TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS
DEPARTMENT OF CIVIL ENGINEERING

A
Report
On

Detailed Engineering Survey, Design and Cost Estimation of Chhaling Road

[Code No.: CE755]

A final year project submitted in partial fulfillment of the requirement for the Degree of Bachelor in Civil Engineering

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CERTIFICATE

This is to certify that this project work entitled "Detailed Engineering Survey, Design and Cost Estimation of Chhaling Road" has been examined and declared successful for the fulfillment of academic requirement towards the completion of Bachelor Degree in Civil Engineering.

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ABSTRACT

This project focuses on the detail design and cost estimation of a road section from Dhungedhara to Macchenarayan Temple (Chhaling Road). The Chhaling road connects the residential areas to the more commercial area, providing transportation service to people, materials and goods, the most frequent were the school buses transporting students. A newly renovated Macchenarayan temple is at the end of the road so we hope we can promote local tourist to visit the religious heritage site. The designed road is a class III road with design speed 40 kmph and follows design standards of NRS-2070. The road section has been designed as intermediate lane road of total width of 5.5m, it is recommended to have two treated shoulders on either side with a total pavement thickness of 375 mm. Civil 3D and Google Earth were used for site study and design works. Since, the road is in rolling terrain, gradients were provided in vertical profile, keeping grade relaxation in consideration. Longitudinal and cross drainage was provided after proper hydrological study, and necessary retaining walls were provided in fill portion for stability. Total earthwork was 64574.9 cu.m. in cut portion and 37951.82 cu.m. in fill portion. Cost estimation showed the total cost of project as Rs 7,84,10,341.37 and Rs 2,83,11,717.89 per km.

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AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
ADV	Average Daily Volume
ALD	Average Least Dimension
BC	Beginning of Curve
CBR	California Bearing Ratio
DHM	Department of Hydrology and Meteorology
DOR	Department of Road
EC	End of Curve
EG	Existing Ground
GIS	Geographic Information System
GPS	Global Positioning System
IOE	Institute of Engineering
IP	Intersection Point
ISD	Intermediate Sight Distance
MC	Middle of Curve
NRRS	Nepal Rural Road Standard
NURS	Nepal Urban Road Standard
NRS	Nepal Road Standard
OMC	Optimum Moisture Content
OSD	Overtaking Sight Distance
PCU	Passenger Car Unit
PHF	Peak Hour Factor
PI	Point of Tangential Intersection
PT	Point of Tangency
PVI	Point of Vertical Intersection
RL	Reduced Level
ROW	Right of Way
SRN	Strategic Road Network
SSD	Stopping Sight Distance
Tc	Time of Concentration

SALIENT FEATURES

Features	**Description**
Name of the Road	Chhaling Road
Scope	Detail Design
Location	
Province	Bagmati
District	Bhaktapur
Municipality/VDC	Changunarayan Municipality
Length	2.76 km
Starting point	Dhunge Dhara
End point	Machhenarayan Temple
Design Life	10 years
Geographical Features	
Terrain	Rolling
Altitude Range	1320-1425 m
Climate	Warm Temperate
Geology	The road passes through area with Kalimati Formation and some parts of Chapagaun formation. Pre Cambrian to Devonian rocks, thin parallel lamination of alternating silt and silty clay.
Meteorology	Unevenly distributed precipitation controlled by Monsoon
Design Standard and Geometrics	
Standard	NRS-2070, DOR-2021, IRC-2018, Road Note-31 etc.
Road category	Administrative Classification: District Road
	Technical Classification: Class III
Design speed	40 kmph
Right of way	10 m on either side
Formation width	7.5m
Carriageway width	5.5m
Shoulder width	1 m on either side
Maximum gradient	9.64%
Minimum gradient	0.51%
Minimum radius	19.27m
Maximum superelevation	7%

Pavement	
Surface course	SD (25mm)
Base course	150mm Granular Material
Sub-base course	175mm Granular Material
Drainage	
Camber	2.0%
Pipe culverts	7, each 600 mm Dia.
Earthwork	
Embankment/Filling	$37951.82m^3$
Excavation/Cutting	$64574.9m^3$
Cost (NRs.)	
Site clearance	92,449.24
Earthwork	93,94,224.541
Pavement	3,80,76,074.73
Drainage work	14,33,045.088
Structure work	1,36,63,314.25
Total project cost	**6,26,59,107.85**
Cost per km	2,27,02,575.31

1. INTRODUCTION

1.1. Background

Nepal is known for its diverse topography, which ranges from flat plains to the foothills of the Himalayas. This diversity extends to the country's people, with significant variations in culture, traditions, and ethnicity. Agriculture remains the primary occupation in the predominantly rural country, although there is a trend of migration from villages to cities due to a lack of infrastructure and employment opportunities outside the capital.

Recently, Nepal has transitioned to a new federal governance system, with roads falling under the management of a new 3-tier government system. As a result, there is an urgent need for appropriate road assignments and confirmation of applicable geometric design standards to avoid delays in development. The Ministry of Physical Infrastructure Development and Transport Infrastructure Directorate of the Bagmati Province Government is responsible for the planning, implementation, and maintenance of provincial roads and bridges.

The focus of this project is on the design of a flexible pavement for the Chhaling Road, which serves as a crucial link between Dhungedhara and the revered Macchenarayan Temple in Nepal. Before this, on November 22, 2022, the decision to go around certain places near Kathmandu valley in order to find some suitable roads to perform road survey was made resulting to reconnaissance of 3 roads. One was Changunarayan Road which started from Pikhel bus stop all the way up to Changunarayan Temple. Another was the Chhaling Road which started from the Dhunge Dhara where Machhenarayan Temple was decided to be the end point. The last place that we decided to perform the reconnaissance was the road from Khokana to Sikali Temple but the route was found to be shorter than the requirement.

Option 1: Changunarayan Road (from Pikhel Bus Stop to Changunarayan Temple to be exact)
Length: ~ 3 km
Road condition: perfectly pitched road with well-maintained condition
Lane: 2 lanes (1 lane in each direction)

Option 2: Chhaling Road (from Dhungedhara to Macchenarayan Temple)
Length: ~3 km
Road Condition: too many potholes, haven't been pitched in a long time

Lane: 1 lane

Option 3: Sikali Road (From Khokana Bus Stop to Sikali Temple)

Length: ~2 km

Road Condition: haven't been pitched before, gravel road

Lane: 1 lane

Among these options, the Chhaling road proved to be the best option as it met the criteria of length and wasn't wide enough for its use. During the reconnaissance survey, a 15-minute traffic survey was performed at those places but particularly the vehicle movement, especially the frequency of school buses made the expansion and maintenance of Chhaling Road much more desirable. In addition to it, a nursery at the beginning of the surveyed road, a brick factory and even a newly renovated Macchenarayan temple at the end was found so, with better designed road their facilitation would be better too. Thus, keeping the above things in mind, the Chhaling road was selected.

The Chhaling Road is a Class-III road with a design speed of 40 kmph that fails to meet current road standards, causing traffic problems and safety risks. Therefore, this project focuses on the redesign of a section of the Chhaling Road, specifically from Dhungedhara to Machhenarayan Temple. The redesign is based on the Nepal Road Standard-2070 and serves as a representation of the overall topography and socio-economic condition of the road.

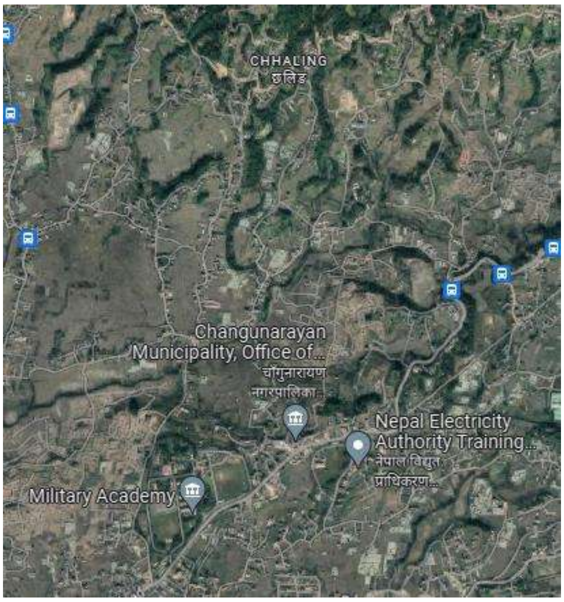


Figure 1: Satellite view of project site

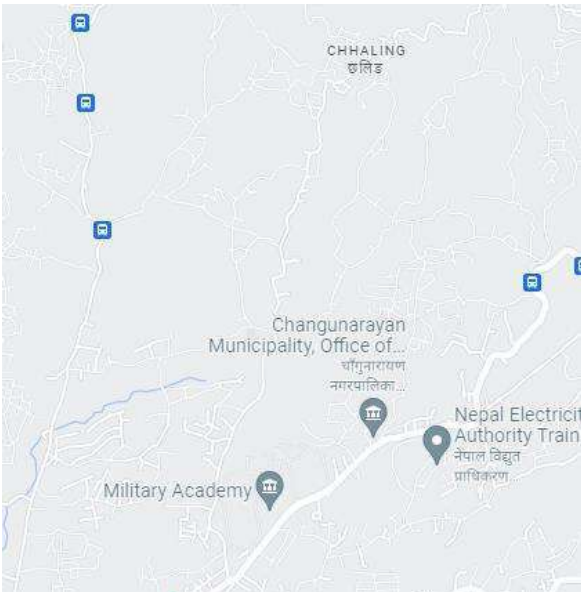


Figure 2: Terrain view of project site

1.2. Title of Project

The project is titled "Detailed Engineering Survey, Design and Cost estimation of Chhaling Road"

1.3. Objectives

The goals of this project are as follows:

- Determine the most suitable route from the starting point to the ending location using the data gathered from a detailed engineering survey.
- Develop comprehensive horizontal and vertical alignment designs
- Perform laboratory tests (such as CBR tests) on soil samples and design the pavement accordingly
- Identify the appropriate catchment area and design both longitudinal and cross drainage structures.
- Prepare a detailed cost estimate that includes detailed quantities of materials and labor.

1.4. Scope and Limitations

In regard to the project, the following outlines its scope:

- Creating a comprehensive road design in accordance with Nepal Road Standard - 2070
- Designing a detailed pavement design using DoR/ Road Note 31
- Designing drainage and side drains
- Designing retaining walls based on IRC
- Creating various drawings including alignment plan, design profile, design cross-section, and mass haul diagram
- Preparing a thorough cost estimate

However, there are also limitations to the project, such as:

- Lack of yearly traffic data. As a result, the traffic growth rate was calculated using data obtained solely from the traffic study conducted during the survey.
- Lack of latest hydrological data due to which rainfall intensity calculated was based upon those collected upto year 2011 only.

- Lack of design provision for low traffic volume road in DoR guidelines for flexible pavement 2021
- Due to inaccessible site conditions in certain areas, it was not possible to take survey readings throughout the entire ROW in the field.
- Criteria for minimum radius could not be fulfilled at a chainage due to topographical conditions.
- CBR value of 5 mm penetration was adopted for first 2 samples and hence calculation was done due to inability of conducting the test for a second time.
- Assumption of the surface category of the site due to inability of performing a probe penetration test given the lack of resources and time constraints. Due to similar circumstances, ALD of the chippings was also assumed.

2. LITERATURE REVIEW

2.1. Engineering Survey and Highway Alignment

Highway alignment is the layout of the center line of the highway. It includes horizontal as well as vertical alignment of the highway. Khanna and Justo (2001) as well as Shrestha and Marsani (2014) provide a comprehensive overview of the fundamental principles of highway alignment. The requirements in an ideal highway alignment are:

- Safe
- Easy
- Short
- Economical
- Comfort

Factors controlling the highway alignment are:

- Obligatory points
- Geological conditions
- Geometric designs
- Economy
- Governmental requirements, etc.

Engineering survey and its stages can be classified as:

Map study: Information regarding ponds, lakes, valleys, etc and possible bridge locations are obtained from the topographical maps of the related area. Based on this information, several potential road alignments are identified on the map.

Reconnaissance: It is an extensive study of an entire area used for highway alignment. Different characteristics of the sites are noted such as valley, ponds and other features which were not identified in the topographical. In this stage, simple survey instruments are used. Soil characteristics along the routes are identified using different tests. Radius of curvature, length and gradient values are also determined.

Preliminary survey: Preliminary survey is carried out to finalize the best possible highway alignment. Necessary information including details of topography, soil characteristics, drainage are collected to compare different alignment routes in view of the requirements of an ideal alignment.

Detailed survey: The finalized alignment from the preliminary survey is located in the field by establishing the center line. Geometric design criteria are checked after establishing control points and inserting central pegs. Detailed survey is carried out to draw soil profiles, calculating earthworks, the data is also used for preparing plans, designing and estimating the road project.

Khanna and Justo (2001) also classify the planning survey into different categories:
Economics studies: The project's economic viability is taken into account by the economic study. The study will need information on the distribution of the population, the trajectory of population growth, industry, agricultural goods, etc.

Financial studies: This investigates a project's financial characteristics and investment requirements to ascertain its viability.

Traffic studies: To project the flow to the design year, an analysis of the existing traffic flow in the area is required. The design is done for a minimum of ten years. Futher study of the origin and destination is required for expansion of road.

Engineering studies: This phase involves in-depth study and all the survey processes stated in the engineering survey process. It establishes the project's technological viability.

2.2. Special Consideration in Hill Road Design

Khanna and Justo (2001) outlines the basic factors controlling hill road design as:

- Stability of slopes
- Drainage such as considering construction of catchpit where necessary
- Geometric standards such as design in ruling gradients
- Resisting length for economic criteria

Some other factors to be considered are; availability of construction materials, cross drainage structures, altitude of roads, etc

Shrestha and Marsani (2014) describe the salient features necessary for the hill roads. Although the survey works are carried out as in the normal highway design, but certain new factors must be taken into account during the preliminary stage such as gradient. The gradient selected is ruling which is suitable for the hill road. Additionally, drainage and directional features, such as an alignment in the south direction, must also be considered.

Shrestha and Marsani divide the alignment of hill routes into two types:

- **Ridge route**: This route is generally not preferred. It is characterized by steep gradient, hairpin bends. It requires extensive earthwork and different stabilizing constructions. It increases cost and is time consuming.
- **River route**: If the location of the route is along a river valley, the route is known as river route. This route is considered to be safest. It runs at a gentle gradient due to which the design speed is relatively high and the construction cost is low.

Extensive amount of earthworks are required in hill roads which increase the construction cost. Though steep gradient reduces the earthwork and length of the road, it decreases the design speed and increases the fuel consumption rate. Considering these factors the best possible route is to be chosen.

General considerations

The route is chosen while planning hill roads to follow valleys, hill sides, and, if necessary, over mountain passes. The trip naturally becomes longer due to the route's difficult geography. It is also necessary to create unique constructions due to the challenging geological conditions. Climate and geological conditions are equally significant, in addition to the severely fragmented relief, which plays a fixed role in determining the alignment and location of distinctive structures. When determining the alignment, particular attention should be paid to changes in:

- Temperature
- Rainfall
- Atmospheric pressure and winds
- Geological conditions

Temperature: The temperature of the air is lower on the hills than it is in the valley. Every 100 meters of upward movement caused a roughly 0.5° temperature reduction. Uneven warming of slopes, sharp temperature variations, and water erosion are the causes of slopes facing south and southwest. Snow disappears quickly and rain water evaporates quickly on slopes facing south and southwest, while rain water or snow may remain for a longer time on slopes facing north and northeast.

Rainfall: With rising sea levels, rainfall rises. The zone of intense cloud formation at 1500–2500 meters above sea level is where rainfall is at its highest. Rainfall typically rises by 40 to 60 mm for every 100 meters of elevation. As much as 15 to 25% of the annual rainfall may occur in single rainfall. These forms of rainfall have major implications and should be carefully considered.

Atmospheric pressure and winds: At high elevations, the wind speeds may reach up to 25-30 m/s, and the depth of frost penetration is likewise 1.5 to 2 m. atmospheric pressure decreases with increases in elevation. The intense weathering of rocks caused by sudden temperature changes that generate strong winds.

Geological conditions: The types of rocks, the degree of strata inclination or dip, the presence of clay seams, the hardness of the rocks, and the availability of ground water all affect how stable a hill slope is. When choosing a path, we must carefully consider the local geology and stick to stable hill slopes free of ground water, landslides, and unstable folds. Folds can have an inclination that ranges from horizontal to vertical rock strata which often have faults. Folds in limestone or sandstone may be surrounded by clay layers that, when wet, could fracture along their surface. Shear or slip folding could arise from this.

2.3. Geometric Design Study

2.3.1. Background

The geometric design of a highway refers to the process of planning and designing the physical features of a highway, including its alignment, cross-section, and vertical profile. The goal of geometric design is to ensure that the highway is safe, efficient, and comfortable for users.

The design must take into account a range of factors, including traffic volume, terrain, and environmental concerns, to create a highway that is well-suited to its surroundings and meets the needs of all users.

2.3.2. Factors Controlling Geometric Design:

Road classification:

As per the Nepal Road Standard 2070, roads are classified as follows:

A. Administrative Classification:

Administrative classification of roads is intended for assigning national importance and level of government responsible for overall management and methods of financing. According to this classification roads are classified into:

National Highways

Feeder Roads

District Roads

Urban Roads

In Nepal the overall management of National Highways and Feeder Roads comes within the responsibility of the Department of Roads (DOR). These roads are collectively called Strategic Roads Network (SRN) roads. District Roads and Urban Roads are managed by Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR). These roads are collectively called Local Roads Network (LRN) roads.

B. Technical/ Functional Classification*:

For assigning various geometric and technical parameters for design, roads are categorized into classes as follows:

Class I:

Class I roads are the highest standard roads with divided carriageway and access control (Expressways) with ADT of 20,000 PCU or more in 20 years perspective period. Design speed adopted for design of this class of roads in plain terrain is120 km/h.

Class II:

Class II roads are those with ADT of 5000-20000 PCU in 20 years perspective period. Design speed adopted for design of this class of roads in plain terrain is 100 km/h.

Class III:

Class III roads are those with ADT of 2000-5000 PCU in 20 years perspective period. Design speed adopted for design of this class of roads in plain terrain is 80 km/h

Class IV:

Class IV roads are those with ADT of less than 2000 PCU in 20 yrs perspective period.

*Approximate equivalence with road classification in other countries is as follows: class I roads correspond to expressways, class II –to arterial roads, class III-to collector roads and class IV-to local roads.

Vehicle Dimensions:

The maximum dimensions of vehicles considered for design of roads in Nepal are as follows:

Table 1: Vehicle Dimensions

Maximum Width, m	2.50
Maximum Height, m	4.75
Maximum Length, m	18.00
Maximum single axle load, kN	100

Equivalency Factors

Different types of vehicles take up differing amounts of road space and have different speeds (For geometric design) and impose differing loads on the road structure (For structural design). It is, therefore, necessary to adopt a standard traffic unit to which other types of vehicles may be related. For geometric design of roads this standard is the 'Passenger Car Unit (PCU)' which is that of a normal car (passenger car), light van or pick-up. Other types of vehicles are taken into account by multiplying by the following equivalency factors.

