343418.2	3065643	1292.845	CL
320	343417.6	3065638.65	1292.91	CL
321	343416.3	3065632.028	1293.22	CL
322	343414	3065624.575	1293.461	CL
323	343411.9	3065618.895	1293.613	CL
324	343408	3065610.222	1293.892	CL
325	343405.7	3065603.623	1294.061	CL
326	343403.2	3065597.239	1294.183	CL
327	343401.8	3065585.503	1294.573	CL
328	343402.6	3065590.328	1294.397	CL
329	343402.3	3065575.18	1295.229	CL
330	343404.3	3065569.719	1295.501	CL
331	343405.7	3065565.921	1295.612	CL
332	343407.4	3065562.208	1295.75	CL
333	343410.7	3065555.372	1296.273	CL
334	343412.2	3065551.702	1296.513	CL
335	343414.2	3065546.09	1296.714	CL
336	343419.4	3065543.039	1297.011	RRC
337	343418.8	3065546.329	1296.519	RRC
338	343418.5	3065539.303	1296.673	RRC
339	343417.8	3065550.625	1296.895	RRC
340	343416.3	3065555.412	1296.361	RRC
341	343414.6	3065559.653	1296.086	RRC
342	343413.4	3065563.004	1296.085	RRC
343	343411.4	3065568.576	1295.606	RRC
344	343408.8	3065572.902	1296.008	RRC
345	343408.8	3065577.443	1295.089	RRC
346	343407.8	3065584.075	1294.541	RRC
347	343407.7	3065592.942	1294.224	RRC
348	343410.1	3065602.008	1294.127	RRC
349	343411.5	3065608.463	1293.945	RRC
350	343413.9	3065614.596	1293.733	RRC
351	343416.2	3065622.022	1293.82	RRC
352	343419.1	3065626.953	1293.588	RRC
353	343422.5	3065641.926	1292.911	RRC
354	343423.3	3065650.391	1292.639	RRC
355	343421.7	3065657.396	1292.182	RRC
356	343421.8	3065668.511	1291.76	RRC
357	343421.9	3065676.116	1291.538	RRC
358	343422	3065681.141	1291.403	RRC
359	343421.9	3065688.814	1291.153	RRC
360	343421.4	3065697.962	1290.973	RRC
361	343421.9	3065712.367	1290.488	RRC
362	343422.5	3065721.708	1290.339	RRC
363	343423.2	3065728.985	1290.225	RRC
364	343424.2	3065739.141	1289.951	RRC
365	343426.7	3065755.854	1289.264	RDC
366	343425.7	3065733.095	1291.662	RDC
367	343425.4	3065722.063	1292.128	RDC
368	343424.7	3065713.899	1292.336	RDC

369	343423.6	3065703.827	1292.141	RDC
370	343423.9	3065699.164	1291.361	RDC
371	343424	3065694.201	1291.055	RDC
372	343424.4	3065685.714	1291.26	RDC
373	343425.1	3065678.842	1291.428	RDC
374	343427.3	3065670.605	1292.15	RDC
375	343417.7	3065617.428	1293.891	RDC
376	343416.4	3065612.675	1294.025	RDC
377	343413	3065602.085	1294.393	RDC
378	343412.8	3065597.111	1294.488	RDC
379	343413.6	3065590.926	1294.817	RDC
380	343417.2	3065587.938	1295.903	RDC
381	343418.9	3065584.229	1296.956	RDC
382	343420.6	3065577.723	1296.3	RDC
383	343422	3065572.772	1296.519	RDC
384	343423.7	3065568.163	1295.936	RDC
385	343425.9	3065563.638	1296.072	RDC
386	343422.8	3065545.001	1297.598	RDC
387	343423.8	3065538.696	1297.998	RDC
388	343424.5	3065535.183	1298.247	RDC
389	343425	3065526.426	1298.654	RDC
390	343422.2	3065523.365	1298.81	RDC
391	343421.4	3065799.341	1288.263	RDC
392	343421.4	3065799.342	1288.235	IS6
393	343408.9	3065702.006	1291.075	LRC
394	343409	3065711.228	1291.01	LRC
395	343410	3065720.583	1290.71	LRC
396	343410.7	3065729.673	1290.297	LRC
397	343411.7	3065737.523	1290.083	LRC
398	343412.3	3065745.543	1289.909	LRC
399	343413.9	3065755.867	1289.696	LRC
400	343414.4	3065758.495	1288.747	LRC
401	343414.4	3065761.306	1288.634	LRC
402	343414.5	3065766.426	1289.521	LRC
403	343415.1	3065776.059	1289.271	LRC
404	343415.6	3065783.86	1289	LRC
405	343416.2	3065791.03	1288.679	LRC
406	343416.8	3065796.556	1288.806	LRC
407	343417.8	3065799.09	1288.781	LRC
408	343418.8	3065800.727	1288.74	LRC
409	343430	3065804.769	1288.019	LRC
410	343438.1	3065809.748	1288.467	LRC
411	343446.1	3065806.737	1288.519	LRC
412	343452.8	3065804.573	1288.609	LRC
413	343460.7	3065801.921	1288.744	LRC
414	343468.9	3065799.79	1289.083	LRC
415	343472.1	3065798.54	1289.148	LRC
416	343475.3	3065798.751	1289.21	LRC
417	343484.7	3065799.252	1289.299	LRC
418	343487.2	3065800.189	1289.244	LRC
419	343491.7	3065801.115	1288.783	LRC
420	343507	3065801.213	1288.608	LRC
421	343514	3065801.052	1288.795	LRC