Table 2: Vehicle Types, Equivalency Factors

SN	Vehicle Type	Equivalency Factor
4	Bicycle, Motorcycle	0.5
1	Car, Auto Rickshaw, SUV, Light Van and Pick Up	1.0
2	Light (Mini) Truck, Tractor, Rickshaw	1.5
3	Truck, Bus, Minibus, Tractor with trailer	3.0
5	Non-motorized carts	6

Design Speed:

Design speed is a selected speed used to determine the various geometric features of the roadway. The assumed design speed should be a logical one with respect to the topography, anticipated operating speed, the adjacent land use, and the functional classification of the highway. The design speed to be adopted for various classes of roads is given in Table 3.

Table 3: Design Speeds, kmph

Road Class	Plain	Rolling	Mountainous	Steep
I	120	100	80	60
II	100	80	60	40
III	80	60	40	30
IV	60	40	30	20

But in very difficult terrains and unavoidable circumstances, design speed can be reduced to 75% of the values given on the Table 3.

2.3.3. Cross Sectional Elements

Carriageway

The width of carriageway depends on many factors including the dimension of vehicles using the road, speed of travel, traffic volume, width of shoulder, level of service etc. The standard width of carriageway shall be as shown on the following Table 4.

Table 4: Width of Carriageways, m

Single lane road	Intermediate lane	Multilane pavements width per lane
3.75 (upto 3.0 m in diificult terrain)	5.5	3.5

In case of single lane road, it is recommended to have two treated shoulders on either side to make a total width of 5.5m of treated surface.

Right of way

Right of way for different types of roads shall be as follows:

Table 5: Right of Way

Road Type	Total Right of Way, m
Highways	50
Feeder Roads	30
District Roads	20

Superelevation

Superelevation is provided on horizontal curves. Value of super elevation is calculated using following formula:

$$e = \frac{V^2}{127R} - f$$

where,

e = Value of superelevation, m/m

R = Radius of horizontal curve

V = Design Speed, km/h

f = coefficient of lateral friction, depends on the vehicle speed (taken as per Table 6)

Table 6: Coefficient of Lateral Friction

Speed(kmph)	**f**
120	0.09
100	0.12
80	0.14
60	0.17
40	0.23
30	0.28
20	0.33

Also, the maximum superelevation to be provided is limited to:

In plain and rolling terrain	7%
In snow bound areas	7%
In hilly areas not bound by snows	10%

Minimum value of superelevation should be equal to the rate of camber of the pavement. The rate of introduction of superelevation (i.e. longitudinal grade developed at the pavement edge compared to through grade along the center line) should be such as not to cause discomfort to travelers or to make the road unsightly. Rate of change of the outer edge of the pavement should not be steeper than 1 in 150 in plain and rolling terrain and 1 in 60 in mountainous and steep terrain in comparison with the grade of the center line.

Sight Distance

The visibility of the road ahead of the driver (sight distance) is necessary as it helps in the safe and efficient operation of the vehicles. Sight distances are usually governed by the distance required for stopping (stopping distance) and overtaking (overtaking distance).

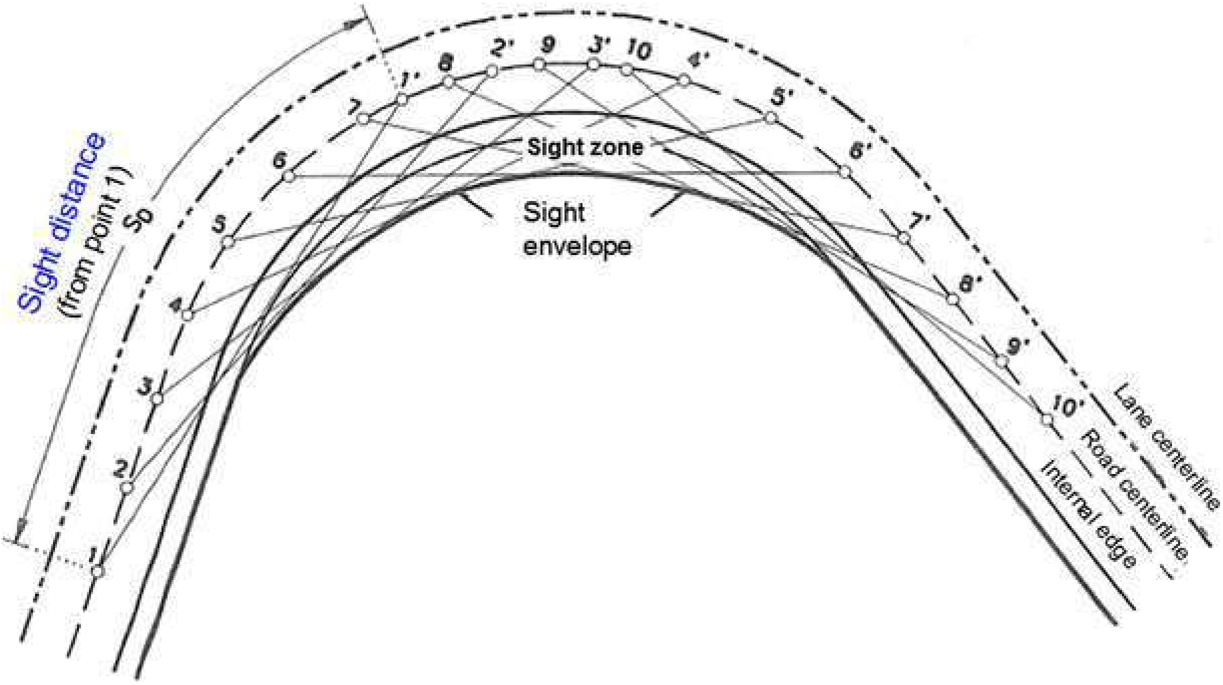


Figure 3: Sight envelope along the horizontal curve

(ref: Sight distance restriction on highways' horizontal curves: insights and sensitivity analysis)

Stopping Distance

Stopping distance is the distance that the driver must be able to see ahead along the roadway while travelling at or near the design speed and to safely stop before reaching an object whether stationary or not.

Table 7: Stopping Distance

Speed, kmph	20	30	40	60	80	100	120
Stopping Distance, m	20	30	50	80	130	190	260

Overtaking Distance

Overtaking sight distance is the minimum distance available for the driver to safely overtake the slow vehicle in front of him by considering the traffic in the opposite direction. This distance will make driver to see whether the road is clear to undergo an overtaking movement.

Table 8: Overtaking speed

Speed, kmph	30	40	60	80	100	120
Minimum Overtaking Distance, m	100	165	300	470	640	880

2.3.4. Horizontal Alignment

Minimum Radius

The minimum recommended values of radius of horizontal curves for various design speeds are given below. However, as far as site conditions permit the largest possible values of radius should be used.

Table 9: Horizontal Alignment

<table>
<tr><th colspan="4" rowspan="2">Road Class</th><th rowspan="2">Design Speed, kmph</th><th colspan="3">Minimum Recommended Radius, m</th></tr>
<tr><th>When no superelevation provided (2.5% camber i.e. negative superelevation)</th><th>When Maximum Superelevation of 10% provided</th><th>From the comfort criteria of passengers(Max lateral force 15% of vertical force)</th></tr>
<tr><td rowspan="4">I</td><td></td><td rowspan="2"></td><td rowspan="3"></td><td>120</td><td>1730</td><td>600</td><td>760</td></tr>
<tr><td rowspan="4">II</td><td>100</td><td>870</td><td>370</td><td>530</td></tr>
<tr><td rowspan="4">III</td><td>80</td><td>440</td><td>210</td><td>340</td></tr>
<tr><td rowspan="4">IV</td><td>60</td><td>200</td><td>110</td><td>190</td></tr>
<tr><td rowspan="3"></td><td>40</td><td>70</td><td>40</td><td>90</td></tr>
<tr><td rowspan="2"></td><td>30</td><td>30</td><td>20</td><td>50</td></tr>
<tr><td></td><td>20</td><td>20</td><td>10</td><td>30</td></tr>
</table>

Transition Curve

Minimum length of transition curves should be as shown:

Table 10: Length of Transition Curves

Radius, m	20	30	50	60	80	100	150	200	250	300	400	500	1000
Length of transition curve, m	20	30	35	40	45	50	60	70	80	90	100	110	120

2.3.5. Vertical Alignment

Maximum gradients

Table 11: Maximum gradients

Design Speed, kmph	20	30	40	60	80	100	120
Maximum Gradient,%	12	10	9	7	6	5	4

Critical Length of Grade

Table 12: Critical Length of Grade

Gradient, %	4	5	6	7	9	10	12
Critical Length, m	600	450	400	300	200	150	150

a) Vertical curve

A. Summit curve:

Length of summit curves is:

$L=\frac{AS^2}{440}$ for L>S

$L=2S-\frac{440}{A}$ for L<S

where,

L= Length of summit curve, m

S = Sight distance taken equal to stopping distance, m

A= Algebric difference in approach grades, %

B. Valley curve:

Length of valley curve is:

$$L=\frac{AS^2}{150+3.5S} \text{ for } L > S$$

$$L=2S-\frac{150+3.5S}{A} \text{ for } L < S$$

Where,

L = Length of valley curve, m

A = Algebraic difference in approach grades, %

S = Stopping distance, m

2.4. Retaining Wall

Retaining wall are structures built to laterally support the soil and hence could be kept at desired slope which wasn't possible in its natural state.

Types of retaining wall are described below:

A) Gravity Retaining Walls

They use their own weight for stability. They are usually constructed of plain concrete or masonry. They aren't economical if the height of the walls is too high.

B) Semi-Gravity Retaining Wall

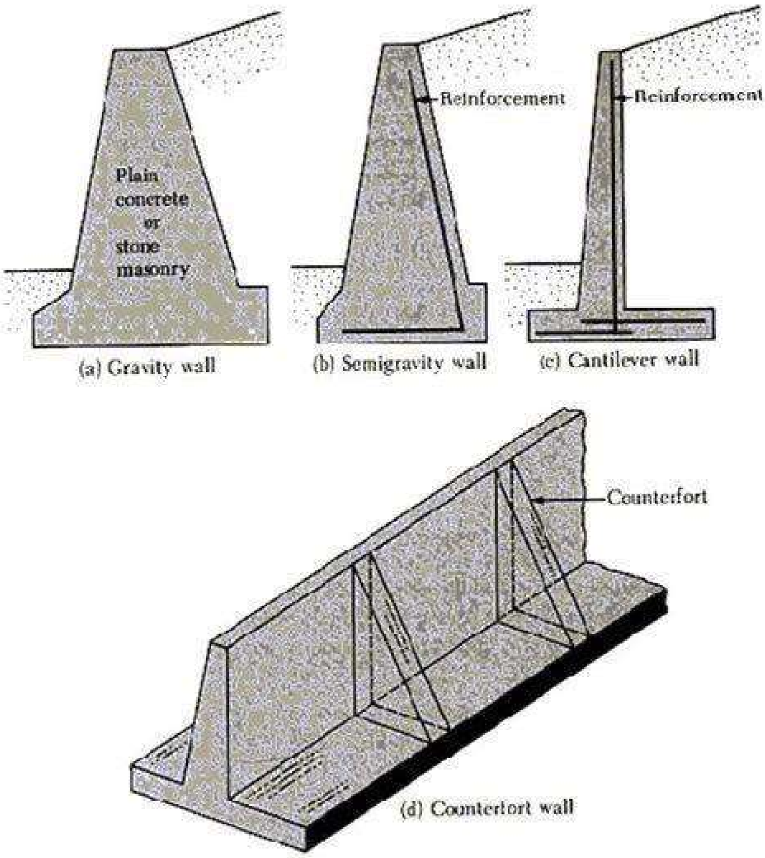
They are specialized form of gravity wall with some tension reinforcing steel near the back face. Because of the use of the reinforcing steel, thickness of the wall is minimized than that of the gravity walls.

C) Cantilever Retaining Wall

They are made of reinforced cement concrete. They consist of relatively thin steam and base slab. They are economical up to about 25ft in height.

D) Counterfort Retaining Wall

They are similar to cantilever walls except that they have thin vertical slabs, known as, counterfort, spaced across the vertical stem at regular intervals. They are more economical than cantilever walls for height above 25ft.



Source: www.concretenetwork.com

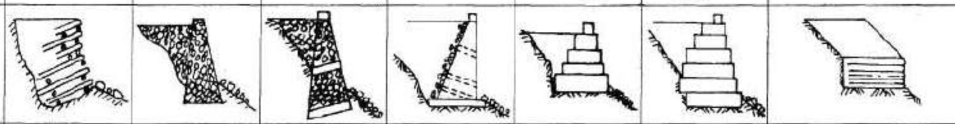
Figure 4: Types of retaining walls

Gravity type concrete masonry retaining walls are designed based on IS 14458 guidelines. Similarly, both gravity and cantilever walls can also be designed based on empirical rule of thumb.

Also, from IS 14458 part-1 cl.3.1.1; For hilly roads, being of low volume, walls may not be designed for earthquake forces. It is economical to repair failed walls after earthquake.

Table 13: Retaining wall guidelines (IS:14458)

(*Clause* 3.1)

	Type	Retaining Walls						
		Timber Crib	Dry Stone	Banded Dry Stone/ Masonary	Cement Masonry	Gabion		Reinforced Earth
						Low	High	
	Diagrammatic Cross-section							
CONSTRUCTION	Top width	2 m	0.6-1.0 m	0.6-1.0 m	0.5-1.0 m	1 m	1-2 m	4 m or 0.7-0.8 m
	Base width	—	0.5-0.7 H	0.6-0.65 H	0.5-0.65 H	0.6-0.75 H	0.55-0.65H	4 m or 0.7-0.8 H
	Front batter	4:1	vertical	varies	10:1	6:1	6:1	3:1
	Back batter	4:1	varies	vertical	varies	varies	varies	3:1
	nward dip of foundation	1:4	1:3	1:3	horizontal or 1:6	1:6	1:6	horizontal
	Foundation depth below drain	0.5-1 m	0.5 m	0.5-1 m	0.5-1 m	0.5 m	1 m	0.5 m
	Range of height	3-9 m	1-6 m	6-8 m	1-10 m	1-6 m	6-10 m	3-25 m
	Hill slope angle	<30°	<35°	20°	35-60	35-60	35-60	<35
	Toe protection in case of soft rock/soil	Boulder pitching	Boulder Pitching					No
NOTES	General	Timbers 15 cm φ with stone rubble well packed behind timbers. 10% of all headers to extend into fill. Ecologically unacceptable.	Set stones along foundation bed. Use long bond stones. Hand packed stones in back fill.	Cement masonry bands of 50 cm thickness at 3 m c/c. Other specifications as for dry stone wall.	Weep holes 15 × 15 cm size at 1-2 m c/c. 50 cm rubble backing for drainage.	Stones to be hand packed. Stone shape important, blocky preferable to tabular. Specify maximum/minimum stone size. No weathered stone to be used. Compact granular back fill in layers (< 15 cm). Use H type gabion wall.		Granular back fill prefered. Use geogrid for H <4 m and tensur grid for H> 4 m. Provide drainage layer in case of seepage problems. Specify spacing of reinforcement grids.

2.5. Drainage Design

To collect and remove the water from over and under the vicinity of roads, we need to design for the drainage system. Design of drainage system can be worked out by dividing it into two steps:

A) Hydrological Analysis
B) Hydraulic Analysis

A) Hydrological Analysis

Runoff for Drainage design is estimated using rational method.

$$\mathbf{Q = \frac{CiA}{3.6}}$$

Where, Q = runoff in m^3/s

C =Catchment Coefficient

A= Area in Km^2

i= intensity of rainfall in mm/hr, governed by time of concentration (t_c)

$$t_c = 0.01947\ K^{0.77}$$

where, $K = \sqrt{(\frac{L^3}{\Delta H})}$

L= Length of travel of water

ΔH= Elevation difference

B) Hydraulic Design

After determining the design runoff (Q), hydraulic design of drains is done. This design is done based on the principles of flow through open channels as design is done for the partially filled side drains and culverts. The area of cross section A of the channel (m2) for the discharge (Q, m3/s) and allowable velocity of flow (V, m/s) on the side drain is given by the following relation:

$$Q = AV$$

$$\text{Or, } A = \frac{Q}{V}$$

The velocity of the unlined channel must be high enough to prevent silting but should not be too high so as to cause erosion. The allowable velocity of flow depends on the soil type of the open side drain. The desirable values of velocity of flow are 0.3 to 0.5 m/sec (for sand and silt), 0.6 to 0.9 (for loam), 0.9 to 1.5 (for clay), 1.2 to 1.5 (for gravel) and 1.5 to 1.8 m/sec (for good soil covered with well- established grass).

The velocity of flow of water along the drain is determined from Manning's formula. It depends on its longitudinal slope. Assuming uniform and steady flow through channel of uniform cross section and slope.

Manning's equation:

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

Where, n = Manning's rugosity coefficient

R = hydraulic radius

S = longitudinal slope of channel

2.6. Soil Survey and Studies:

Optimum Moisture Content (OMC) test:

Optimum Moisture Content (OMC) test is a commonly used laboratory test to determine the moisture content of a soil sample at which the soil has the maximum density or minimum porosity. It is a critical parameter in designing and constructing earthworks, such as roads, embankments, and foundations. For road works, it is essential to ensure proper compaction of the soil to provide a stable and long-lasting base for the pavement structure. Inadequate compaction can result in soil settlement, which can lead to pavement distress such as rutting, cracking, and potholes. The values obtained is used to calculate the amount of soil required for embankments, backfills, and other earthworks. By knowing the MDD of the soil, the amount of soil required to achieve the desired compacted thickness of a layer can be accurately calculated which can further optimize the use of construction materials and reduce costs.
Following are the list of equipment required for the test:
Mould (diameter inside 150mm, 120 mm height, detachable collar of 50 mm height, detachable plate of 10 mm thickness)
Rammer (2.5 kg, freefall 310 mm)
Thermostatically controlled oven
Balance
IS sieve 20mm and 4.75 mm
Apparatus containing graduated jar with water, mixing tools, knife
Containers

California Bearing Ratio (CBR) test:

California Bearing Ratio (CBR) test is used to determine the strength of the materials of subgrade, base sub base for designing or determining thickness of pavement. It is a penetration test which measures the resistive strength of materials in subgrade, sub-base, base against standard penetration. It can be performed in lab in controlled conditions of moisture and density or in-situ. However, in this project, the CBR was performed in controlled conditions of moisture and density due to prolonged duration of soil stayed without the test which might have resulted to the loss in field moisture. It is also defined as ratio of unit load to penetrate 2.5 mm and 5mm of soil material to the unit load required for the penetration of standard material.

$CBR = (penetration\ load/\ standard\ load)*100$

where,

Penetration load is in kg/cm2

Diameter of plunger (d) = 5 cm

Area of plunger = 3.1416* d *d

Standard unit load = 70 kg/cm^2 for 2.5 mm penetration

= 105 kg/cm^2 for 5 mm penetration

Given load factor = 3.57 kg/div

CBR value of 2.5 mm should be greater than that of 5 mm else the test should be repeated again and if again CBR value of 5 mm is greater than only this value is accepted.

Following is the list of equipment required for the test:

Mould (diameter inside 150mm,175 mm height, detachable collar of 50 mm height, detachable plate of 10 mm thickness)

Rammer (4.89 kg, freefall 450 mm)

Apparatus containing perforated pipe, dial gauge stand, surcharge, filter paper.

Dial gauges (Accuracy 0.01 mm)

Cutting collar.

Penetration piston (50 mm diameter, 100 mm long).

IS sieve 20mm and 4.75 mm.

Loader (have movable base at rate of 1.25 mm per minute).

2.7. Surface Dressing

In case of surface dressing, there are factors which are required to be considered like traffic intensity, climatic conditions, existing surface, etc. Its type, single surface dressings, are normally adequate when applied to a bituminous layer while double surface dressings are always used on non-bituminous layers.

To enhance the quality of the double surface dressing, traffic is only allowed to run on the first dressing surface after minimum time period of 2-3 weeks before second layer of dressing is applied. This is done to ensure chippings of first dressing to be stable interlocking mosaic, which in return provides a firm foundation for the second dressing. This first dressing layer should be thoroughly cleaned before the second dressing is applied. In second dressing, sometimes, sand may also be used as an alternative to chipping.

3. DESIGN METHODOLOGY

3.1. Data Collection

Detailed engineering field survey was performed for the design and selection of best alignment.
Primary sources of data collection were surveys, lab experiments and interviews with locals. Internet, pamphlets, books, journals etc. were the secondary sources.

3.2. Traffic Study

Traffic volume throughout the day, 9 – 11 am, 1 – 3 pm and 3 – 5 pm was counted in the starting point of the road section at Dhungedhara (0+000 m) and then the peak hour was observed from each time period. Finally, the average value was then calculated for the ADT. Suitable section was selected for study based on following parameters:

1. The station should represent homogeneous traffic section (The road section should have uniform geometric characteristics along)
2. The station should be outside urban area and local traffic influence
3. The station should be located in a reasonably level section of the road with good visibility.
4. Section of the road to have an uninterrupted traffic flow.

OBSERVATIONS

Table 14: Traffic Study

Table 14. 1

Time Interval	**Bicycle, Motorcycle**		**Car, Auto Rickshaw, SUV, Light Van and Pick Up**		**Light (Mini) Truck, Tractor, Rickshaw**		**Truck, Bus, Minibus, Tractor with trailer**		**Nonmotorized carts**		**PCU in 15 mins**	**PCU in 1 hour**
	From	To	From	To	From	To	From	To	From	To		
9:00 - 9:15	11	8	0	0	0	1	1	0	0	0	14	

9:15 - 9:30	16	11	2	1	0	0	2	1	0	0	25.5	
9:30 - 9:45	20	9	0	1	0	0	1	1	0	0	21.5	
9:45 - 10:00	21	16	2	1	1	1	2	3	0	0	39.5	**100.5**
10:00 - 10:15	26	18	1	2	1	1	1	2	0	0	37	**123.5**
10:15 - 10:30	29	21	3	3	4	2	3	3	0	0	58	**156**
10:30 - 10:45	16	12	2	1	2	1	1	2	0	0	30.5	**165**
10:45 - 11:00	18	13	0	1	0	1	0	1	0	0	21	**146.5**
	157	108	10	10	8	7	11	13	0	0		

Table 14. 2

Time Interval	**Bicycle, Motorcycle**		**Car, Auto Rickshaw, SUV, Light Van and Pick Up**		**Light (Mini) Truck, Tractor, Rickshaw**		**Truck, Bus, Minibus, Tractor with trailer**		**Nonmotorized carts**		**PCU in 15 mins**	**PCU in 1 hour**
	From	To	From	To	From	To	From	To	From	To		
1:00 - 1:15	15	13	1	2	1	0	0	0	1	0	24.5	
1:15 - 1:30	12	14	0	2	2	1	0	1	0	0	22.5	
1:30 - 1:45	9	11	1	1	0	0	2	0	0	0	18	
1:45 - 2:00	15	15	0	2	1	0	0	1	0	0	21.5	**86.5**
2:00 - 2:15	17	21	0	1	0	1	0	0	0	0	21.5	**83.5**
2:15 - 2:30	11	16	1	0	0	1	1	0	0	1	25	**86**
2:30 - 2:45	19	18	1	0	1	0	0	1	0	0	24	**92**
2:45 - 3:00	23	12	2	2	2	0	0	2	1	0	36.5	**107**
	121	120	6	10	7	3	3	5	2	1		

Table 14. 3

Time Interval	Bicycle, Motorcycle		Car, Auto Rickshaw, SUV, Light Van and Pick Up		Light (Mini) Truck, Tractor, Rickshaw		Truck, Bus, Minibus, Tractor with trailer		Nonmotorized carts		PCU in 15 mins	PCU in 1 hour
	From	To	From	To	From	To	From	To	From	To		
3:00 - 3:15	19	23	2	4	2	1	2	1	0	0	40.5	
3:15 - 3:30	22	24	1	5	0	3	3	2	0	0	48.5	
3:30 - 3:45	21	17	0	3	2	1	4	1	1	0	47.5	
3:45 - 4:00	17	11	2	0	2	1	3	0	0	2	41.5	**178**
4:00 - 4:15	27	22	0	3	2	1	3	1	0	0	44	**181.5**
4:15 - 4:30	24	22	3	5	1	2	2	3	1	0	62.5	**190**
4:30 - 4:45	26	22	1	2	0	0	2	1	2	0	48	**196**
4:45 - 5:00	27	15	1	2	2	1	0	2	1	1	46.5	**201**
	183	156	10	24	11	10	21	11	5	3		

(Equivalency factors are taken according to NRS-2070)

Sample Calculation:

From table (i), peak hour volume between 9 to 11 am is observed.

PCU in 15 min = 58 and PCU in 1 hour = 165

And, peak hour factor (PHF) = $\frac{165}{4*58}$ = 0.71121

Now, Design Hourly Volume (DHV) = $\frac{Peak\ Hour\ Volume}{Peak\ Hour\ Factor} = \frac{165}{0.71}$ = 232

From NURS 2076 Equation 1, Average Daily Traffic = $\frac{DHV}{0.15}$

So, ADT= $\frac{232}{0.15}$= 1546.67 PCU

ADT in 20 years, taking rate of growth = 5%

ADT (20yrs) = $(1 + 0.05)^{20}$*1546.67 = 4104

Table 14. 4

Table No.	PHF	DHV	ADT	ADT in 20 years
(i)	0.71121	232	1546.67	4104
(ii)	0.73288	146	973.33	2583
(iii)	0.86283	226	1506.67	3998
			Average	**3562**

For determination of diverted traffic, a survey was done with 100 local individuals asking whether they would prefer our road for transportation after it would be expanded and 20% of them answered positive. It is expected that 20% of traffic will be generated since the road will act as a roadway to tourism destination like Macchenarayan Temple.

Taking 20% diverted traffic and 20% generated traffic,
Average ADT in 20 years = 3562(1+0.2+0.2) = 4987
Hence, road can be designed as Class-III road (2000 – 5000 PCU).

3.3. Geometric Design Parameters

3.3.1. Road Classification

A. Administrative Classification:

According to DTMP Final Report for Bhaktapur District, Volume I prepared on the basis of DOLIDAR's DTMP Guidelines for the Preparation of District Transport Master Plan 2012, the road can be classified as **District Road**.

Table 2.3.2 District road core Network in Kathmandu District (km)

Code	Description	Total length	Black Top	Gravel	Earthen	All weather	Fair weather
27DR001	Char Dabota Chowk_ Balkot VDC	**0.15**	0.06	0.09	0	0.15	-
27DR002	Shankdhar Chowk_ Gamcha Road	**2.10**	2.1	0	0	2.10	-
27DR003	Byasi_Jhaukhel VDC_Road	**2.10**	2.1	0	0	2.10	-
27DR004	Aadarsa bus stand_ Sipadol VDC_Road	**3.00**	0.7	2.3	0	3.00	-
27DR005	Bhatkeko pati_Bhaktapur_Nagarkot_Road	**4.50**	4.1	0.4	0	4.50	-
27DR006	Sainik School(Kharipati)_Chaling	**2.45**	1.4	0.85	0.2	2.25	0.20

Figure 5: District Road Core Network

B. Technical Classification:

From the traffic study and corresponding calculations in 3.2, the road can be classified as **Class-III** road.

3.3.2. Type of terrain

With accordance to NRS 2070, the percent cross slope was determined as below:

Table 15: Cross Slope Examination

Chainage	Length of line perpendicular to alignment	Number of 1-m contours	Approx. Cross slope (%)
0+000	40	6	15
0+200	100	7	7
0+400	80	4	5
0+600	100	7	7
0+800	80	9	11.25
1+000	90	16	17.78
1+200	80	3	3.75
1+400	60	1	1.67
1+600	50	3	6
1+800	80	7	8.75
2+000	100	22	22
2+200	90	10	11.11
2+400	80	11	13.75
2+600	80	20	25
2+774	40	10	25
		Average	**12.004**

From the above average cross slope, the terrain is hence classified as **rolling** terrain (>10 – 25).

3.3.3. Selection of Design speed

From above table and table 3, the design speed for class III road is selected as 40 kmph for rolling terrain.

3.4. Design of elements of horizontal curve

3.4.1. Design of Superelevation

Superelevation is the banking of a road around a horizontal curve with the purpose of counteracting the centrifugal force experienced by the vehicles travelling around the curve at high speed. The outer edge of the road is raised higher than the inner edge, thus providing a transverse slope throughout the length of the horizontal curve and allowing a more comfortable and safer ride for drivers or passengers.

For the design of superelevation, following steps are taken in order with accordance to IRC guidelines.

Step (i): Calculation of superelevation for 75% of design speed neglecting the friction.

$$e = \frac{(0.75V)^2}{127R}$$

Step (ii): If e<0.07, the value so obtained is provided. For the case of 'e' exceeding 0.07, the value is taken as 0.07 and proceeded.

Step (iii): Check for the friction 'f' for maximum value of 'e'= 0.07

$$f = \frac{V^2}{127*R} - 0.07$$

If the calculated 'f'<0.15, the superelevation of 0.07 is safe for design speed. Else, calculate the allowable speed according to step (iv).

Step (iv): Calculation of allowable speed at the curve for the design coefficient of friction and maximum e.

$$e + f = \frac{{V_a}^2}{127*R} = 0.07 + 0.15$$

$$\text{or, } 0.22 = \frac{{V_a}^2}{127*R}$$

then, calculate the allowable speed,

$$V_a = \sqrt{27.94R} \text{ kmph}$$

Sample Calculation at Chainage 0+204.14m:

Design speed (V) = 40 kmph

Radius of curve (R) = 55.762m

Now,

$$\text{Superelevation } (e) = \frac{(0.75V)^2}{127R}$$

or, (e) =0.127

which is greater than 0.07.

So, adopt e=0.07.

Then, coefficient of friction $(f) = \frac{V^2}{127*R} - e$

or, (f) = 0.156

which is less than 0.23

So, adopt f=0.156.

Hence, we don't need to calculate the allowable velocity and design velocity of 40kmph is adopted.

So, the design superelevation (e) in this case is 0.07.

3.4.2. Design of Extra widening

Extra widening is the additional width of the road or railway track provided beyond the superelevated section to compensate for the offset of the center of gravity of the vehicles towards the outside of the curve. The extra widening of the pavement on horizontal curves is divided into two parts:

i. Mechanical widening (W_m), i.e., the widening required to account for thee off-tracking due to rigidity of wheel based
ii. Psychological widening (W_p), which is provided for psychological reasons regarding maneuverability of steering, clearance for overtaking and crossing, etc.

Sample Calculation at Chainage 0+204.14m:

Design speed (V) = 40 kmph

Radius of curve (R) = 55.762m

Length of wheel base of Design Vehicle (l)=6.1m

No of lane (n)=1

Then,

Extra Widening (W_e)= Mechanical widening (W_m) + Psychological widening (W_p)

Or, $W_e = \frac{nl^2}{2R} + \frac{V}{9.5\sqrt{R}}$

Or, W_e = 0.33365 + 0.56385

Or, W_e = 0.8975 m

But as per NRS-2070, there is no need of extra widening for radius greater than 60m.

In this case, Radius of curve is 55.762m < 60m. So, we need to provide extra widening at this curve of 0.8975m.

3.4.3. Design of Transition Curve

Transition curve, as given by its name, is provided with the purpose of a gradual and smooth transition between a tangent section and a circular curve. Besides this, avoiding a sudden jerk on vehicle with the introduction of gradual centrifugal force, enabling a gradual introduction of designed superelevation and extra widening to the circular curve and driver's comfort are few other reasons for the provision. The radius of a transition curve decreases from infinity at the tangent point to a designed radius of the circular curve. They are designed with the calculation of length to be provided fulfilling following three conditions:

a) Rate of change of centrifugal acceleration
b) Rate of introduction of super elevation
c) By empirical formula

Three lengths of transition curve are thus obtained and the maximum is selected as the designed length of transition curve.

Sample calculation of Transition curve (At chainage 0+204.14)

Radius of curve (R) = 55.76 m

Width of pavement (W) = 5.5m

Extra widening (We) = 1.0643m

Superelevation(e) = 0.07

Design speed (V) = 40km/hr

(i) Length according to rate of change of centrifugal acceleration (l_1):

Here, rate of change of centrifugal acceleration(C) $=\frac{80}{75+V}$,Subject to 0.5<C<0.8

or, (C) =0.696

According to NRS 2070, (l_1) = $\frac{V^3}{47CR}$

or, (l_1) =35.105m

(ii) Length according to rate of introduction of super elevation(l_2):

Here, rate of introduction of super elevation (N) =150 (in rolling terrain)

Now, length(l_2) = $\frac{N*e*(W+We)}{2}$

or, (l_2) = 34.463m

(iii) Length according to empirical formula(l_3):

Length(l_3) = $\frac{2.7V^2}{R}$ (for plain and rolling terrain)

or, (l_3) = 77.472m

Now, designed length of transition curve(l) =max(l_1:l_2:l_3)

= 77.472m

Note: All the required calculations of the horizontal curves are tabulated in **Annex-F**

3.5. Design of elements of vertical curves

Vertical curves are necessary in a road alignment, particularly in areas with steep terrain for the provision of a smooth and safe transition for drivers between two different grades, reducing the likelihood of accidents and ensuring that drivers can maintain a safe and consistent speed. It is a gradual transition between two different grades or slopes, typically used to connect two tangent sections of a road that have different elevations. Mainly, they are classified into two categories, summit curves with convexity upwards and valley curves with concavity upwards.

3.5.1. Summit curves

In summit curves, the centrifugal force acts in the upward direction against gravity which makes the centrifugal force act for relieving the pressure on springs and suspensions of the vehicle.

Sample calculation (At chainage 1+239.88m):

Given, Grade in (n_1) = 5.65%

Grade out (n_2) = 0.51%

Algebraic difference in approach grades (A) = 5.14%

Speed (V) = 40 kmph

Now from the table in NRS 2070,

Stopping Sight Distance (S) = 50m [for V = 40 kmph]

Minimum length of summit curve L is to be found from the consideration of providing a sight distance (S) throughout the curve equal to stopping distance or overtaking distance whichever gives the higher value.

i) Length of summit curve (L) for stopping sight distance (SSD)

The value of H, the height of driver's eye above the pavement surface is taken as 1.2m and the height of object, h above the pavement surface for the purpose of safe stopping distance is taken as 0.15m as per IRC standard and NRS – 2070

- When L < SSD

  $L = 2S - \frac{440}{A} = 14.40m$

- When L > SSD

  $L = \frac{AS^2}{440} = 29.20m$ (Ok)

ii) Length of summit curve for overtaking sight distance (OSD) or intermediate sight distance (ISD)

Here, both height of eye level of driver above roadway surface and height of subject above the pavement surface is taken as 1.2m.

Two cases are to be considered in deciding the lengths are:

a) When the length of curve, L is greater than the OSD or ISD (L > S)
b) When the length of curve, L is less than the OSD or ISD (L < S)

We have, overtaking distance for 40kmph = 165m > 2*50 = 100.

We take, Intermediate Sight Distance, ISD = 100m

- When sight distance (S) is more than L (S > L)

  $L = 2S - \frac{960}{A}$

  $= 2*100 - \frac{960}{5.14}$

  = 13.23m

- When sight distance (S) is more than L (S < L)

  $L = \frac{AS^2}{960}$

  $= \frac{5.14*100^2}{960}$

  = 53.54m

So, the maximum of the two is 13.23m but the provided length of curve obtained from the profile is 180.793m which is greater than 13.23m and hence is chosen as the design length of valley curve.

When the deviation angle is small, the length of summit curve generally works less than the sight distance. In very small deviation angles, the length required sometimes works out as a negative value indicating that there is no problem of sight restriction at the summit curve.

Note: All the required calculations of the vertical curves are tabulated in **Annex-G**

3.5.2. Valley curves

In valley curves, the centrifugal force along with the weight of the vehicle acts in downward direction which adds pressure on the springs and suspensions of the vehicle. So, the allowable rate of change of centrifugal acceleration should govern the design. Valley curves are designed with the consideration of following factors:

i. Impact-free movement of vehicles at design speed or the comfort to the passengers
ii. Availability of stopping sight distance under head lights of vehicles for night driving

Sample calculation (At chainage 1+045.26)

Given, Grade in (n_1) = -7.71%

Grade out (n_2) = 5.65%

Grade Change (A) = 13.36%

Speed (V) = 40 kmph

Now from NRS 2070,

Stopping Sight Distance (S) = 50m [for V= 40 kmph]

Now, for Minimum length of valley curve (L) from the consideration of night visibility of road surface by the illumination by the head light

Taking,

Height of mounting of head light above pavement surface = 0.75m

Angle of illumination of the headlight = 2^{o}

- When Stopping Distance(S) is less than L(S<L),

$$L = \frac{AS^2}{150+3.5*S} = 102.8m \text{ (OK)}$$

- When Stopping Distance(S) is greater than L(S>L),

$$L = 2S - \frac{150+3.5S}{A} = 75.7m$$

Also,

Minimum length of valley curve (L) from the consideration of the riding comfort of the passengers and overloading on the suspension system of the automobile is found as follows:

$$L = \frac{AV^2}{390}$$

$$= \frac{13.36*40^2}{390}$$

$$= 54.8 \text{ m.}$$

So, the maximum of the three is 102.8m but the provided length of curve obtained from the profile is 147.285m which is greater than 102.8m and hence is chosen as the design length of valley curve.

3.6. OMC Test of Subgrade

For the OMC test, the Standard Proctor test was performed where the samples collected were first dried and then sieved in order to remove large particles. It was then weighed and mixed with different water content in increments. A compaction test was performed for each sample with each water content by placing the sample in a cylindrical mould and compacting it in 3 layers using 2.5 kg rammer, with 25 blows to each layer. The moisture content of each mixture was determined through the oven drying method, while the dry density of each compacted specimen was determined by weighing. Further, the OMC was determined by plotting the dry density values against the moisture content values and identifying the moisture content at which the maximum dry density occurred.