422	343564.7	3065802.227	1288.845	LRC
423	343602	3065791.655	1289.18	LRC
424	343579.7	3065797.485	1288.673	LRC
425	343588.8	3065797.201	1288.824	LRC
426	343595.5	3065797.175	1289.022	LRC
427	343602.8	3065796.354	1289.303	LRC
428	343605.4	3065796.155	1289.356	LRC
429	343613.8	3065791.247	1289.413	LRC
430	343623.3	3065788.879	1289.144	LRC
431	343624.1	3065782.85	1289.155	CL
432	343617.1	3065783.655	1289.163	CL
433	343604.4	3065786.136	1289.276	CL
434	343592.1	3065788.836	1289.049	CL
435	343579.8	3065791.48	1288.67	CL
436	343569.8	3065795.578	1288.525	CL
437	343551.8	3065797.339	1288.564	CL
438	343563.6	3065796.681	1288.494	CL
439	343540.5	3065797.53	1288.504	CL
440	343529.4	3065797.934	1288.532	CL
441	343515.9	3065795.617	1288.85	CL
442	343504	3065793.539	1289.1	CL
443	343494.7	3065793.474	1289.246	CL
444	343487.5	3065794.205	1289.166	CL
445	343481.6	3065794.604	1289.035	CL
446	343477.2	3065795.168	1288.937	CL
447	343468.9	3065796.433	1288.727	CL
448	343459	3065798.688	1288.629	CL
449	343452.6	3065800.263	1288.485	CL
450	343444.9	3065801.633	1288.37	CL
451	343437.8	3065802.427	1288.171	CL
452	343432.3	3065801.996	1288.037	CL
453	343428.9	3065801.038	1288.08	CL
454	343425.9	3065799.414	1288.117	CL
455	343423.9	3065797.604	1288.168	CL
456	343421.2	3065794.404	1288.215	CL
457	343421.1	3065791.203	1288.314	CL
458	343421	3065786.329	1288.588	CL
459	343420.3	3065780.384	1288.682	CL
460	343420.9	3065769.5	1288.94	CL
461	343419.8	3065762.106	1289.145	CL
462	343419	3065751.644	1289.404	CL
463	343417.9	3065743.602	1289.696	CL
464	343416.9	3065734.384	1290.042	CL
465	343415.7	3065724.635	1290.348	CL
466	343415.2	3065717.884	1290.547	CL
467	343425.4	3065765.743	1288.95	RRC
468	343425.1	3065760.025	1289.107	RRC
469	343427.2	3065778.457	1288.396	RRC
470	343427.4	3065783.73	1288.224	RRC
471	343427.3	3065790.116	1288.297	RRC
472	343427.5	3065793.847	1288.374	RRC
473	343426.5	3065795.777	1288.197	RRC
474	343427.1	3065796.834	1288.197	RRC

475	343428.5	3065797.915	1288.178	RRC
476	343431.4	3065799.079	1288.208	RRC
477	343435.4	3065799.224	1288.105	RRC
478	343442.9	3065797.815	1288.532	RRC
479	343448.9	3065797.08	1288.704	RRC
480	343459	3065795.552	1288.874	RRC
481	343468.6	3065793.549	1288.891	RRC
482	343478.1	3065789.474	1289.832	RRC
483	343490.7	3065787.148	1289.525	RRC
484	343497.7	3065785.201	1289.572	RRC
485	343504.5	3065784.018	1289.517	RRC
486	343526.5	3065790.203	1288.645	RRC
487	343535.7	3065791.614	1288.457	RRC
488	343543.8	3065791.592	1288.656	RRC
489	343549.2	3065789.623	1288.414	RRC
490	343561.6	3065787.529	1288.377	RRC
491	343574.1	3065785.788	1288.51	RRC
492	343586.6	3065783.575	1288.634	RRC
493	343597	3065781.668	1288.779	RRC
494	343610.4	3065779.864	1288.901	RRC
495	343586.7	3065782.674	1288.617	RDC
496	343579	3065784.013	1288.594	RDC
497	343568.6	3065785.37	1288.451	RDC
498	343553.9	3065787.898	1288.366	RDC
499	343543.7	3065789.2	1288.408	RDC
500	343532.6	3065789.265	1288.502	RDC
501	343529.3	3065788.298	1288.553	RDC
502	343447.1	3065794.395	1289.246	RDC
503	343442.5	3065795.378	1288.952	RDC
504	343435.2	3065797.085	1288.724	RDC
505	343432.2	3065796.956	1288.589	RDC
506	343432	3065793.954	1288.129	RDC
507	343431.4	3065788.738	1288.356	RDC
508	343429.4	3065780.593	1288.361	RDC
509	343429.1	3065773.247	1289.239	RDC
510	343426.3	3065757.891	1289.258	RDC
511	343426.7	3065753.311	1289.254	RDC
512	343426.5	3065796.223	1288.172	CUL
513	343428.4	3065797.775	1288.192	CUL
514	343423.6	3065802.507	1287.919	CUL
515	343421.5	3065801.136	1287.788	CUL
516	343664.5	3065782.302	1289.861	IS7
517	343635.5	3065789.109	1289.137	LRC
518	343641.1	3065788.483	1289.127	LRC
519	343644.7	3065788.73	1289.17	LRC
520	343649.2	3065789.912	1289.22	LRC
521	343653.2	3065792.813	1288.775	LRC
522	343656.5	3065795.087	1288.951	LRC
523	343661.7	3065798.362	1288.866	LRC
524	343664.9	3065800.701	1288.695	LRC
525	343670.7	3065805.137	1288.791	LRC
526	343673.4	3065807.366	1288.793	LRC
527	343676.7	3065810.987	1288.694	LRC