Table 16: Determination of Moisture Content of Samples using Oven Dry Method

	Wet Sample(gm)	Dry Sample(gm)	Water Content	w(%)
Sample 1	81.124	74.98	0.081941851	8.194185116
	90.235	81.21	0.111131634	11.1131634
	80.214	70.311	0.140845671	14.08456714
	140.25	119.8	0.170701169	17.07011686
Sample 2	76.124	71.854	0.059426058	5.94260584
	68.476	63.328	0.081291056	8.129105609
	82.498	74.259	0.110949515	11.09495145
	56.472	48.887	0.155153722	15.51537218
Sample 3	57.541	53.21	0.081394475	8.139447472
	60.325	54.33	0.110344193	11.03441929
	88.129	77.25	0.140828479	14.0828479
	67.57	57.746	0.170124338	17.01243376

Sample Calculation:

$$\text{Water Content} = \frac{Wet\ Sample - Dry\ Sample}{Dry\ Sample}$$

$$= \frac{81.124 - 74.98}{74.98}$$

$$= 0.0819$$

w(%) = Water Content x 100 %

= 0.0819 x 100 %

= 8.19 %

Determination of Optimum Moisture Content using Standard Proctor's Test

Table 16. 1: Sample 1

S.N.	Description	Determination No.			
		1	2	3	4
1	Volume of Mould, V(cm3)	2102.24	2102.24	2102.24	2102.24
2	Weight of Mould, W1 (g)	8244	8244	8244	8244
3	Wt. of Mould + Compacted Soil, W2(g)	12005	12295	12346	12268
4	Wt. of Compacted Soil, W(g) [W2-W1]	3761	4051	4102	4024
5	Bulk Density, ɣ [W/V] (g/cm3)	1.78905	1.92699	1.95125	1.91415
6	Water Content, w (%)	8.194185	11.11316	14.08457	17.07012
7	Dry Density [ɣ/(1+w)]	1.65355	1.73426	1.71036	1.63505

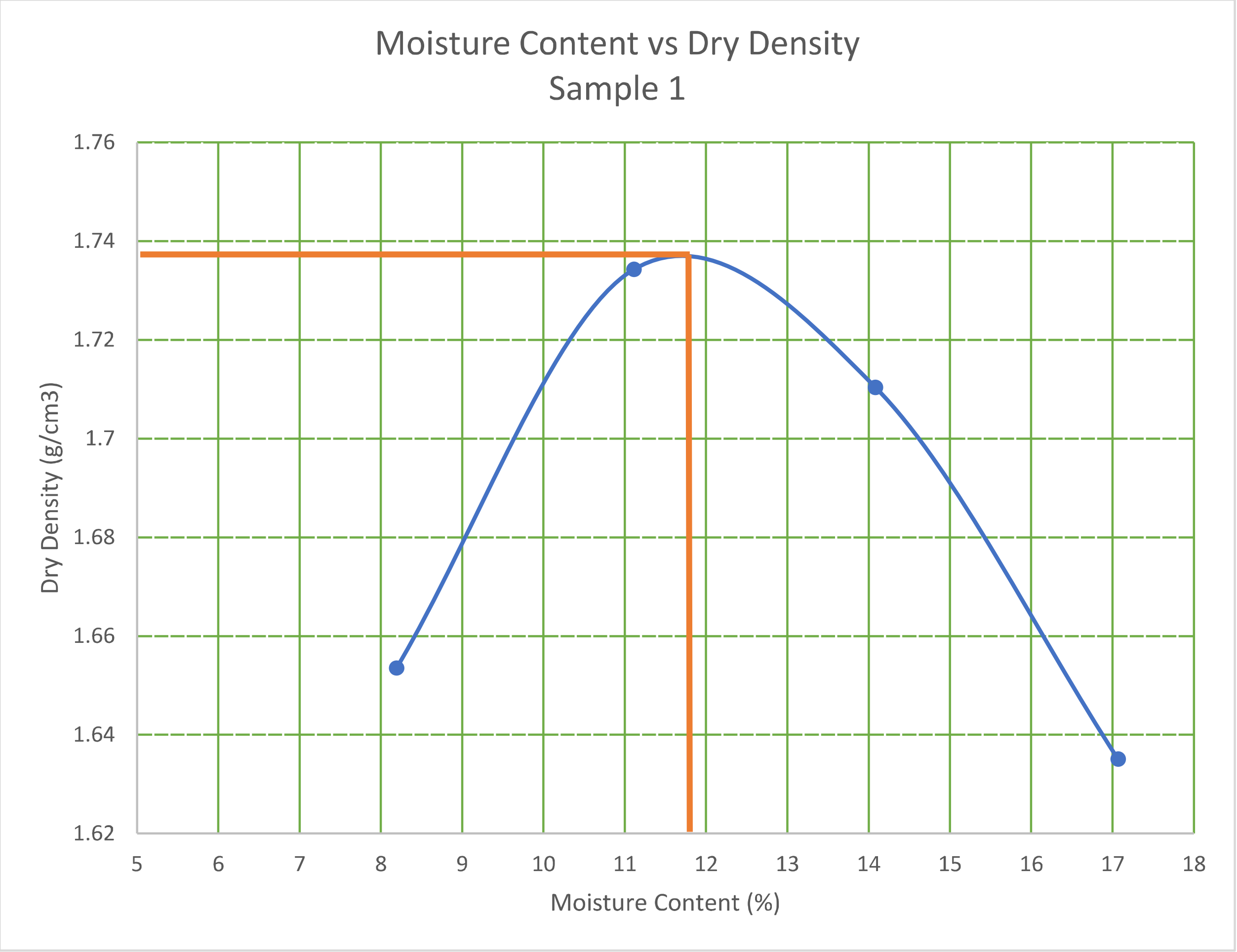


Figure 6: Moisture Content Vs Dry Density Graph for Sample 1

Optimum Moisture Content = 11.8% for Sample 1

Table 16. 2: Sample 2

S.N.	Description	Determination No.			
		1	2	3	4
1	Volume of Mould, V(cm3)	2225.34	2225.34	2225.34	2225.34
2	Weight of Mould, W1 (g)	4562	4562	4562	4562
3	Wt. of Mould + Compacted Soil, W2(g)	8212	8640	8707	8520
4	Wt. of Compacted Soil, W(g) [W2-W1]	3650	4078	4145	3958
5	Bulk Density, ɣ [W/V] (g/cm3)	1.6402	1.83253	1.86264	1.77861
6	Water Content, w (%)	5.94261	8.12911	11.095	15.5154
7	Dry Density [ɣ/(1+w)]	1.5482	1.69476	1.67662	1.53972

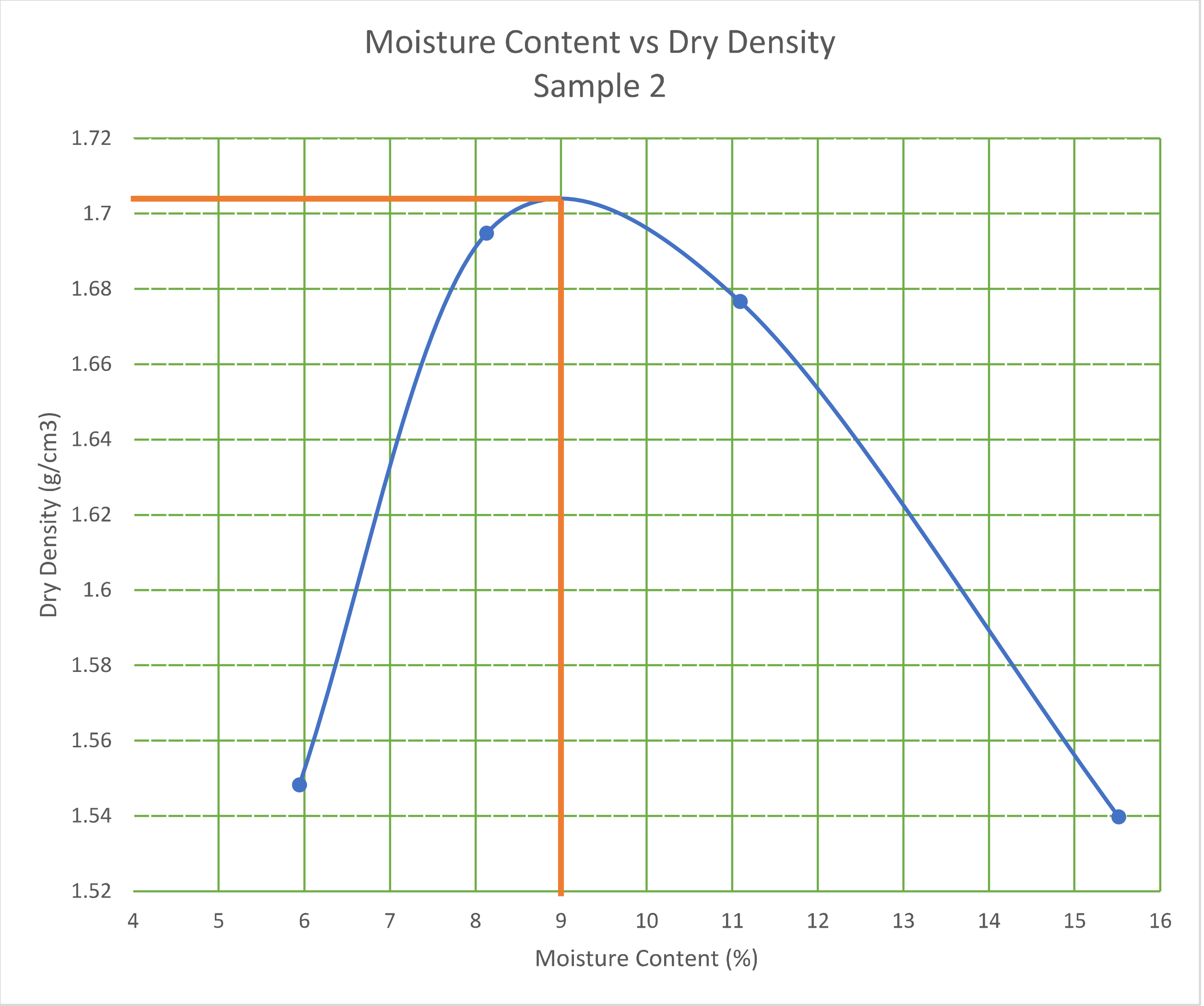


Figure 7: Moisture Content Vs Dry Density Graph for Sample 2

Optimum Moisture Content = 9% for Sample 2

Table 16. 3: Sample 3

S.N.	Description	Determination No.				
		1	2	3	4	5
1	Volume of Mould, V(cm3)	2225.34	2225.34	2225.34	2225.34	2225.34
2	Weight of Mould, W1 (g)	4556	4556	4556	4556	4556
3	Wt. of Mould + Compacted Soil, W2(g)	8509	8685	8685	8523	8395
4	Wt. of Compacted Soil, W(g) [W2-W1]	3953	4129	4129	3967	3839
5	Bulk Density, ɣ [W/V] (g/cm3)	1.77636	1.85545	1.85545	1.78265	1.72513
6	Water Content, w (%)	5.013	8.13945	11.0344	14.0828	17.0124
7	Dry Density [ɣ/(1+w)]	1.69156	1.71579	1.67106	1.56259	1.47432

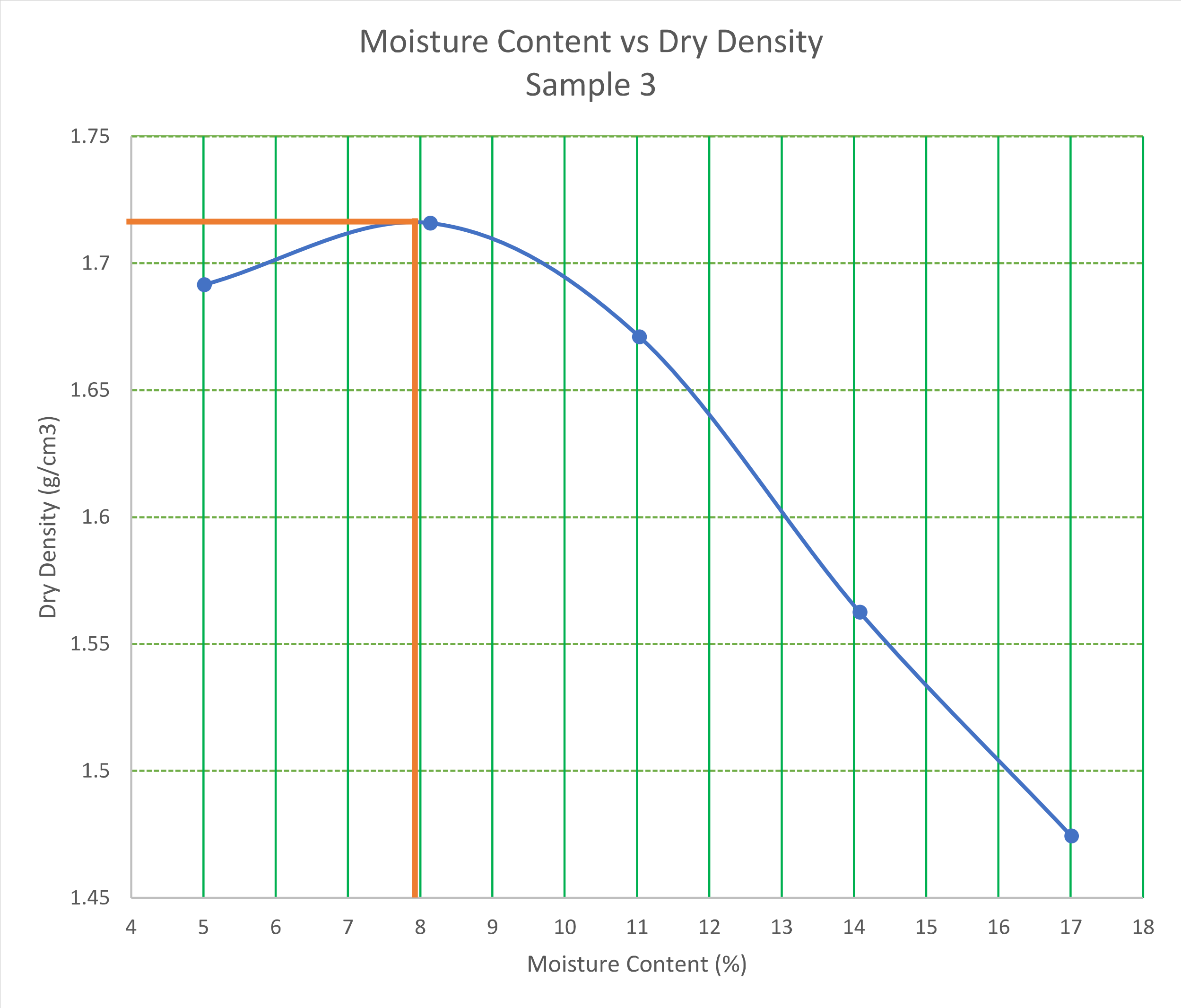


Figure 8: Moisture Content Vs Dry Density Graph for Sample 3

Optimum Moisture Content = 7.9% for Sample 3

3.7. CBR Test of Subgrade and Pavement Design

3.7.1. CBR test of Subgrade

After conducting the OMC test, the sample soils were then made ready by drying, sieving and by mixing with the OMC for the CBR test. The soil samples were to be collected at each 500 m interval along the alignment as per NRS 2070, however, due to constraint of time and insufficient equipment, only three samples were collected, one each at the start and the end of alignments and one in between. For the test, the samples were placed in cylindrical mould and compacted in 5 layers using 4.89 kg rammer, with 56 blows to each layer. To ensure a robust pavement design that doesn't fail for worst hydrological condition, the soaked CBR test was performed. Furthermore, the tests were performed in CMTL and subsequently the load v/s penetration graphs were drawn and corrected to calculate the actual CBR of the subgrade.

Note: Minimum seven samples are required for CBR calculation. However, due to aforementioned reasons, only three were collected.

Figure 9: CBR test of subgrade

Observations and Load vs Deflection curves are shown below

Penetration	Load		
	Sample 1	Sample 2	Sample 3
0	0	0	0
0.5	10.71	14.28	7.14
1	21.42	35.7	21.42
1.5	35.7	60.69	42.84
2	57.12	92.82	67.83
2.5	78.54	124.95	89.25
3	107.1	149.94	110.67
3.5	132.09	174.93	124.95
4	160.65	196.35	135.66
4.5	185.64	242.76	264.18
5	203.49	224.91	153.51
5.5	214.2	292.74	321.3
6	228.48	242.76	171.36
6.5	239.19	342.72	357
7	249.9	260.61	185.64
7.5	264.18	392.7	392.7

Penetration	Load		
	Sample 1	Sample 2	Sample 3
8	267.75	271.32	196.35
8.5	285.6	439.11	424.83
9	282.03	282.03	207.06
9.5	307.02	485.52	453.39
10	292.74	296.31	217.77
10.5	321.3	524.79	481.95
11	307.02	307.02	228.48
11.5	339.15	567.63	510.51
12	317.73	317.73	239.19
12.5	321.3	324.87	246.33

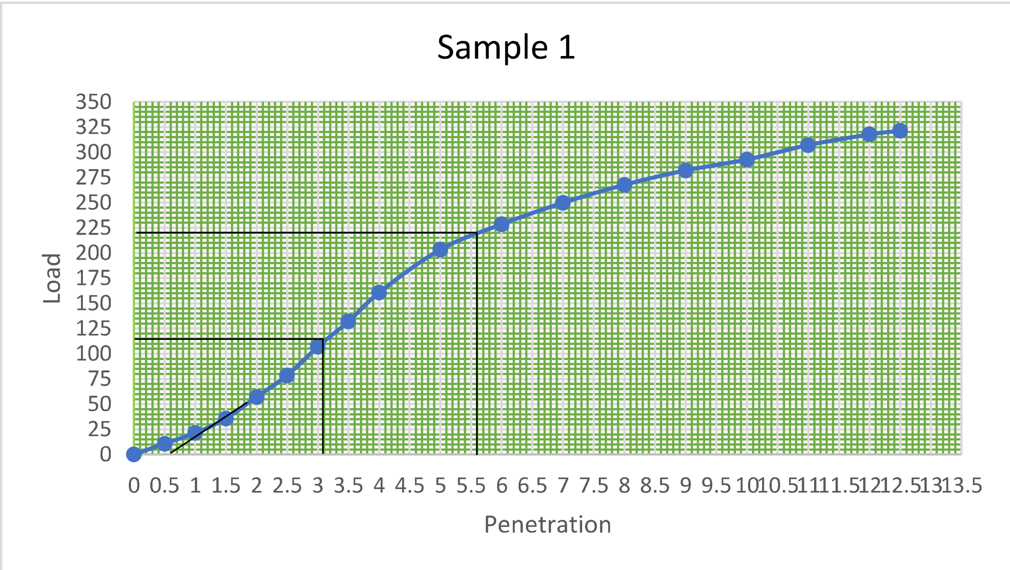


Figure 10: Load Vs Penetration Graph for Sample 1

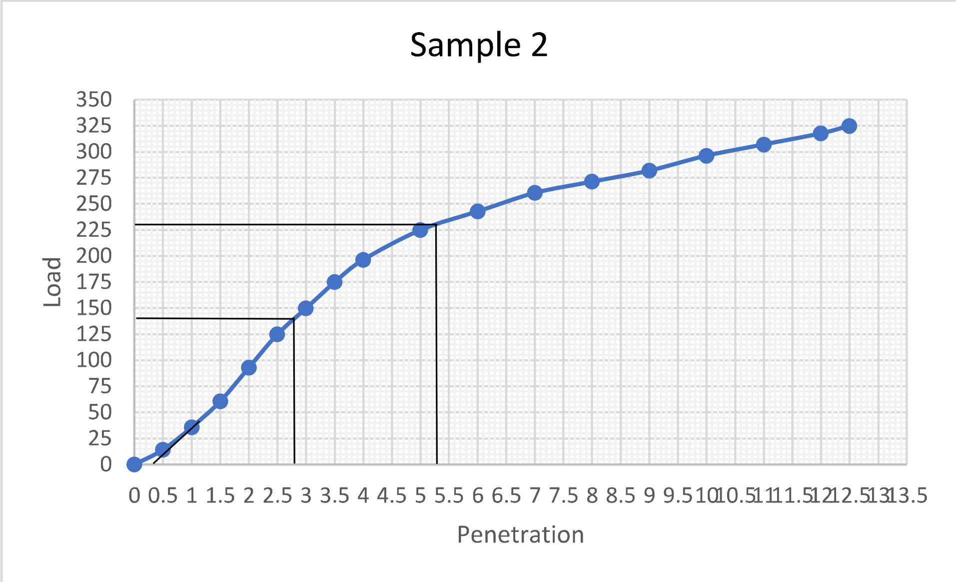


Figure 11: Load Vs Penetration Graph for Sample 2

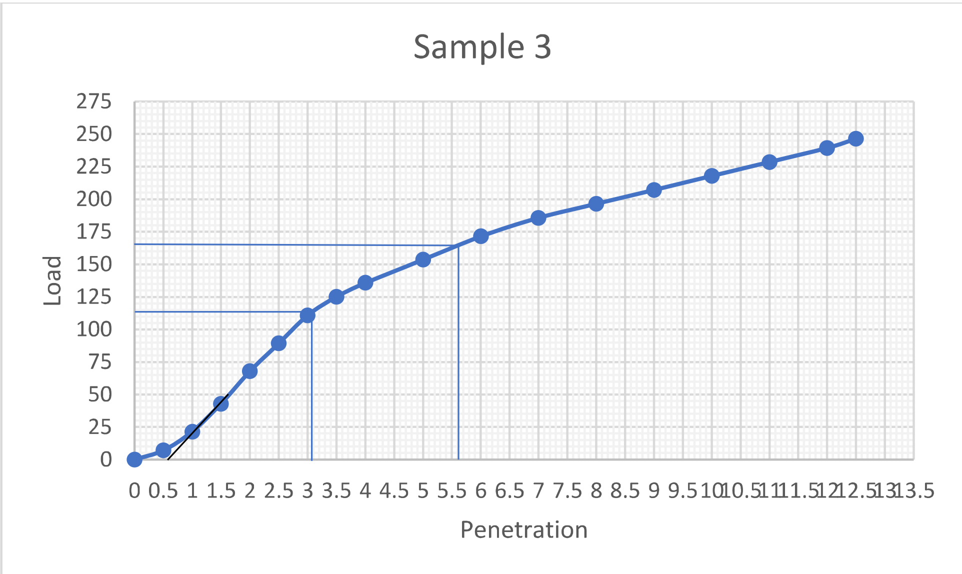


Figure 12: Load Vs Penetration Graph for Sample 3

Calculations

Standard load for 2.5 mm= 1370 kg, 5 mm= 2055 kg

Table 17: CBR Test

Sample	Penetration(mm)	Corrected Load (KN)	CBR	Adopted CBR
0+000	2.5	105	7.66	**10.22**
	5	210	**10.22**	
1+600	2.5	140	10.22	**11.19**
	5	230	**11.19**	
2+700	2.5	110	**8.03**	**8.03**
	5	160	7.78	

For the selection of 80th percentile, CBR value for pavement design, the obtained values are arranged in ascending order and plotted against % equal or greater than values as shown below

SN	CBR %	No. equal or greater than	% equal or greater than
1	11.19	1	33.33
2	10.22	2	66.67
3	8.03	3	100

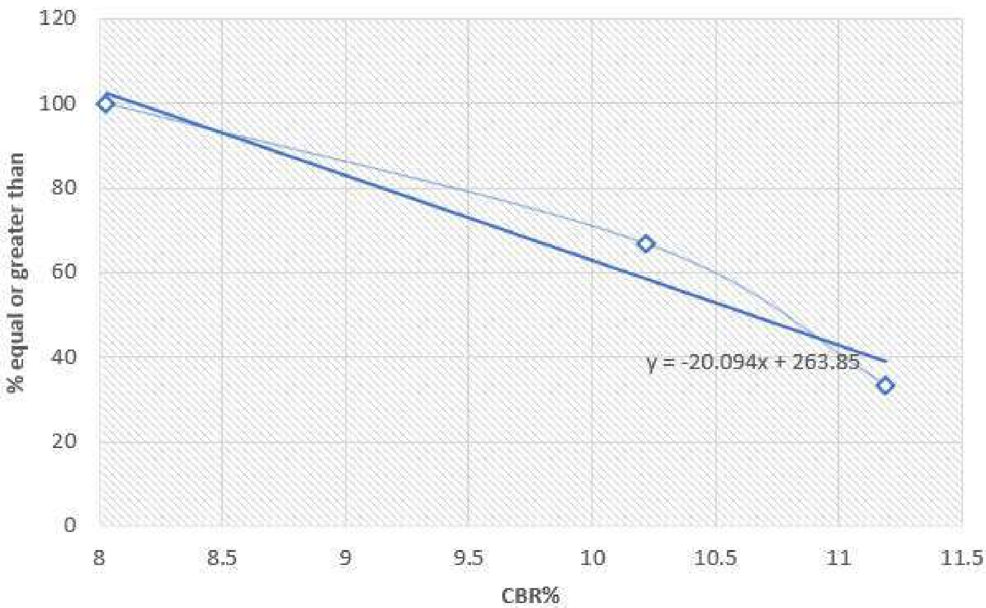


Figure 13: CBR Value Calculation Graph

From the graph, for y=80%, x=9.149%

Therefore, CBR for pavement design= 9.1%

3.7.2. Pavement Design

Steps for Pavement Design

- The number of commercial vehicles expected to use the roadway on the day it is opened was determined.
- The traffic was projected over the lifetime of roadway.
- The total equivalent standard axle load of 8160 kg was calculated from the number of commercial vehicles for use in design.
- The 80th percentile CBR value was determined in order to assess the subgrade soil strength over which the road is to be constructed.
- Flexible Pavement Design Guidelines recommended by Road Note 31 was used to determine the thickness of different pavement layers as the pavement is to be designed for low traffic volume and Road Note 31 came handy.
- Overall design was done using guidelines recommended by DOR Flexible Pavement Guideline 2021 and Road Note 31.

Design

The road construction is expected to complete within 2 years and its design life is assumed to be 10 years (For low volume roads other than national highways and expressways)

The traffic data in our road was determined by performing field count of live traffic from 9AM to 5PM. The growth rate of 5% was taken in accordance with traffic growth rate data of last 2 years obtained from concerned local authorities. The expected traffic at the opening of road at the end of construction period was calculated using formula below:

$A=P*(1+r)^n$

where,

A= number of heavy vehicles per day for design (laden weight> 3 tonnes)

P= number of heavy vehicles per day least count

r= growth rate (5%)

n= number of years between last count and the year of completion of construction.

The Vehicle Damage Factor was adopted from DOR Guidelines for design of flexible pavements. 2021. The cumulative number of traffic for the period of 10 years was calculated using the formula below:

Cumulative no. of standard axles for design period,

$N_s = \frac{365*(1+r)^n-1}{r} * A * LDF * VDF$

where,

LDF= Lane distribution Factor (0.75 for intermediate lane)

For determination of diverted traffic, a survey was done with 100 local individuals asking whether they would prefer our road for transportation after it would be expanded and 20% of them answered positive. It is expected that 20% of traffic will be generated since the road will act as a roadway to tourism destination like Macchenarayan Temple.

Sample Calculation

Design traffic at the end of construction period in terms of standard axles,

$A= P*(1+r)^n$

$= 46*(1+0.05)^2$

= 53.15875

Cumulative number of standard axles at the end of design period,

$N_s = \frac{365*(1+r)^n-1}{r} * A * LDF * VDF$

$= 365*((1+0.05)^{10}-1)/0.05 * 53.15875*0.75*1.0$

= 183036.106020599

20% of the traffic = 36607.2212041198

Generated Traffic= Diverted Traffic = 36607.2212041198

Total design traffic = 256250.54843

Similarly, design traffic is calculated for all vehicles which is shown in table below:

Growth rate (%)	0.05
Base period (years)	5
Design life (years)	10

Table 18: Calculation for Total Design Traffic

Vehicle Type	Traffic data in 2079	Data upto the end of construction period	Vehicle damage factor	No. of cumulative standard axles (csa)	Diverted traffic (20% of csa)	Generated traffic (Expected = Diverted)	Total design traffic (msa)
Truck	46	53.15875	1	183036.11	36607.22	36607.22	0.2562505
Bus	62	71.64875	0.35	86345.29	17269.06	17269.06	0.1208834
							0.337135

As per Flexible Pavement Design Guideline (2nd Revision, 2021), ANNEX E:

For cumulative traffic of 0.377 msa and CBR value of 9.1%

Table E2: ***Traffic category***

Traffic Code	Cumulative ESAL (For 10yr Design Life)
T1	10000-30000
T2	>30000-60000
T3	>60000-100000
T4	>100000-200000
T5	>200000-300000
T6	>300000-600000
T7	>600000-1000000
T8	>1000000-1500000
T9	>1500000-2000000 (2 msa)

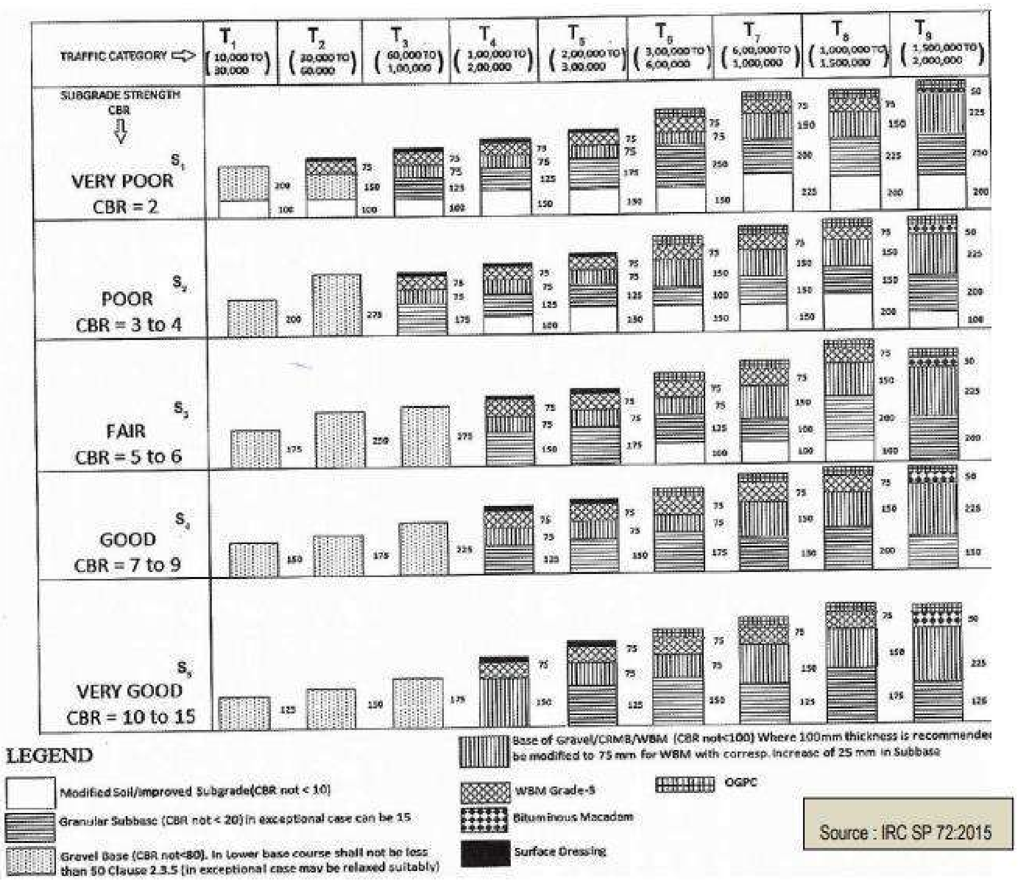
Table E4: ***Sub-grade Class***

Quality	Range of CBR, %	Class of Sub-grade
Very Poor	2	S1
Poor	3-4	S2
Fair	5-6	S3
Good	7-9	S4
Very Good	10-15	S5

Traffic Class= **T6**

Class of Sub-grade= **S4**

Using provided design chart,



Pavement Composition is as follows:

Granular Sub-base= 175mm

Gravel Base= 75mm

WBM Grade-3= 75mm

Open Graded Premix Carpet (OPGC) layer on top

Using Road Note 31,

KEY TO STRUCTURAL CATALOGUE

Traffic classes (10^6 esa)	Subgrade strength classes (CBR%)
T1 = < 0.3	S1 = 2
T2 = 0.3 - 0.7	S2 = 3 , 4
T3 = 0.7 - 1.5	S3 = 5 - 7
T4 = 1.5 - 3.0	S4 = 8 - 14
T5 = 3.0 - 6.0	S5 = 15 - 29
T6 = 6.0 - 10	S6 = 30+
T7 = 10 - 17	
T8 = 17 - 30	

Figure (i): Traffic and subgrade strength classification as per Road Note 31

For,

Traffic Class= **T2**

Subgrade Strength in CBR= **S4**

Using Chart 1,

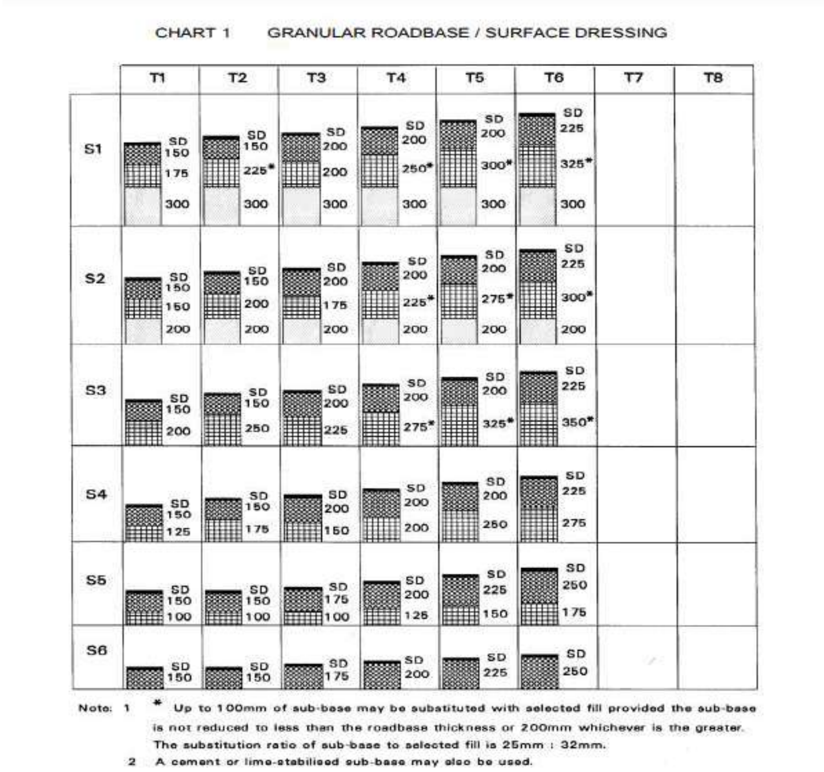


Figure (ii): Pavement layer thickness for Granular Road base

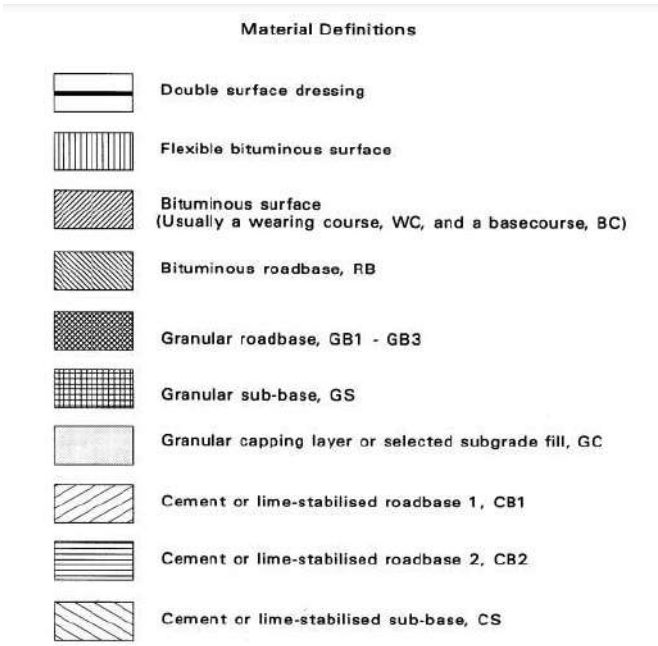


Figure (iii): Index for different materials used in pavement

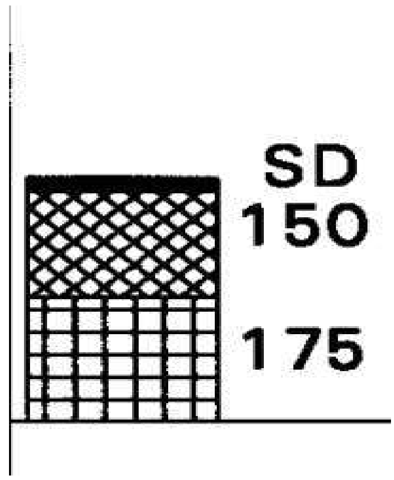


Figure (iv): Cross section of pavement

Pavement Composition is as follows:

Surface course- Surface Dressing (SD)

Granular Base Layer = 150 mm

Granular Sub-base = 175mm

Both Flexible Pavement Design Guideline (2nd Revision, 2021) and Road Note-31 yielded comparable pavement compositions for design purposes; however, Road Note-31 was favored due to its inherent simplicity in pavement composition.

For Surface Dressing (with reference to Road note 31)

- Type of surface

Embedment of the chippings under traffic depends on the hardness of the layer to be sealed and the size of the chippings.

Assessment of layer hardness can be based on descriptive definitions or measured using a simple penetration test probe. Details of surface category, penetration values, and descriptive definitions are given in Table 9.1.

TABLE 9.1

Categories of road surface hardness

Surface category	Penetration * at 30°C (mm)	Definition
Very hard	0 - 2	Surfaces such as concrete or chemically stabilised roadbases into which negligible penetration of chippings will occur under heavy traffic
Hard	2 - 5	Granular roadbases into which chippings will penetrate only slightly under heavy traffic
Normal	5 - 8	Bituminous roadbases or basecourses into which chippings will penetrate moderately under medium and heavy traffic
Soft	8 - 12	Bitumen rich asphalts into which chippings will penetrate considerably under medium and heavy traffic

From *table 9.1,*

Surface category = hard

- Traffic category

The volume of traffic is considered in terms of the number of commercial vehicles per day in the lane under consideration.