528	343678.5	3065813.985	1288.296	LRC
529	343680.3	3065818.168	1288.241	LRC
530	343682.2	3065824.037	1288.168	LRC
531	343684.9	3065828.03	1288.152	LRC
532	343618.7	3065788.82	1289.239	LRC
533	343694.7	3065845.824	1287.758	LRC
534	343694.7	3065845.826	1287.86	LRC
535	343699.2	3065854.399	1287.9	LRC
536	343699.2	3065861.542	1288.271	LRC
537	343705.5	3065870.097	1288.309	LRC
538	343714.1	3065883.566	1288.252	LRC
539	343719.1	3065891.215	1288.134	LRC
540	343723.3	3065899.239	1288.039	LRC
541	343726.4	3065906.817	1288.014	LRC
542	343728.6	3065912.524	1288.092	LRC
543	343730.6	3065917.129	1288.061	LRC
544	343733.7	3065923.216	1288.101	LRC
545	343739.9	3065935.831	1288.08	LRC
546	343749.3	3065955.176	1288.07	LRC
547	343752.9	3065962.227	1287.955	LRC
548	343757.2	3065969.248	1287.586	LRC
549	343760.2	3065977.218	1287.913	LRC
550	343764.9	3065986.086	1287.92	LRC
551	343769.4	3065992.039	1287.925	LRC
552	343772	3065995.154	1288.035	LRC
553	343776.3	3065999.561	1287.818	LRC
554	343780.9	3066005.058	1287.763	LRC
555	343785.8	3066011.95	1287.7	LRC
556	343789.1	3066016.394	1287.68	LRC
557	343798.4	3066024.373	1287.729	LRC
558	343798.2	3066019.352	1287.504	CL
559	343792.5	3066009.802	1287.476	CL
560	343788.4	3066005.03	1287.523	CL
561	343778	3065991.524	1287.7	CL
562	343774	3065986.213	1287.816	CL
563	343769.2	3065978.747	1287.898	CL
564	343763.8	3065968.544	1287.95	CL
565	343757	3065960.147	1287.884	CL
566	343752.9	3065950.988	1288.005	CL
567	343744.9	3065934.245	1288.048	CL
568	343742	3065926.213	1287.968	CL
569	343737.4	3065913.863	1287.96	CL
570	343730.9	3065900.646	1288.256	CL
571	343726.8	3065892.68	1288.215	CL
572	343721.3	3065883.487	1288.12	CL
573	343716.5	3065874.745	1288.148	CL
574	343713	3065866.786	1288.292	CL
575	343706.4	3065855.655	1288.279	CL
576	343702.4	3065847.343	1288.196	CL
577	343700.7	3065842.207	1288.125	CL
578	343695.7	3065835.26	1288.145	CL
579	343691.9	3065828.554	1288.235	CL
580	343689.4	3065823.234	1288.24	CL

581	343687.8	3065819.072	1288.162	CL
582	343686.3	3065816.112	1288.28	CL
583	343684.6	3065812.479	1288.407	CL
584	343683	3065809.354	1288.467	CL
585	343680.4	3065806.103	1288.56	CL
586	343677.4	3065802.531	1288.648	CL
587	343673.1	3065798.5	1288.714	CL
588	343669.3	3065795.958	1288.681	CL
589	343660.8	3065790.18	1288.72	CL
590	343654.9	3065786.482	1288.828	CL
591	343650.1	3065783.68	1288.928	CL
592	343645.5	3065782.03	1288.98	CL
593	343640.2	3065781.216	1288.991	CL
594	343635.8	3065780.797	1289.037	CL
595	343630.3	3065781.257	1289.046	CL
596	343623.1	3065782.38	1289.13	CL
597	343615.4	3065783.713	1289.163	CL
598	343588	3065783.268	1288.669	RRC
599	343612.4	3065778.05	1288.795	RRC
600	343617	3065777.136	1288.804	RRC
601	343624.8	3065776.074	1289.082	RRC
602	343629	3065775.057	1288.856	RRC
603	343633.7	3065773.861	1288.808	RRC
604	343637.6	3065773.482	1288.79	RRC
605	343645	3065774.711	1288.728	RRC
606	343650.1	3065776.549	1288.73	RRC
607	343658.8	3065782.144	1288.776	RRC
608	343668.2	3065787.877	1288.727	RRC
609	343672.6	3065790.778	1288.809	RRC
610	343679.9	3065796.485	1288.802	RRC
611	343683.9	3065800.091	1288.881	RRC
612	343687	3065803.695	1288.731	RRC
613	343689.2	3065808.511	1288.504	RRC
614	343692.6	3065816.03	1288.345	RRC
615	343697.8	3065827.083	1288.169	RRC
616	343703.8	3065836.625	1288.258	RRC
617	343709.2	3065846.145	1288.232	RRC
618	343715.8	3065858.419	1288.337	RRC
619	343719.9	3065865.722	1288.37	RRC
620	343725.1	3065875.504	1288.279	RRC
621	343731.2	3065886.689	1288.238	RRC
622	343735.9	3065899.653	1288.084	RRC
623	343744.5	3065919.008	1288.241	RRC
624	343749.4	3065927.841	1288.185	RRC
625	343752.7	3065937.102	1288.097	RRC
626	343756.9	3065946.381	1288.009	RRC
627	343762	3065957.276	1288.141	RRC
628	343765.1	3065962.625	1288.092	RRC
629	343770.7	3065970.898	1288.013	RRC
630	343774.1	3065976.342	1287.897	RRC
631	343780.1	3065986.595	1287.904	RRC
632	343784	3065993.984	1287.962	RRC
633	343765.4	3065961.099	1289.036	RDC