The traffic categories are defined in Table 9 2.

TABLE 9.2

Traffic categories for surface dressing

Category	Approximate number of vehicles with unladen weight greater than 1.5 tonnes (per day)
1	Over 2000
2	1000 - 2000
3	200 - 1000
4	20 - 200
5	Less than 20

From *table 9.2,*

Traffic category = 5

- Chippings

The size of chippings should be chosen to suit the level of traffic and the hardness of the underlying surface as shown in Table 9.3.

TABLE 9.3

Recommended maximum chipping size (mm)

Surface category	Traffic category 1	2	3	4	5
Very hard	10	10	6	6	6
Hard	14	14	10	6	6
Normal	20	14	14	10	6
Soft	*	20	14	14	10

* Not suitable for surface dressing

From *table 9.3*,

Recommended chipping size = 6mm

Also, in the case of a hard existing surface where little embedment of the first layer of chippings is possible, such as a newly constructed cement-stabilised roadbase or a dense crushed rock roadbase, a 'pad coat' of 6 mm chippings should be applied first followed by 10 mm or 14 mm chippings in the second layer. The first layer of small chippings will adhere well to the hard surface and will provide a 'key' for the larger stone of the second dressing.

So, we take,

Pad coat = 6mm chipping

Second layer = 10mm chipping

- Binders

To determine the rate of application of binder, an appropriate factor should be selected from Table 9.4 for each of the four sets of conditions listed. The four factors are then added together to give the total weighting factor. The Average Least Dimension of the chippings and the total weighting factor obtained from the condition constants in Table 9.4 are then used with Figure 7 to obtain the rate of application of binder.

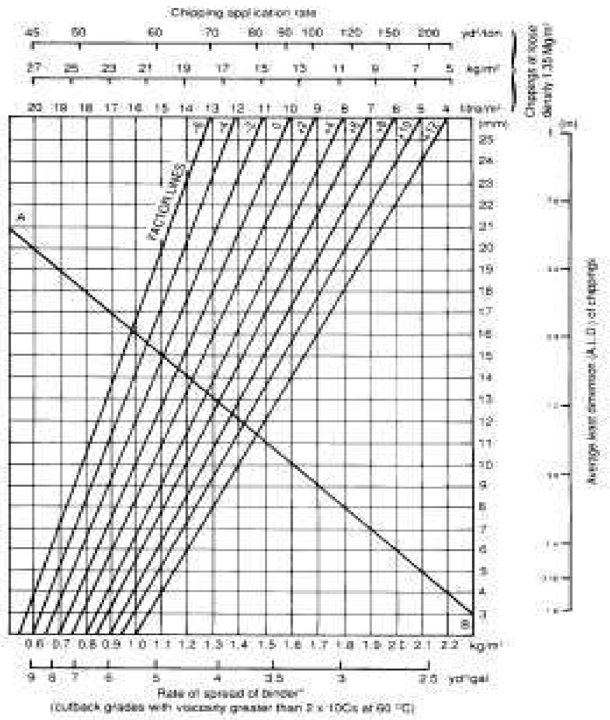
If the correct binder is not available it is sometimes possible to blend suitable materials on site (Hitch and Stewart (1987)).

TABLE 9.4

Condition constants for determining the rate of application of binder

Traffic	Vehicles/day*	Constant	Type of Chippings	Constant
Very light	0 - 50	+3	Round/dusty	+2
Light	50 - 250	+1		
Medium	250 - 500	0	Cubical	0
Medium Heavy	500 - 1500	–1		
Heavy	1500 - 3000	–3	Flaky	–2
Very Heavy	3000+	–5		
			Pre-coated	–2
Existing surface			**Climatic conditions**	
Untreated/primed roadbase		+6	Wet and cold	+2
Very lean bituminous		+4	Tropical (wet and hot)	+1
Lean bituminous		0	Temperate	0
Average bituminous		–1	Semi-arid (dry and hot)	–1
Very rich bituminous		–3	Arid (very dry and very hot)	–2

*All vehicles in one direction



1. For slow traffic or climbing grades steeper than 3 per cent, reduce the rate of spread of binder by 10 per cent
2. For fast traffic or down grades steeper than 3 per cent increase the rate of spread of binder by 10 to 20 per cent

Fig.7 Surface dressing design chart

From *table 9.4*,

Conditions	Traffic	Type of chippings	Existing surface	Climatic conditions
Constants	+1 (light traffic)	0 (assume, cubical)	+6 (untreated)	1 (temperate)

We have, total weighting factor = +1+0+6+0 = +7

Now, from *Fig 7*

We can find the rate at which chipping should be speared.

Let, Average Least Dimension' (ALD) = 10mm

The least dimension of at least 200 chippings should be measured and the 'Average Least Dimension' (ALD) determined

Chipping application rate = 13.8 $liter/m^2$

Rate of spread of binder = 1.22 kg/m^2

Thickness of Surface Dressing

As per recommendation given by IRC for the CBR method of design (IRC: 37-1970) are given below:

When sub-base course materials contain substantial proportion of aggregates of size above 20mm, the CBR value of these materials would not be valid for the design of subsequent layers above them. The thin layers of wearing course such as surface dressing or open graded premixed carpet up to 2.5 cm thickness should not be counted towards the total thickness as they do not increase the structural capacity of the pavement.

So, we provide surface dressing of thickness 2.5 cm (25 mm).

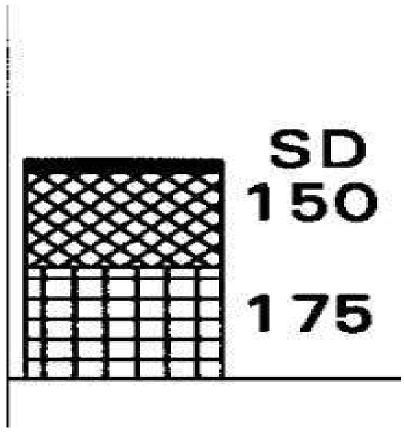


Figure 14: Cross section of pavement

Pavement Composition is as follows:

Surface course- Surface Dressing (SD) = 25mm

Granular Base Layer = 150 mm

Granular Sub-base = 175mm

3.8. Design of Longitudinal drain and Cross-drain

3.8.1. Rainfall Data

The extreme rainfall data of Changunarayan Station (St. No. 1059) of the years 1974-2011 was collected from DHM Nepal. Which is the nearest meteorological station from our catchment area. Since only daily data was available, it was converted into hourly data using necessary formulae. They were arranged in descending order and plotted against return period in log-arithmetic graph to calculate peak hourly rainfall with return period of 33 years. Calculations of max rainfall in 33 yr return period is shown below.

Table 19: Rainfall Data

Year	24h accumulated Precipitation from manual station	Hourly rainfall calculated as Hhr = 0.38*Hday (PCJ, 2006) mm	Hourly Rainfall arranged in descending order	Rank (m)	T= n/m
1974	68	25.8	62.9	1	31.0
1975	101.2	38.5	40.9	2	15.5
1976	60.1	22.8	38.5	3	10.3
1977	86	32.7	38.4	4	7.8
1978	77	29.3	36.7	5	6.2
1979	63.3	24.1	34.7	6	5.2
1980	60.2	22.9	34.7	7	4.4
1981	49.4	18.8	34.2	8	3.9
1982	62.2	23.6	32.9	9	3.4
1983	86.2	32.8	32.8	10	3.1
1984	86.5	32.9	32.8	11	2.8
1985	75.5	28.7	32.7	12	2.6
1986	78.4	29.8	31.0	13	2.4
1987	91.4	34.7	30.1	14	2.2
1988	61.7	23.4	30.1	15	2.1
1989	79.3	30.1	29.8	16	1.9
1990	79.2	30.1	29.3	17	1.8
1991	47.9	18.2	29.3	18	1.7
1992	52.2	19.8	28.7	19	1.6
1993	51.1	19.4	28.7	20	1.6
1994	72.5	27.6	28.5	21	1.5
1995	96.7	36.7	27.6	22	1.4
1996	101.1	38.4	27.4	23	1.3
1997	75.6	28.7	26.8	24	1.3

1998	86.3	32.8	25.8	25	1.2
1999	91.3	34.7	24.1	26	1.2
2000	77.1	29.3	23.9	27	1.1
2001	107.7	40.9	23.9	28	1.1
2002	165.5	62.9	23.6	29	1.1
2003	72.2	27.4	23.4	30	1.0
2004	57.8	22.0	22.9	31	1.0
2005	60	22.8	22.8	32	1.0
2006	63	23.9	22.8	33	0.9
2007	90.1	34.2	22.0	34	0.9
2008	62.9	23.9	19.8	35	0.9
2009	81.5	31.0	19.4	36	0.9
2010	75	28.5	18.8	37	0.8
2011	70.5	26.8	18.2	38	0.8

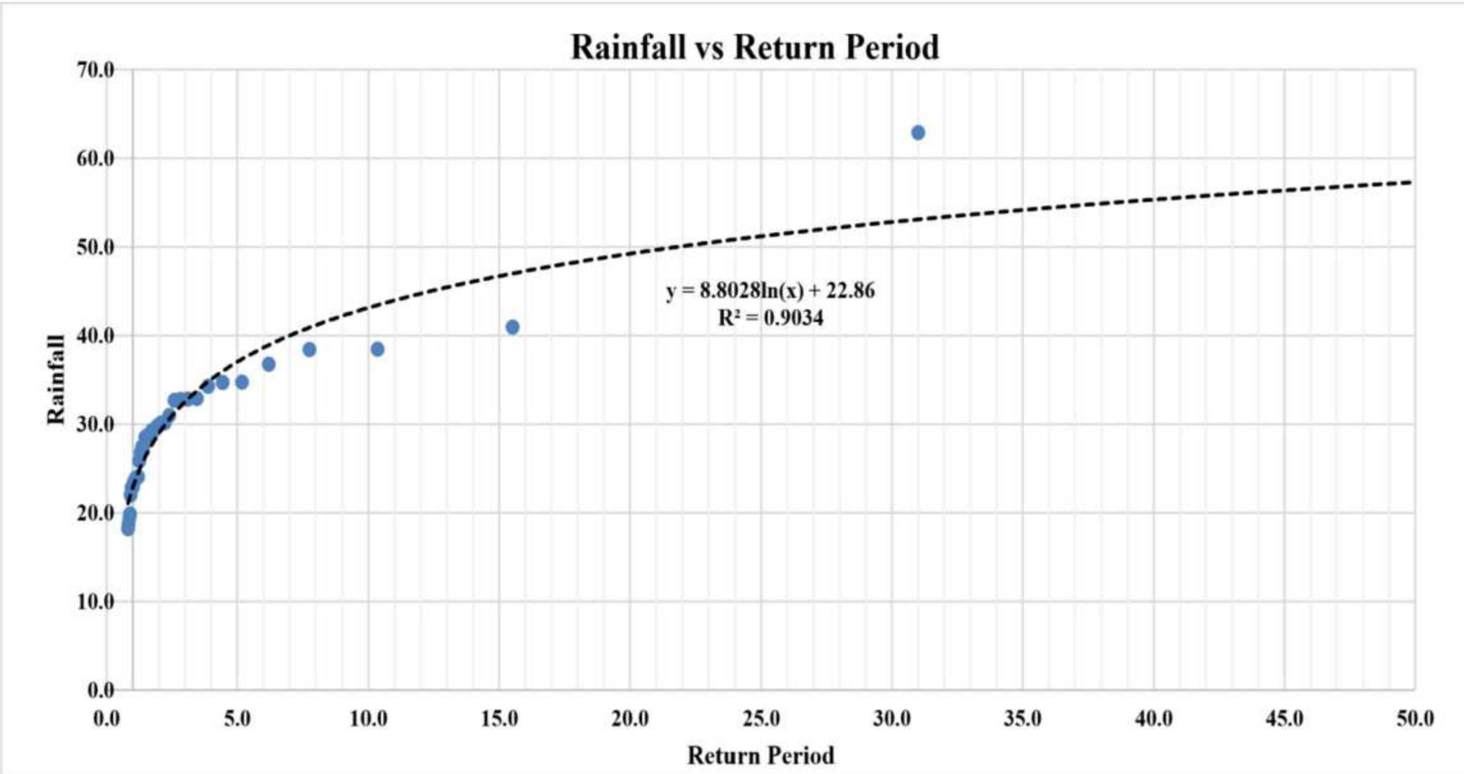
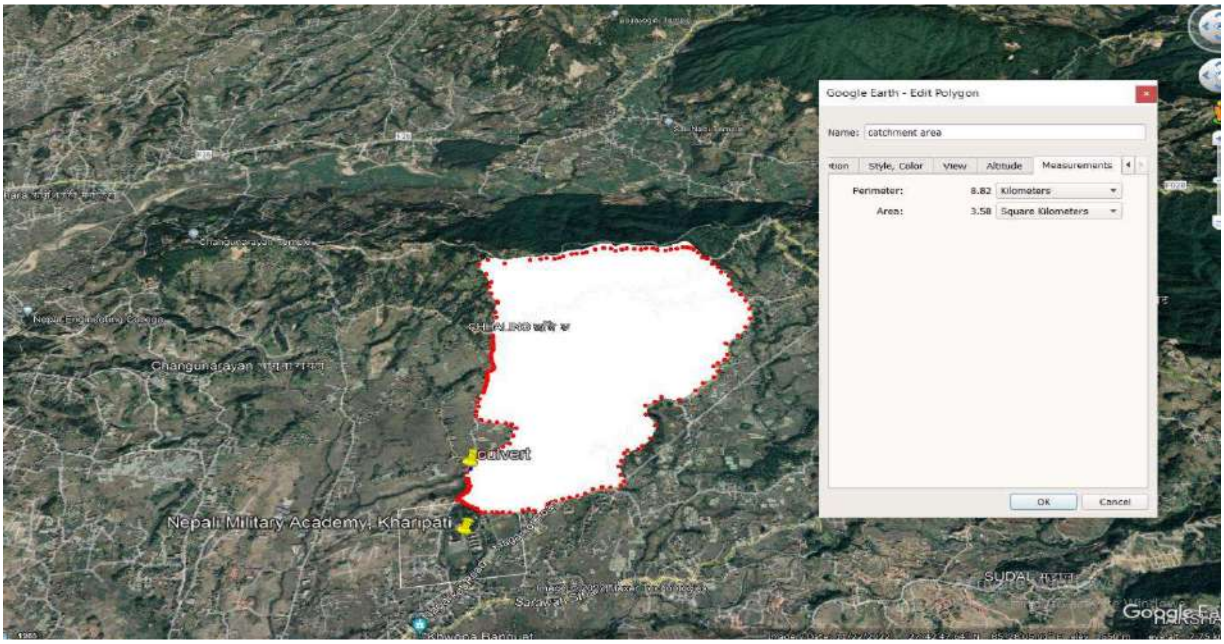


Figure 15: Rainfall Vs Return Period Graph

Rainfall with 33 year return period= 53.6 mm

3.8.2. Catchment Data



Source: Google earth

Figure 16: Catchment area at different Chainage

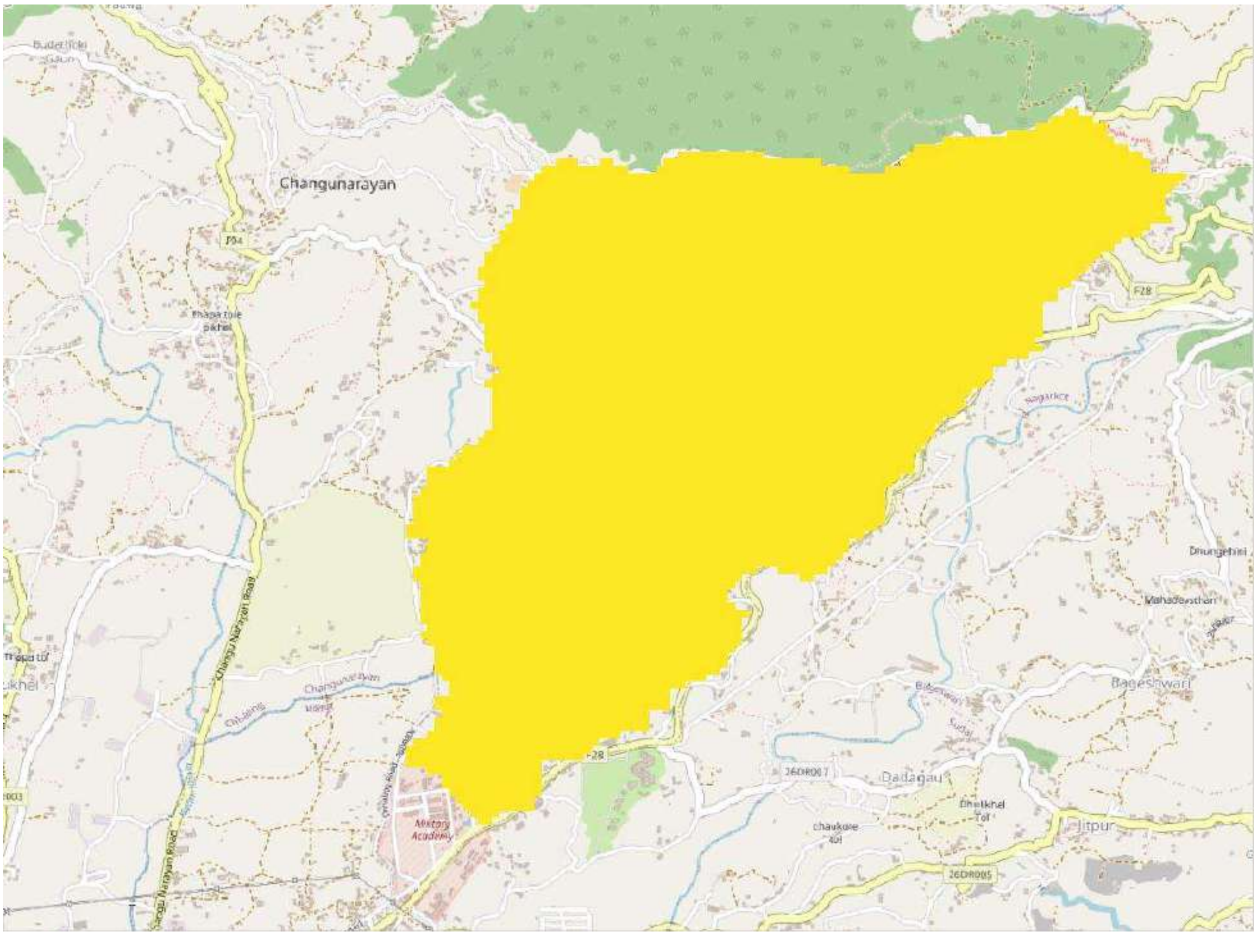


Figure 17: Catchment area (from GIS)

S.N	Catchment	Catchment area (m^2)	Remarks
1	Proposed Pipe Culvert 1	31,265	
2	Proposed Pipe Culvert 2	91,567	**Highest**

Rainfall intensity (i) = 53.6 mm/hr

Area (A) = 0.1km^2 (Taking maximum catchment area)

We know,

$Q = (1/3.6) * CiA$

Where, Q = runoff in m^3/s

C =Catchment Coefficient

A= Area in Km^2

i= intensity of rainfall in mm/hr,

Q = (1/3.6) * 0.4*53.6*0.1 = 0.6 m^3/s

Adding 10% extra for factor of safety

Therefore, Q = 0.66 cumecs

3.8.3. Design of Culvert

So, Discharge in each culvert = 0.66 m^3/s

Average longitudinal slope, S= 0.07

Manning's coefficient=0.014 (alternating frequently)

For maximum discharge through a circular channel, the depth of flow

= 0.95XD

Now, discharge= area X velocity

$0.66 = (3.14*D^2)/4 \times (1/0.014) \times (0.29D)^{2/3} \times (0.07)^{1/2}$

D = 0.43 m

Hence, we choose commercially available pipe of **diameter 0.45m**

But pipe culvert of standard dimension 0.6m dia was adopted for the purpose of easy cleaning and to prevent from chocking and clogging by sediment and boulders coming from upside catchment.