634	343761.6	3065954.562	1289.049	RDC
635	343759.5	3065947.669	1288.961	RDC
636	343755.9	3065941.215	1288.99	RDC
637	343752.1	3065930.199	1289.113	RDC
638	343749.3	3065923.08	1289.137	RDC
639	343743.8	3065912.917	1289.129	RDC
640	343741.8	3065905.284	1289.315	RDC
641	343737.6	3065898.284	1288.444	RDC
642	343735.3	3065892.382	1288.611	RDC
643	343730.8	3065882.206	1288.421	RDC
644	343726.4	3065874.907	1288.438	RDC
645	343715.4	3065854.655	1288.593	RDC
646	343703.3	3065833.59	1288.538	RDC
647	343697.7	3065824.084	1288.864	RDC
648	343693.4	3065814.682	1289.073	RDC
649	343691.1	3065809.605	1289.081	RDC
650	343688.7	3065804.719	1289.228	RDC
651	343686.5	3065801.084	1289.338	RDC
652	343681.3	3065796.14	1289.377	RDC
653	343674.9	3065790.81	1289.334	RDC
654	343669.5	3065787.357	1289.324	RDC
655	343659.1	3065780.761	1289.306	RDC
656	343651.5	3065775.857	1289.273	RDC
657	343641	3065772.747	1289.29	RDC
658	343629	3065773.655	1289.297	RDC
659	343620.1	3065775.621	1289.043	RDC
660	343613.3	3065777.001	1288.943	RDC
661	343605.3	3065778.789	1288.794	RDC
662	343593	3065781.382	1288.737	RDC
663	343612.3	3065770.945	1289.611	HC
664	343623.3	3065771.1	1289.633	HC
665	343658.2	3065798.221	1288.296	GT
666	343661.2	3065799.817	1287.934	GT
667	343662.1	3065800.842	1287.918	GT
668	343647.7	3065794.246	1289.525	HC
669	343642.6	3065792.166	1289.456	HC
670	343687.4	3065801.111	1289.481	HC
671	343690.6	3065808.469	1289.135	HC
672	343794.5	3066019.702	1287.897	IS8
673	343765.4	3065963.045	1288.068	RRC
674	343769.2	3065968.965	1288.013	RRC
675	343774.7	3065977.622	1287.827	RRC
676	343779.7	3065984.308	1287.716	RRC
677	343782.3	3065988.369	1287.688	RRC
678	343785.2	3065991.858	1287.685	RRC
679	343788.3	3065996.607	1287.699	RRC
680	343792.1	3066001.542	1287.709	RRC
681	343796.9	3066007.179	1287.761	RRC
682	343800.6	3066011.436	1287.701	RRC
683	343804.2	3066021.515	1287.642	RRC
684	343808.1	3066027.373	1287.64	RRC
685	343812.5	3066032.865	1288.002	RRC
686	343817.7	3066039.086	1287.968	RRC

687	343823.1	3066047.823	1287.93	RRC
688	343828.7	3066054.741	1287.912	RRC
689	343832.9	3066060.367	1288.372	RRC
690	343835.2	3066063.723	1288.529	RRC
691	343836.6	3066067.206	1288.61	RRC
692	343837	3066068.699	1288.624	RRC
693	343836.9	3066070.93	1288.578	RRC
694	343836.5	3066073.04	1288.617	RRC
695	343836	3066076.422	1288.581	RRC
696	343835.2	3066081.173	1288.581	RRC
697	343834.8	3066084.789	1288.518	RRC
698	343833.2	3066078.229	1288.605	CL
699	343833.4	3066075.015	1288.625	CL
700	343833.9	3066071.877	1288.624	CL
701	343834.2	3066067.871	1288.592	CL
702	343832.4	3066064.93	1288.453	CL
703	343831.1	3066062.724	1288.314	CL
704	343829.7	3066060.48	1288.168	CL
705	343826.7	3066056.619	1287.859	CL
706	343823	3066052.077	1287.694	CL
707	343817.7	3066045.342	1287.712	CL
708	343810.7	3066035.784	1287.678	CL
709	343804.4	3066026.873	1287.621	CL
710	343799.9	3066019.845	1287.553	CL
711	343830	3066072.94	1288.501	CL
712	343829.5	3066075.329	1288.483	CL
713	343830.5	3066070.024	1288.456	CL
714	343830.6	3066067.906	1288.373	CL
715	343829.2	3066064.77	1288.219	CL
716	343825.5	3066059.539	1287.971	CL
717	343817.7	3066049.788	1287.606	CL
718	343810.3	3066040.146	1287.666	CL
719	343804.2	3066031.868	1287.699	CL
720	343796.5	3066022.114	1287.798	CL
721	343795.1	3066020.57	1287.884	CL
722	343767.9	3065964.605	1288.947	RDC
723	343773.3	3065972.78	1288.889	RDC
724	343776.4	3065977.314	1288.875	RDC
725	343780	3065982.008	1288.738	RDC
726	343783.2	3065986.307	1288.631	RDC
727	343784.5	3065987.844	1288.763	RDC
728	343787.6	3065992.928	1288.896	RDC
729	343793.3	3066000.762	1289.128	RDC
730	343795.7	3066003.71	1289.072	RDC
731	343798.1	3066006.323	1289.026	RDC
732	343800.1	3066007.047	1289.127	RDC
733	343803.7	3066006.974	1289.293	RDC
734	343804.6	3066020.782	1287.917	RDC
735	343831.5	3066057.04	1288.166	RDC
736	343836.9	3066064.35	1288.768	RDC
737	343837.8	3066068.581	1288.538	RDC
738	343837.8	3066071.434	1288.592	RDC
739	343836.6	3066077.704	1288.775	RDC