3.8.4. Design of Side Drains

Design discharge (Q) = 0.66 m^3/s

Design longitudinal slope = 0.07 (assumption based on average gradient)

Trapezoidal section is selected with **side slope of 1:1.5**

Let, B/D=1.5 so B=1.5D

Cross sectional area of drain (A) = $B*D+ZD^2 = 1.5D^2+1.5D^2$

$= 3D^2$

Wetted perimeter (P) = $1.5D+2D\sqrt{1+1.5^2} = 5.1D$

Hydraulic radius R = 0.587D

Manning's coefficient (n) = 0.017 (concrete finish with gravel on bottom)

Using manning's equation,

$0.66 = \frac{1}{0.017} x3D\hat{}2x(0.587D)\hat{}2/3x0.07^{1/2}$

On solving above equation, we get D = 0.25 m

B = 1.5D = 0.4m

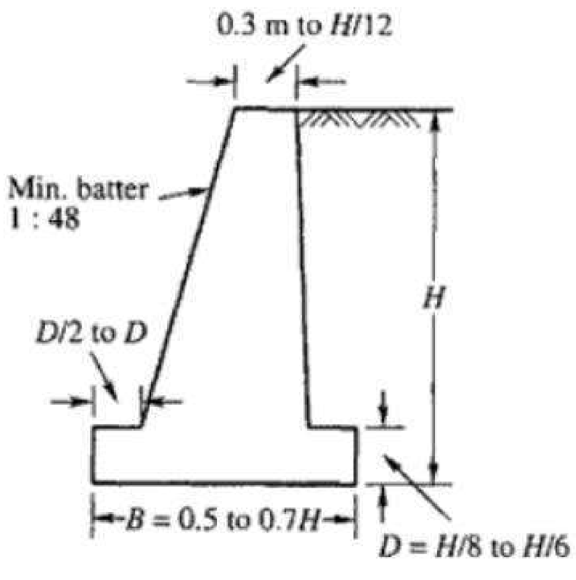
Free board = 0.20m

Hence, adopted **depth of side drain = 0.45m**

Check for permissible velocity,
For,
B = 0.4m
D = 0.45m
n = 0.017
by calculations
velocity v = 4.8m/s (OK)
permissible velocity for concrete finish with gravel (2.5-5)

3.9. Design of retaining wall

Retaining wall is designed to overcome the lateral forces and must be safe against sliding, overturning and tension crack. These walls are designed to hold back soil on slopes that would otherwise be too steep or vertical. We adopted the design based on IS 14458 guidelines for gravity wall whose dimension was designed based on empirical rule of thumb as shown in given figure:



(Source: Pinterest)

Figure 18: Thumb rule for dimensioning masonry retaining wall

Height = 3m

Base width = 0.5 to 0.7H = 2.0m

Top width = 0.7m

Back slope = vertical

Sample calculations to check FOS against sliding, overturning, tension failure and bearing capacity failure is shown in **Annex - B**

4. ESTIMATION AND COSTING

Estimate, for any project, can be defined as the process involving the calculation of quantity and costs of various items required in connection with the work. Estimation involves forecasting the amount of time, resources, and materials that will be required to complete the project successfully. Costing, on the other hand, involves determining the overall cost of the project, including all expenses related to materials, labor, equipment, and other direct and indirect costs.

4.1. Quantity Estimation

Quantity estimation helps the owner or builder to have a thorough knowledge about the volume of work that can be completed within the limits of one's funds. In addition to it, quantity estimation helps to ensure the right amount of materials to be ordered and delivered to the construction site, avoiding unnecessary delays, and minimizing waste. For the project, quantity estimation was carried out after detailed engineering survey and design in the Civil 3D software. Quantity estimation sheets for site clearance, earthwork, pavement works, drainage works and structural works can be found in **ANNEX - C.**

4.2. Cost Estimation

Cost estimation helps to gather information regarding probable cost that may be required to complete the contemplated work. For ensuring the financial feasibility along with better budgeting and financial planning, cost estimation becomes an important aspect of a project. In this report, cost estimation is done for the calculated quantity estimation following the prevailing practices of Nepal, included in **Annex**. Rate analysis is carried out following the district rate of Bhaktapur 79/80. The table below shows the abstract of costs of the project.

Table 20: Abstract of Cost

S.N.	Particulars	Cost (NRs.)
1	Site Clearance	92449.24
2	Earthworks	9394224.541
3	Pavement works	38076074.73
4	Drainage works	1433042.088
5	Structural works	13663314.25
	Total	62659107.85
	Cost per km	22702575.31

The total cost of the project is estimated to be NRs. 6,26,55,912.86 and the cost per km is estimated to be 2,27,02,575.31.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This project involves the detailed alignment, engineering design plus estimation and costing for a hill road section of 2.76 km length. The road section lies in Chhaling area, Changunarayan Municipality, Bhaktapur District. It starts from Dhunge Dhara and ends in Machhenarayan Temple. The road section is believed to assists the locals by providing easy transportation access, which benefits their quality of life, economic development, and local tourism. The road also helps connect the main city of Bhaktapur with religious heritage of Machhenarayan Temple.

A bituminous road pavement of thickness 375 mm with 150 mm thick granular base layer, 170 mm thick granular sub-base and 50 mm surface course has been designed as per Road note 31. Detailed drainage structures have been also designed. Pipe culverts (diameter: 450mm) have been proposed at seven locations. Total cut volume is $64574.9m^3$ and fill volume is $37951.82m^3$. Retaining structures have been provided for the stability of the road. The total cost of the project is Rs 6,26,59,107.85 and Rs 2,27,02,575.31 per km.

5.2. Recommendations

Speed limits should be properly implemented through the use of traffic signs, speed breakers etc. to ensure safety in sharp turnings. Slope protection and soil stabilization methods such as gabion walls, wire meshing, vegetation plantation etc. should be done to prevent landslide and soil erosion. Drop structure and energy dissipating structures should be built for safe dispose of the discharges from the side drain.

6. REFERENCES

[1] Bhaktapur District Rate for FY 2079/80

[2] Chakraborty, M(1963), Estimating Costing and Specification, R. K. Printers

[3] Department of Roads. *Guidelines for the design of flexible pavement-2014*. Second Edition 2021

[4] Department of Roads. *Nepal Roads Standard*. 2070 B.S.

[5] Department of Roads. *Nepal Urban Roads Standard*. 2076 B.S.

[6] Department of Roads. *Norms for rate analysis of road and bridge works*. 2075

[7] IRC-37-2018: Guidelines for the design of flexible pavements (fourth revision)

[8] Justo, C E G., Khanna S K(2001), Highway Engineering, Khanna Publications

[9] Marsani, A., Shrestha, D K.(2014), Transportation Engineering, Heritage Publications

[10] Overseas Road Note 31: A guide to the structural design of bitumen-surfaced roads in tropical and sub-tropical countries

[11] Subramanya, K(2008), Engineering Hydrology, Tata Mcgraw Hill

7. ANNEXES

ANNEX- A: SUPERELEVATION AND EXTRA WIDENING

PI Station	Radius	Super elevation (e)	Extra widening (W)	W (min)	W (provided)	R comfort (m)	Minimum R (for e=7%)	Remarks
0+204.14	55.762	0.07	1.064	0.60	1.064	80	55.762	Ok
0+263.42	19.269	0.07	2.408	0.60	2.408	80	19.269	Ok
0+330.77	42.000	0.07	1.314	0.60	1.314	80	42	Ok
0+515.91	58.992	0.07	1.021	0.60	1.021	80	58.992	Ok
0+568.29	71.138	0.07	0.892	0.00	0.000	80	71.138	Ok
0+667.13	200.00	0.035	0.437	0.00	0.000	80	200	Ok
0+737.45	200.00	0.035	0.437	0.00	0.000	80	200	Ok
0+836.18	61.661	0.07	0.989	0.00	0.000	80	61.661	Ok
1+010.17	57.064	0.07	1.046	0.60	1.046	80	57.064	Ok
1+093.35	73.352	0.07	0.872	0.00	0.000	80	73.352	Ok
1+136.52	62.963	0.07	0.974	0.00	0.000	80	62.963	Ok
1+173.13	42.000	0.07	1.314	0.60	1.314	80	42	Ok
1+253.76	83.122	0.07	0.798	0.00	0.000	80	83.122	Ok
1+290.59	47.913	0.07	1.191	0.60	1.191	80	47.913	Ok
1+396.41	50.487	0.07	1.145	0.60	1.145	80	50.487	Ok
1+469.91	54.355	0.07	1.085	0.60	1.085	80	54.355	Ok
1+576.42	74.019	0.07	0.866	0.00	0.000	80	74.019	Ok
1+652.08	78.352	0.07	0.832	0.00	0.000	80	78.352	Ok
1+703.70	42.112	0.07	1.312	0.60	1.312	80	42.112	Ok
1+770.58	200.00	0.035	0.437	0.00	0.000	80	200	Ok
1+924.08	200.00	0.035	0.437	0.00	0.000	80	200	Ok
2+013.94	200.00	0.035	0.437	0.00	0.000	80	200	Ok
2+083.83	42.112	0.07	1.312	0.60	1.312	80	42.112	Ok
2+234.62	75.125	0.07	0.857	0.00	0.000	80	75.125	Ok
2+289.33	61.677	0.07	0.989	0.00	0.000	80	61.677	Ok
2+392.96	42.112	0.07	1.312	0.60	1.312	80	42.112	Ok
2+464.18	111.67	0.063	0.648	0.00	0.000	80	111.671	Ok
2+652.68	61.811	0.07	0.987	0.00	0.000	80	61.811	Ok
2+702.25	48.469	0.07	1.181	0.60	1.181	80	48.469	Ok

ANNEX- B: SAMPLE CALCULATION OF RETAINING WALL

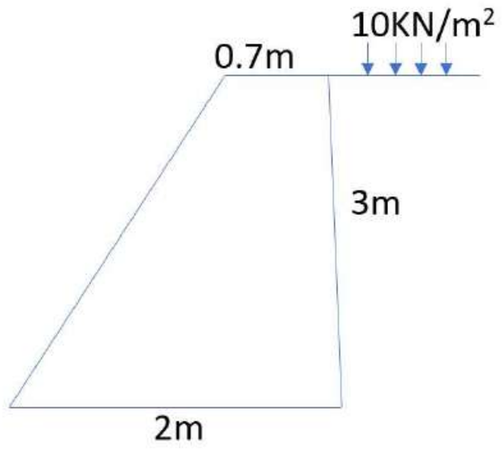


Figure 19: Sample Calculation of Retaining wall

A typical section of the retaining wall is as per the standard thumb rule is shown in figure above.

As per BS 8002, retaining structure should be designed for the surcharge load of $10kN/m^2$. But for shallower walls, it can be reduced as per the site condition. However, let's design for the worst case taking $10kN/m^2$.

1st design for cohesive soil assuming value for Cohesion (C)$20kN/m^2$ and angle of friction (ø) as 27°.

Unit weight of soil (γ_{soil}) = 16 N/m^3

Submerged unit weight ((γ_{sub}) = 16-10 = 6 KN/m^3

Unit weight of concrete ($\gamma_{concrete}$) = $24kN/m^3$

Active earth pressure coefficient (K_a) = $\frac{1-\sin\emptyset}{1+\sin\emptyset}$ = 0.375

Now,

$q_{top} = 10kN/m^2$

$P_{top}= k*q_{top} - 2c\sqrt{k} = 0.375*10 - 2*20*\sqrt{(0.375)} = -20.745\ kN/m^2$

$q_{bottom} = \gamma_{sub}*H + q = 6*3 + 10 = 28\ kN/m^2$

$P_{bottom} = k*q_{bottom} - 2c\sqrt{k} = 0.375*28- 2*20*\sqrt{(0.375)} = -14kN/m^2$

Here, pressure is -ve from top to the bottom of the wall. S0, wall is safe considering all the safe requirements.

Now, let's design for the Sandy soil(C=0) taking ø = 34°. Then,

Active earth pressure coefficient (K_a) = $\frac{1-\sin\emptyset}{1+\sin\emptyset}$ = 0.287

Here,

$q_{top} = 10kN/m^2$

$P_{top} = k*q_{top} - 2c\sqrt{k} = 0.287*10 = 2.87\ kN/m^2$

$q_{bottom} = \gamma_{sub}*H + q = 6*3 + 10 = 28\ kN/m^2$

$P_{bottom} = k*q_{bottom} - 2c\sqrt{k} = 0.287*28 = 8.036\ kN/m^2$

Now,

$P_{total} = 2.87*3 + 0.5*(8.036-2.87)*3 = 8.61+7.75=16.36\ kN/m$

Point of application (h) = $\frac{8.61*\frac{3}{2}+7.75*\frac{1}{3}*3}{16.36}$ = 1.263 m from base

Now,

Weight of concrete= $\frac{3*(0.7+2)}{2} * 24 = 97.2\ kN/m$

Point of Application (x) = $\frac{\frac{1}{2}*(2-0.7)^2*3*\frac{2}{3}+0.7*3*(2-\frac{0.7}{2})}{97.2}$ = 1.27 m

Therefore,

Taking $\delta = \frac{2}{3} * ø$=26.667°

Then,

Case (a) No Sliding:

FOS= $\frac{\text{Resisting force}}{\text{Sliding force}} = \frac{97.2*\tan 26.667}{16.36}$ = 2.98 > 1.5 (safe)

Case (b) No Overturning:

FOS= $\frac{\text{Resisting Moment}}{\text{Sliding Moment}} = \frac{97.2*1.27}{16.36*1.263}$ = 5.97 > 2 (safe)

Case (c) No Tension:

$\bar{x} = \frac{\Sigma M}{\Sigma V} = \frac{97.2*1.27-16.36*1.263}{97.2}$ = 1.057m

Also, eccentricity (e) = $\frac{b}{2} - \bar{x}$ = -0.057m which is within ± $\frac{b}{6}$ i.e., ±0.333m. Hence safe.

Case (d) No Bearing capacity failure:

$p_{max} = \frac{\Sigma V}{b} * (1 + 6\frac{e}{b}) = 56.91$ kN/ m^2

then,

FOS = $\frac{q_{allowable}}{pmax} = \frac{180}{56.91} = 3.163 > 3$. So safe.

ANNEX- C: QUANTITY ESTIMATION

S.N	Description	No.	L	B	H	Quantity	Unit	Remarks
1	Site Clearance	1	2760	11	-	30360	m^2	
2	Sub grade Preparation	1	2760	7.5		20700	m^3	
3	Sub base Preparation	1	2760	7.5	0.175	3622.5	m^3	
4	Base course	1	2760	7.5	0.150	3105	m^3	
5	Prime coat	1	2760	7.5	-	18630	Lit	0.9 lit/m2
6	Tack coat	1	2760	7.5	-	24840	Lit	1.2 lit/m2
7	Surface Dressing	1	2760	7.5	-	20700	m^2	
8	Earthwork in excavation	1	2760	0.484	-	1324.8	m^3	
9	PCC work (12 mm)	1	2760	2.022	0.012	67	m^3	
10	Pipe Culvert (600 mm dia)	7	7.5			52.5	rm	
11	Retaining Wall	1	280	4.05		1134	m^3	

ANNEX- D: SCHEDULE OF RATES

Based on 'Department of Roads Norms for Rate Analysis of Road and Bridge Works, 2075', 'DoR Equipment Hire Rate' and 'Bhaktapur District rate 79/80'

SITE CLEARANCE					
Clearing and grubbing road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable Material to be used or auctioned, up to a lead of 30 meters including removal and disposal of top organic soil not exceeding 150 mm in thickness. (Unit = 10,000 sq.m)					
S.N.	**Name of Items**	**Quantity**	**Unit**	**Rate**	**Amount (NRs.)**
A.	Cost of materials				
				Sub-total	0
B.	Cost of labors				
	Skilled	0	/day	1200	0
	Unskilled	9	/day	890	8010
				Sub-total	8010
C.	Cost of tools, equipments and plants				
	Dozer/ Excavator	12	/hour	1800	21600
				Sub-total	21600
				A+B+C	29610
	Contractor's overhead and profit charges (15%)				4441.5
				Total	**34051.5**
				per m^2	**3.0451**

EARTHWORK EXCAVATION IN CUTTING					
Removal of unserviceable soil including excavation, loading and disposal upto 1000 meters lead (Unit =360 cum)					
S.N.	**Name of Items**	**Quantity**	**Unit**	**Rate**	**Amount (NRs.)**
A.	Cost of materials				
				Sub-total	0
B.	Cost of labors				
	Skilled	1	/day	1200	1200
	Unskilled	4	/day	890	3560
				Sub-total	4760
C.	Cost of tools, equipments and plants				

	Excavator	6	/hour	1800	10800
	Tipper	18	/hour	450	8100
				Sub-total	18900
	A+B+C				23660
	Contractor's overhead and profit charges (15%)				3549
	Total				**27209**
	per m³				**75.58056**

EARTHWORK EXCAVATION IN FILLING					
Providing, laying, spreading and compacting embankment with roadway cutting material and compact to the required density as per Drawing and Technical Specifications. (With machine) Unit = cum (For 300 cum)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Water	72	KL	260	18720
				Sub-total	18720
B.	Cost of labors				
	Skilled	1	/day	1200	1200
	Unskilled	10	/day	890	8900
				Sub-total	10100
C.	Cost of tools, equipments and plants				
	Dozer	6	/hour	3000	18000
	Motor Grader	6	/hour	1600	9600
	Vibratory equipment	6	/hour	800	4800
				Sub-total	32400
	A+B+C				61220
	Contractor's overhead and profit charges (15%)				9183
	Total				**70403**
	per m³				**234.6767**

SUBGRADE PREPARATION					
Compacting ground supporting sub-grade Loosening of the ground up to a level of 500 mm below the sub-grade level, watered, graded and compacted in layers as per Drawing and Technical Specifications. Unit = cum (For 600 cum = 1200sq.m area* 500mm depth)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				

	Water	24	KL	260	6240
				Sub-total	6240
B.	Cost of labors				
	Skilled	1	/day	1200	1200
	Unskilled	5	/day	890	4450
				Sub-total	5650
C.	Cost of tools, equipments and plants				
	Tractor with ripper attachment	12	/hour	440	5280
	Motor Grader	6	/hour	1600	9600
	Vibratory equipment	12	/hour	800	9600
				Sub-total	24480
	A+B+C				36370
	Contractor's overhead and profit charges (15%)				5455.5
	Total				**41825.5**
	per m^3				**34.85**