740	343774	3066001.666	1287.112	LBW
741	343785.4	3066015.834	1286.565	LBW
742	343785.9	3066017.41	1286.577	LBW
743	343785.7	3066017.936	1286.599	LBW
744	343785.6	3066018.567	1286.615	LBW
745	343785.5	3066019.181	1286.614	LBW
746	343785	3066019.736	1286.616	LBW
747	343787.7	3066022.28	1286.649	LBW
748	343829.6	3066074.945	1288.516	IS9
749	343835.3	3066079.565	1288.599	RRC
750	343834.7	3066082.661	1288.536	RRC
751	343834.9	3066085.473	1288.512	RRC
752	343834.4	3066088.759	1288.497	RRC
753	343834.1	3066091.905	1288.519	RRC
754	343833.7	3066095.302	1288.51	RRC
755	343834	3066100.317	1288.419	RRC
756	343834.7	3066103.703	1288.398	RRC
757	343834.4	3066102.255	1288.381	RRC
758	343835.8	3066111.93	1288.409	CL
759	343834	3066109.211	1288.342	CL
760	343833.2	3066106.758	1288.332	CL
761	343832.1	3066102.207	1288.39	CL
762	343831.5	3066099.476	1288.382	CL
763	343831.5	3066095.239	1288.414	CL
764	343831.2	3066091.167	1288.435	CL
765	343831.9	3066086.943	1288.47	CL
766	343832.8	3066079.958	1288.575	CL
767	343832.3	3066083.377	1288.523	CL
768	343833.4	3066075.168	1288.602	CL
769	343828.6	3066077.561	1288.379	LRC
770	343827.7	3066087.548	1288.102	LRC
771	343827.3	3066091.04	1288.332	LRC
772	343826.7	3066093.602	1288.454	LRC
773	343826.5	3066096.021	1288.511	LRC
774	343826.6	3066098.733	1288.427	LRC
775	343826.7	3066101.926	1288.417	LRC
776	343827.9	3066105.122	1288.33	LRC
777	343829.1	3066108.464	1288.335	LRC
778	343830.6	3066110.907	1288.264	LRC
779	343831.4	3066114.078	1288.303	LRC
780	343834.5	3066116.318	1288.151	LRC
781	343836.8	3066117.967	1288.647	LRC
782	343835.6	3066117.799	1288.154	GT
783	343832	3066116.21	1288.024	GT
784	343830.1	3066115.466	1288.035	GT
785	343826.5	3066104.465	1288.43	TR
786	343825.5	3066100.164	1288.451	TR
787	343825.2	3066094.955	1288.584	TR
788	343827.2	3066087.147	1287.974	SRP
789	343825.3	3066087.166	1287.504	SRP
790	343823.7	3066087.42	1287.117	SRP
791	343822.8	3066084.531	1287.232	SRP
792	343824.6	3066083.144	1287.477	SRP

793	343826.5	3066080.873	1288.035	SRP
794	343838.1	3066118.436	1288.742	IS10
795	343834.5	3066102.689	1288.38	RRC
796	343834.9	3066104.064	1288.372	RRC
797	343835.5	3066105.445	1288.327	RRC
798	343836.7	3066107.797	1288.413	RRC
799	343838.3	3066110.349	1288.428	RRC
800	343840	3066112.451	1288.562	RRC
801	343842	3066114.223	1288.571	RRC
802	343843.8	3066115.601	1288.956	RRC
803	343845.7	3066116.825	1289.486	RRC
804	343847.3	3066118.067	1289.463	RRC
805	343849.3	3066118.507	1289.464	RRC
806	343850.9	3066118.796	1289.565	RRC
807	343854.3	3066119.338	1289.857	RRC
808	343857.3	3066119.355	1290.119	RRC
809	343836.4	3066112.354	1288.39	CL
810	343835.2	3066110.461	1288.373	CL
811	343837.9	3066114.318	1288.516	CL
812	343839.9	3066116.371	1288.752	CL
813	343841.6	3066117.844	1288.892	CL
814	343843.5	3066118.889	1289.094	CL
815	343845.5	3066120.223	1289.256	CL
816	343849	3066121.201	1289.577	CL
817	343851.2	3066121.412	1289.763	CL
818	343854.3	3066122.019	1290.021	CL
819	343858.3	3066121.959	1290.23	CL
820	343862.6	3066121.92	1290.524	CL
821	343868.2	3066121.523	1290.746	CL
822	343872.6	3066121.148	1290.986	CL
823	343878.1	3066120.41	1291.138	CL
824	343840.3	3066120.448	1288.977	LRC
825	343842.4	3066121.665	1289.22	LRC
826	343845.2	3066123.011	1289.405	LRC
827	343849.1	3066123.916	1289.628	LRC
828	343852.8	3066124.351	1289.896	LRC
829	343857.2	3066124.618	1290.19	LRC
830	343860.7	3066124.496	1290.453	LRC
831	343863.3	3066124.674	1290.765	LRC
832	343867.8	3066124.526	1291.087	LRC
833	343871.4	3066124.147	1290.952	LRC
834	343874.9	3066123.769	1291.025	LRC
835	343878.9	3066122.855	1291.129	LRC
836	343883.9	3066122.095	1291.29	LRC
837	343888.6	3066121.264	1291.947	LRC
838	343894.6	3066121.302	1291.688	LRC
839	343925.8	3066127.944	1292.403	LRC
840	343926.7	3066129.925	1292.711	LRC
841	343936	3066133.613	1293.01	IS11
842	343934.2	3066129.944	1292.891	RRC
843	343932.3	3066126.663	1292.771	RRC
844	343931.1	3066124.604	1292.704	RRC
845	343929.6	3066122.24	1292.435	RRC

846	343928.4	3066120.44	1292.262	RRC
847	343927.3	3066119.322	1292.291	RRC
848	343925.4	3066118.097	1292.205	RRC
849	343924.2	3066117.247	1292.285	RRC
850	343922.8	3066116.531	1292.462	RRC
851	343919.8	3066114.946	1292.749	RRC
852	343918	3066114.349	1292.781	RRC
853	343916.1	3066114.027	1292.704	RRC
854	343913.9	3066113.928	1292.771	RRC
855	343911.7	3066113.732	1292.856	RRC
856	343909.2	3066114.198	1292.49	RRC
857	343906.7	3066115.035	1292.346	RRC
858	343902.1	3066115.108	1292.214	RRC
859	343895.7	3066115.164	1291.883	RRC
860	343888.5	3066114.922	1291.556	RRC
861	343884.4	3066114.797	1291.966	RRC
862	343877.2	3066116.301	1290.945	RRC
863	343872.1	3066117.83	1290.832	RRC
864	343868	3066118.308	1290.587	RRC
865	343864	3066118.886	1290.423	RRC
866	343861.2	3066118.859	1290.263	RRC
867	343858.4	3066119.144	1290.165	RRC
868	343855.4	3066119.135	1289.977	RRC
869	343876.8	3066120.146	1291.081	CL
870	343883.4	3066119.366	1291.419	CL
871	343895.3	3066117.703	1291.835	CL
872	343911.1	3066117.626	1292.579	CL
873	343913.6	3066117.367	1292.557	CL
874	343916.1	3066117.65	1292.562	CL
875	343918	3066118.099	1292.485	CL
876	343919.6	3066118.946	1292.417	CL
877	343921.5	3066119.503	1292.281	CL
878	343923.9	3066121.932	1292.024	CL
879	343925.5	3066123.27	1292.073	CL
880	343928.9	3066128.169	1292.62	CL
881	343932.2	3066131.961	1292.797	CL
882	343936.3	3066138.264	1293.087	CL
883	343939.8	3066144.763	1293.474	CL
884	343944.4	3066154.853	1293.94	CL
885	343948	3066163.94	1294.508	CL
886	343952	3066175.735	1295.208	CL
887	343953	3066179.253	1295.44	CL
888	343955	3066187.569	1295.732	CL
889	343955.6	3066193.841	1295.814	CL
890	343956.4	3066198.206	1295.943	CL
891	343963.5	3066216.149	1296.179	RRC
892	343961.7	3066212.389	1296.1	RRC
893	343960.4	3066208.748	1296.089	RRC
894	343959.3	3066205.529	1296.073	RRC
895	343958.6	3066202.415	1296.017	RRC
896	343958	3066198.7	1296.026	RRC
897	343958.1	3066195.584	1296.021	RRC
898	343958.4	3066191.176	1295.922	RRC

899	343958.1	3066187.503	1295.726	RRC
900	343957.2	3066184.594	1295.704	RRC
901	343956.1	3066182.009	1295.566	RRC
902	343954.9	3066177.786	1295.451	RRC
903	343953.4	3066173.458	1295.132	RRC
904	343952.2	3066169.185	1294.879	RRC
905	343950.3	3066164.481	1294.347	RRC
906	343945.9	3066153.605	1293.743	RRC
907	343942.4	3066145.535	1293.445	RRC
908	343938.6	3066137.793	1293.098	RRC
909	343893.8	3066120.927	1291.84	LRC
910	343899	3066120.378	1292.089	LRC
911	343905.6	3066120.431	1292.357	LRC
912	343911.7	3066120.332	1292.636	LRC
913	343916.5	3066121.011	1292.582	LRC
914	343921.1	3066122.113	1292.134	LRC
915	343923.9	3066125.787	1292.044	LRC
916	343927	3066131.125	1292.798	LRC
917	343928.6	3066134.452	1293.036	LRC
918	343935	3066142.574	1293.291	LRC
919	343938	3066147.228	1293.603	LRC
920	343942.6	3066157.076	1293.916	LRC
921	343946.5	3066166.5	1294.528	LRC
922	343949.3	3066174.629	1295.185	LRC
923	343951	3066180.897	1295.666	LRC
924	343952.7	3066187.006	1295.697	LRC
925	343952.8	3066189.335	1295.816	LRC
926	343955.1	3066174.078	1295.272	RDC
927	343952.7	3066167.123	1294.829	RDC
928	343950	3066160.925	1294.246	RDC
929	343945.3	3066150.167	1293.768	RDC
930	343941.3	3066140.882	1293.358	RDC
931	343935.4	3066129.655	1293.125	RDC
932	343931.5	3066121.118	1292.47	RDC
933	343929	3066121.812	1292.328	CUL
934	343927.1	3066118.635	1292.319	CUL
935	343921.6	3066122.533	1292.043	CUL
936	343924.3	3066125.848	1292.128	CUL
937	343921.7	3066134.69	1293.805	HC
938	343926.7	3066147.477	1293.767	HC
939	343968.1	3066233.425	1296.765	IS12
940	343951.5	3066181.969	1295.541	LRC
941	343951.9	3066184.819	1295.688	LRC
942	343952.5	3066191.575	1295.905	LRC
943	343953.1	3066195.648	1295.923	LRC
944	343953.5	3066200.033	1296.035	LRC
945	343953.7	3066203.068	1296.084	LRC
946	343954.1	3066205.988	1296.117	LRC
947	343955.3	3066210.697	1296.121	LRC
948	343956.8	3066214.726	1296.196	LRC
949	343958.6	3066218.508	1296.224	LRC
950	343963.2	3066227.004	1296.395	LRC
951	343966	3066230.897	1296.515	LRC

952	343972.8	3066237.726	1296.984	LRC
953	343979.8	3066243.109	1297.396	LRC
954	343982.8	3066246.005	1297.403	LRC
955	343993	3066254.396	1297.14	CL
956	343991.4	3066251.681	1297.188	CL
957	343989.7	3066249.074	1297.242	CL
958	343988.2	3066247.629	1297.235	CL
959	343986.6	3066245.942	1297.233	CL
960	343980.6	3066241.724	1297.319	CL
961	343975.9	3066237.638	1297.043	CL
962	343971.8	3066234.064	1296.742	CL
963	343967.2	3066228.279	1296.383	CL
964	343963	3066221.235	1296.22	CL
965	343960	3066215.593	1296.111	CL
966	343957.6	3066207.623	1295.912	CL
967	343955.9	3066202.114	1295.979	CL
968	343955.2	3066196.047	1295.864	CL
969	343954.7	3066190.776	1295.791	CL
970	343963.5	3066215.548	1296.152	RRC
971	343966.1	3066220.411	1296.235	RRC
972	343968.3	3066225.578	1296.382	RRC
973	343970.2	3066228.905	1296.486	RRC
974	343971.8	3066230.928	1296.608	RRC
975	343974	3066232.949	1296.766	RRC
976	343978.9	3066237.618	1297.201	RRC
977	343985	3066242.019	1297.4	RRC
978	343992	3066244.649	1297.455	RRC
979	343997.5	3066246.769	1297.653	RRC
980	344001.7	3066249.795	1298.122	RRC
981	343997.3	3066250.269	1297.505	IS13
982	344002.1	3066254.486	1298.302	RRC
983	344000.9	3066258.745	1297.926	RRC
984	343983.8	3066238.026	1298.339	HC
985	343977	3066229.387	1298.161	HC
986	343983.8	3066247.458	1297.36	LRC
987	343985.4	3066249.632	1297.265	LRC
988	343987.3	3066252.164	1297.292	LRC
989	343988.5	3066254.56	1297.284	LRC
990	343989.3	3066256.92	1297.225	LRC
991	343990.1	3066259.823	1297.078	LRC
992	343990.5	3066263.293	1296.952	LRC
993	343989.1	3066270.012	1296.744	LRC
994	343985.4	3066279.41	1296.503	LRC
995	343981.6	3066287.152	1296.313	LRC
996	343978.1	3066294.853	1296.197	LRC
997	343975.9	3066300.888	1296.003	LRC
998	343974.9	3066305.921	1295.76	LRC
999	343974	3066310.964	1295.642	LRC
1000	343973.8	3066317.155	1295.461	LRC
1001	343974.5	3066324.281	1295.301	LRC
1002	343974.6	3066328.672	1295.21	LRC
1003	343975.9	3066317.825	1295.194	CL
1004	343976.4	3066309.825	1295.51	CL

1005	343977.5	3066304.875	1295.62	CL
1006	343979.7	3066296.526	1295.968	CL
1007	343982.1	3066292.466	1296.111	CL
1008	343985.4	3066285.472	1296.224	CL
1009	343987.8	3066280.021	1296.374	CL
1010	343990.4	3066272.873	1296.514	CL
1011	343993.1	3066266.855	1296.688	CL
1012	343994	3066262.537	1296.895	CL
1013	343995	3066257.666	1297.135	CL
1014	343994.7	3066255.39	1297.202	CL
1015	344000.7	3066261.503	1297.474	RRC
1016	343999.8	3066263.491	1297.471	RRC
1017	343998.5	3066266.308	1297.24	RRC
1018	343997.1	3066269.047	1297.037	RRC
1019	343994.2	3066276.589	1296.453	RRC
1020	343987.2	3066288.649	1296.076	RRC
1021	343985.3	3066293.293	1296.032	RRC
1022	343983.2	3066296.366	1295.819	RRC
1023	343981.1	3066301.945	1295.718	RRC
1024	343980.5	3066304.604	1295.629	RRC
1025	343979.1	3066308.153	1295.268	RRC
1026	343978.5	3066312.079	1295.065	RRC
1027	343978.4	3066314.462	1295.311	RRC
1028	343979.5	3066311.75	1295.508	RRC
1029	343981	3066305.973	1295.586	RDC
1030	343982	3066303.033	1295.851	RDC
1031	343982.9	3066299.901	1295.775	RDC
1032	343985.1	3066295.029	1295.993	RDC
1033	343986.3	3066292.709	1295.924	RDC
1034	343993.8	3066280.887	1296.478	RDC
1035	343996.4	3066274.651	1296.465	RDC
1036	343998	3066270.962	1296.462	RDC
1037	344004.9	3066259.678	1298.317	RDC
1038	344003.9	3066251.397	1298.593	RP
1039	344006.5	3066251.603	1298.484	RP
1040	344010.5	3066249.415	1299.342	RP
1041	344004.5	3066258.002	1298.44	RP
1042	344010.5	3066255.786	1299.217	RP
1043	343999.6	3066271.926	1296.769	HC
1044	343995.9	3066279.368	1296.835	HC
1045	343986.3	3066263.783	1296.956	HC
1046	343985.7	3066269.934	1296.976	HC
1047	343974.9	3066327.341	1295.34	IS14
1048	343978.7	3066318.978	1295.215	RRC
1049	343979.6	3066324.652	1294.892	RRC
1050	343980.2	3066329.526	1295.03	RRC
1051	343982.3	3066336.143	1294.943	RRC
1052	343985.6	3066345.432	1294.617	RRC
1053	343988.4	3066351.823	1294.475	RRC
1054	343993.4	3066361.791	1294.13	RRC
1055	343997	3066370.955	1294.001	RRC
1056	343999.1	3066379.041	1293.862	RRC
1057	344000.5	3066387.896	1293.569	RRC

1058	344000	3066396.608	1293.294	RRC
1059	343999	3066405.399	1292.98	RRC
1060	343997.7	3066394.552	1293.148	CL
1061	343997.2	3066388.354	1293.37	CL
1062	343996.9	3066384.204	1293.594	CL
1063	343996.3	3066379.814	1293.773	CL
1064	343995.1	3066374.589	1293.968	CL
1065	343993.7	3066369.567	1294.117	CL
1066	343991.4	3066364.21	1294.243	CL
1067	343989.3	3066359.98	1294.286	CL
1068	343986.1	3066353.854	1294.437	CL
1069	343983.8	3066348.9	1294.596	CL
1070	343982.2	3066344.597	1294.636	CL
1071	343980.5	3066339.754	1294.756	CL
1072	343979.3	3066335.47	1294.845	CL
1073	343978.1	3066331.27	1294.892	CL
1074	343977.4	3066328.046	1294.943	CL
1075	343976.7	3066324.677	1295.024	CL
1076	343975.9	3066331.858	1294.914	LRC
1077	343976.6	3066337.664	1294.832	LRC
1078	343978.9	3066346.039	1294.826	LRC
1079	343983.7	3066355.588	1294.691	LRC
1080	343988	3066362.77	1294.457	LRC
1081	343990.7	3066368.812	1294.364	LRC
1082	343992.3	3066373.516	1294.223	LRC
1083	343993.5	3066378.513	1294.004	LRC
1084	343994.1	3066383.483	1293.868	LRC
1085	343994.6	3066388.781	1293.588	LRC
1086	343994.9	3066392.309	1293.312	LRC
1087	344001.5	3066394.342	1293.365	RDC
1088	344001.8	3066390.533	1293.638	RDC
1089	344001.8	3066386.664	1293.62	RDC
1090	344000	3066378.895	1294.008	RDC
1091	343998.8	3066373.66	1294.383	RDC
1092	343997.9	3066370.164	1294.164	RDC
1093	343994.1	3066360.364	1294.217	RDC
1094	343991.8	3066355.695	1294.333	RDC
1095	343988.6	3066348.956	1294.491	RDC
1096	343986.4	3066344.179	1294.579	RDC
1097	343985.3	3066340.928	1294.753	RDC
1098	343984.4	3066337.925	1294.946	RDC
1099	343982.2	3066331.067	1295.406	RDC
1100	343980.8	3066326.11	1294.94	RDC
1101	343980.2	3066322.142	1295.147	RDC
1102	343979.7	3066318.186	1295.325	RDC
1103	343979.3	3066314.961	1295.297	RDC
1104	343973.2	3066333.657	1295.332	HC
1105	343975.5	3066346.812	1295.403	HC
1106	344005.7	3066414.708	1293.785	HC

ANNEX 2
QUANTITY AND COST

ANNEX 3
DRAWING