FOR SUB-BASE					
Providing and laying granular sub-base on prepared surface, mixing at OMC, and compacting to achieve the desired density, complete as per Drawing and Technical Specifications. (300 cum)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Crusher run sub-base material (63 mm down)	384	cu.m	2805.8	1077427.2
	Water	18	KL	260	4680
				Sub-total	1082107.2
B.	Cost of labors				
	Skilled	2	/day	1200	2400
	Unskilled	12	/day	890	10680
				Sub-total	13080
C.	Cost of tools, equipments and plants				
	Motor Grader	6	/hour	1600	9600
	Vibratory equipment	12	/hour	800	9600
	Tractor	12	/hour	300	3600
				Sub-total	22800
	A+B+C				1117987.2
	Contractor's overhead and profit charges (15%)				167698.08
	Total				**1285685.28**
	per m^3				**4285.62**

FOR BASE COURSE					
Providing and laying Crusher Run Macadam on a prepared surface, spreading and mixing, watering and compacting to form a layer of Base course as per Drawing and Technical Specifications. Unit = cum (For 360 cum)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Aggregate (For 45mm maximum size)				
	44 - 22.5 mm	24.12	cu.m	3371	81308.52
	22.4 – 5.6 mm	237.6	cu.m	3268	776476.8
	Below 5.6	213.48	cu.m	2973	63467.04
	Water	36	KL	260	9360
				Sub-total	1501821.36
B.	Cost of labors				
	Skilled	3	/day	1200	3600
	Unskilled	14	/day	890	12460
				Sub-total	16060
C.	Cost of tools, equipments and plants				
	Motor Grader	6	/hour	1600	9600
	Vibratory equipment	6	/hour	800	4800
				Sub-total	14400
	A+B+C				1532281.36
	Contractor's overhead and profit charges (15%)				229842.204
	Total				**1762122.564**
	per m^3				**4894.785**

PRIME COAT					
Prime Coat, with MC 30 / 70 by Mechanical Means Providing and applying prime coat with Hot Bitumen (including cutter) on prepared surface of granular base including cleaning of road surface and spraying by mechanical means as per Technical Specification Unit = lit (For 5000 lit)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Bitumen Cutback	5.25	tonne	115000	603750
	Water	10	KL	260	2600
				Sub-total	606350
B.	Cost of labors				
	Skilled	3	/day	1200	3600

	Unskilled	50	/day	890	44500
				Sub-total	48100
C.	Cost of tools, equipments and plants				
	Mechanical Broom	8	/hour	260	2080
	Air Compressor	8	/hour	250	2000
	Bitumen Distributor	6	/hour	1300	7800
	Boiler	8	/hour	180	1440
	Generator	8	/hour	150	1200
				Sub-total	14520
				A+B+C	668970
				Contractor's overhead and profit charges (15%)	100345.5
				Total	**769315.5**
				per litre	**153.8631**

TACK COAT					
Tack coat with Bitumen By Mechanical Means Providing and applying tack coat with hot Bitumen at specified rate on the prepared non-bituminous surfaces including cleaning as per Technical Speciation. Unit = lit. (For 5000 lit=5cu.m					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Bitumen	5.25	tonne	115000	603750
				Sub-total	603750
B.	Cost of labors				
	Skilled	3	/day	1200	3600
	Unskilled	20	/day	890	17800
				Sub-total	23400
C.	Cost of tools, equipments and plants				
	Air Compressor	6	/hour	250	1500
	Bitumen Distributor	6	/hour	1300	7800
	Boiler	6	/hour	180	1080
	Generator	6	/hour	150	900
				Sub-total	11280
				A+B+C	638430
				Contractor's overhead and profit charges (15%)	95764.5
				Total	**734194.5**
				per litre	**146.8389**

SURFACE DRESSING					
Providing and laying surface dressing as wearing course in single coat using gravel of specified size on a recently applied layer of bituminous binder on prepared surface as per Drawing and Technical Specifications 25 mm thick Unit = sqm [For 9000 sqm]					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Crushed stone chippings, 6 mm nominal size	48.2	cum	2.7615	133.104
	Crushed stone chippings, 10 mm nominal size	80.3	cum	2.9716	238.62
				Sub-total	271.724
B.	Cost of labors				
	Skilled	3	/day	1200	3600
	Unskilled	12	/day	890	10680
				Sub-total	14280
C.	Cost of tools, equipments and plants				
	Chip Spreader	6	/hour	2600	15600
	Pneumatic Roller	12	/hour	1200	14400
				Sub-total	30000
	A+B+C				44551.724
	Contractor's overhead and profit charges (15%)				6682.76
	Total				**51234.48**
	per m^2				**5.69272**

RETAINING WALL					
Providing and laying of stone masonry work un cement mortar 1:4 in Foundation complete as per Drawing and Technical Specifications. Unit = cum (For 5 cum)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Stone	5.75	cu.m	2800	16100
	Sand	1.74	cu.m	3128.156	5442.99144
	Cement	0.62	tonne	14000	8680
	Water	1	KL	260	260
				Sub-total	30482.9914
B.	Cost of labors				
	Skilled	7	/day	1200	8400

	Unskilled	14	/day	890	12460
				Sub-total	20860
C.	Cost of tools, equipments and plants				
	Concrete mixer or other tools (5% of labour cost)				1043
				Sub-total	1043
				A+B+C	52385.9914
	Contractor's overhead and profit charges (15%)				7857.89872
				Total	**60243.902**
				per m^3	**12048.778**

CULVERT PIPES (600 MM INTERNAL DIA)					
Providing and Laying Reinforced Cement Concrete Flush jointed Pipe for culverts Providing and Laying Reinforced cement concrete NP3 Flush jointed pipe for culverts including fixing with cement mortar 1:2 as per Drawing and Technical Specifications. Unit = meter (For 12.5 m. 5 pipes of 2.5 m length each) (600 mm internal dia.)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	RCC Pipes	12.5	m	3077	38462.5
	Sand	0.1	cu.m	3128.156	312.892
	Cement	0.08	tonne	14000	1120
				Sub-total	39895.982
B.	Cost of labors				
	Skilled	1	/day	1200	1200
	Unskilled	7	/day	890	6230
				Sub-total	7430
C.	Cost of tools, equipments and plants				
	Add 3 % of Labour cost for bellies, crow bars, chain pulley and other T&P				222.9
				Sub-total	222.9
				A+B+C	47548.292
	Contractor's overhead and profit charges (15%)				7132.2438
				Total	**71322.438**
				per m	**5705.795**

SIDE DRAINS					
Providing and laying of Plain/Reinforced Cement Concrete in foundation complete as per Drawing and Technical Specifications. PCC Grade M 15 Unit = cum (For 15 cum)					
S.N.	**Name of Items**	**Quantity**	Unit	Rate	**Amount (NRs.)**
A.	Cost of materials				
	Cement	4.13	tonne	14000	57680
	Coarse sand	6.75	cu.m	3128.93	21120.2775
	40 mm aggregate	8.1	cu.m	3595.75	29125.575
	20 mm aggregate	4.05	cu.m	3708.12	15017.886
	10 mm aggregate	1.35	cu.m	3445.93	4652
	Water	2	KL	260	520
				Sub-total	128115.73
B.	Cost of labors				
	Skilled	3	/day	1200	3600
	Unskilled	30	/day	890	26700
				Sub-total	30300
C.	Manual mixing				
	In case of manual mixed concrete add 50 % of Labour component and reduce Equipment				15150
				Sub-total	15150
D.	Formwork @ 4 per cent on cost of concrete i.e. cost of Material, Labour and Equipment				6942.6292
	A+B+C+D				180508.35
	Contractor's overhead and profit charges (15%)				27076.25
	Total				**207584.61**
	per m^3				**13838.97**

ANNEX- E: ABSTRACT OF COST

S.N.	Particulars	Quantity	Unit	Rate	Cost (NRs.)
1	**Site Clearance**	30360	m^2	3.0451	92449.24
2	**Earthwork**				
	Earthwork in cutting	64574.9	m^3	75.58	488070.942
	Earthwork in filling	37951.82	m^3	234.67	8906153.599
				Total	9394224.541
3	**Pavement Works**				
	Sub grade preparation	20700	m^2	34.85	721395
	Sub Base Preparation	3622.5	m^3	4285.62	15524658.45
	Base Preparation	3105	m^3	4894.78	15198291.9
	Prime Coat	18630	lit	153.86	2866411.8
	Tack Coat	24840	lit	146.839	3647478.276
	Surface Dressing	20700	m^2	5.69272	117839.304
				Total	38076074.73
4	**Drainage Works**				
	Side Drainage				
	Earthwork in excavation	1324.8	m^3	75.58	100128.38
	12 mm PCC works (M15)	67	m^3	13838.97	927210.99
	Cross Drainage				
	Pipe Culvert (600 mm)	52.5	rm	5705.795	299554.23
	Transportation	8% of total cost			106151.488
				Total	1433045.088
5	**Structural Works**				
	Retaining Wall	1134	m^3	12048.778	13663314.25
				Grand Total	62659107.85

ANNEX- F: ELEMENTS OF HORIZONTAL CURVE

PI Station	Radius	Width of Pavement	Design speed	Superelevation	Extra widening	C	L_1	L_2	L_3	Length of transition curve	Lateral Shift	πR	Check $L \leq \pi R$	L_{min} from NRS	Provided length of Transition Curve(m)
0+213.15	55.76	5.5	40	0.07	1.06	0.7	35.1	34.463	77.47	77.47	4.48	175.18	ok	35	77
0+249.27	19.27	5.5	40	0.07	2.41	0.7	101.59	41.514	224.19	224.19	108.69	60.54		20	224
0+315.99	42	5.5	40	0.07	1.31	0.7	46.61	35.774	102.86	102.86	10.5	131.95	ok	30	103
0+524.96	58.99	5.5	40	0.07	1.02	0.7	33.18	34.237	73.23	73.23	3.79	185.33	ok	35	73
0+568.36	71.14	5.5	40	0.07	0	0.7	27.52	28.875	60.73	60.73	2.16	223.49	ok	40	61
0+662.59	200	5.5	40	0.05	0	0.7	9.79	19.488	21.6	21.6	0.1				22
0+741.99	200	5.5	40	0.05	0	0.7	9.79	19.488	21.6	21.6	0.1				22
0+825.97	61.66	5.5	40	0.07	0	0.7	31.75	28.875	70.06	70.06	3.32	193.71	ok	40	70
1+009.45	57.06	5.5	40	0.07	1.05	0.7	34.3	34.369	75.7	75.7	4.18	179.27	ok	35	76
1+097.82	73.35	5.5	40	0.07	0	0.7	26.69	28.875	58.89	58.89	1.97	230.44	ok	40	59
1+138.98	62.96	5.5	40	0.07	0	0.7	31.09	28.875	68.61	68.61	3.12	197.8	ok	40	69
1+162.19	42	5.5	40	0.07	1.31	0.7	46.61	35.774	102.86	102.86	10.5	131.95	ok	30	103
1+257.00	83.12	5.5	40	0.07	0	0.7	23.55	28.875	51.97	51.97	1.35	261.14	ok	45	52
1+281.39	47.91	5.5	40	0.07	1.19	0.7	40.85	35.126	90.16	90.16	7.07	150.52	ok	30	90
1+399.66	50.49	5.5	40	0.07	1.15	0.7	38.77	34.888	85.57	85.57	6.04	158.61	ok	35	86
1+463.06	54.36	5.5	40	0.07	1.08	0.7	36.01	34.569	79.48	79.48	4.84	170.76	ok	35	79
1+578.83	74.02	5.5	40	0.07	0	0.7	26.45	28.875	58.36	58.36	1.92	232.54	ok	40	58
1+655.40	78.35	5.5	40	0.07	0	0.7	24.98	28.875	55.14	55.14	1.62	246.15	ok	40	55
1+700.10	42.11	5.5	40	0.07	1.31	0.7	46.48	35.761	102.58	102.58	10.41	132.3	ok	30	103
1+762.90	200	5.5	40	0.05	0	0.7	9.79	19.488	21.6	21.6	0.1				22
1+928.86	200	5.5	40	0.05	0	0.7	9.79	19.488	21.6	21.6	0.1				22
2+017.02	200	5.5	40	0.05	0	0.7	9.79	19.488	21.6	21.6	0.1				22
2+076.25	42.11	5.5	40	0.07	1.31	0.7	46.48	35.761	102.58	102.58	10.41	132.3	ok	30	103
2+240.42	75.13	5.5	40	0.07	0	0.7	26.06	28.875	57.5	57.5	1.83	236.01	ok	40	58
2+284.85	61.68	5.5	40	0.07	0	0.7	31.74	28.875	70.04	70.04	3.31	193.76	ok	40	70
2+399.64	42.11	5.5	40	0.07	1.31	0.7	46.48	35.761	102.58	102.58	10.41	132.3	ok	30	103
2+457.01	111.67	5.5	40	0.07	0	0.7	17.53	28.875	38.69	38.69	0.56	350.82	ok	50	39
2+662.01	61.81	5.5	40	0.07	0	0.7	31.67	28.875	69.89	69.89	3.29	194.18	ok	40	70
2+692.42	48.47	5.5	40	0.07	1.18	0.7	40.39	35.073	89.13	89.13	6.83	152.27	ok	30	89

ANNEX- G: ELEMENTS OF VERTICAL CURVE

PVI Station	PVI Elevation	Grade In	Grade Out	A (Grade Change)	Profile Curve Type	K Value	Curve Radius (m)	Summit Curves			Valley Curves				Curve Length from Graph (m)
								ISD>L	ISD<L	L provided (m)	S>L	S<L	Comfort Criteria	L provided (m)	
0+000.00	1350.023		0.57%												
0+673.76	1353.893	0.57%	-7.71%	8.28%	Crest	29.095	2909.476	84.05797		241					241
0+826.72	1342.102m	-7.71%	-7.71%	0.00%	Sag	20449.65	2044965	0		52.613					52.613
1+045.26	1325.261	-7.71%	5.65%	13.36%	Sag	11.027	1102.676	0	139.1667		0	102.7692	54.81026	147.285	147.285
1+239.88	1336.258	5.65%	0.51%	5.14%	Crest	35.157	3515.727	13.22957		180.793					180.793
1+450.09	1337.327	0.51%	3.13%	2.63%	Sag	57.12	5712.036	-165.019			-23.5741	0	10.78974	150	150
1+602.26	1342.096	3.13%	4.66%	1.52%	Sag	98.422	9842.194	0			-113.816	0	6.235897	150	150
1+781.45	1350.444	4.66%	9.64%	4.99%	Sag	30.089	3008.931	7.61523			34.86974	0	20.47179	150	150
1+956.91	1367.365	9.64%	5.53%	4.11%	Crest	23	2300	-33.5766		94.636					94.636
2+282.61	1385.373	5.53%	9.24%	3.71%	Sag	40.384	4038.395	-58.7601			12.39892	0	15.22051	150	150
2+475.08	1403.163	9.24%	7.09%	2.16%	Crest	51.768	5176.766	-244.444		111.561					111.561
2+585.69	1411.004	7.09%	6.07%	1.02%	Crest	95.569	9556.878	0		97.122					97.122
2+713.86	1418.787	6.07%	5.64%	0.43%	Crest	239.2	23920.04	0		102.89					102.89
2+760.00	1421.993	5.64%													

ANNEX- H: MASS HAUL DATA

	Area Type	**Area** sq.m.	**Inc.Vol.** cu.m.	**Cum.Vol.** cu.m.	**MassHaul** cu.m.
Station: 0+000.000					
	Adjusted Cut	30.12	0	0	
	Adjusted Usable	30.12	0	0	
	Adjusted Fill	0	0	0	
					0
Station: 0+020.000					
	Adjusted Cut	13.46	435.84	435.84	
	Adjusted Usable	13.46	435.84	435.84	
	Adjusted Fill	0.1	0.96	0.96	
					434.88
Station: 0+040.000					
	Adjusted Cut	13.91	273.73	709.57	
	Adjusted Usable	13.91	273.73	709.57	
	Adjusted Fill	0.06	1.52	2.48	
					707.09
Station: 0+060.000					
	Adjusted Cut	4.79	187	896.57	
	Adjusted Usable	4.79	187	896.57	
	Adjusted Fill	6.01	60.67	63.15	
					833.42
Station: 0+080.000					
	Adjusted Cut	4.05	88.36	984.93	
	Adjusted Usable	4.05	88.36	984.93	
	Adjusted Fill	1.7	77.08	140.23	
					844.7
Station: 0+100.000					
	Adjusted Cut	7.11	111.53	1096.46	
	Adjusted Usable	7.11	111.53	1096.46	
	Adjusted Fill	0.32	20.14	160.36	
					936.09
Station: 0+120.000					
	Adjusted Cut	8.08	151.83	1248.29	
	Adjusted Usable	8.08	151.83	1248.29	

	Adjusted Fill	0	3.17	163.54	
					1084.75
Station: 0+140.000					
	Adjusted Cut	6.21	142.86	1391.15	
	Adjusted Usable	6.21	142.86	1391.15	
	Adjusted Fill	2.41	24.1	187.64	
					1203.51
Station: 0+160.000					
	Adjusted Cut	12.17	183.78	1574.93	
	Adjusted Usable	12.17	183.78	1574.93	
	Adjusted Fill	0.11	25.18	212.82	
					1362.11
Station: 0+180.000					
	Adjusted Cut	4.68	170.11	1745.05	
	Adjusted Usable	4.68	170.11	1745.05	
	Adjusted Fill	6.05	60.67	273.49	
					1471.55
Station: 0+200.000					
	Adjusted Cut	2.3	77.65	1822.7	
	Adjusted Usable	2.3	77.65	1822.7	
	Adjusted Fill	12.48	175.81	449.3	
					1373.4
Station: 0+220.000					
	Adjusted Cut	2.83	54.54	1877.24	
	Adjusted Usable	2.83	54.54	1877.24	
	Adjusted Fill	0.75	123.32	572.63	
					1304.62
Station: 0+240.000					
	Adjusted Cut	3.16	57.5	1934.74	
	Adjusted Usable	3.16	57.5	1934.74	
	Adjusted Fill	0.56	13.73	586.36	
					1348.39
Station: 0+260.000					
	Adjusted Cut	4.66	55.71	1990.45	
	Adjusted Usable	4.66	55.71	1990.45	
	Adjusted Fill	1.94	28.17	614.53	
					1375.92
Station: 0+280.000					

	Adjusted Cut	0	37.16	2027.61	
	Adjusted Usable	0	37.16	2027.61	
	Adjusted Fill	26.13	281.42	895.95	
					1131.66
Station: 0+299.576					
	Adjusted Cut	0	0	2027.61	
	Adjusted Usable	0	0	2027.61	
	Adjusted Fill	39.63	655.46	1551.41	
					476.2
Station: 0+300.000					
	Adjusted Cut	0	0	2027.61	
	Adjusted Usable	0	0	2027.61	
	Adjusted Fill	40.97	17.08	1568.49	
					459.11
Station: 0+320.000					
	Adjusted Cut	0	0	2027.61	
	Adjusted Usable	0	0	2027.61	
	Adjusted Fill	18.79	622.4	2190.9	
					-163.29
Station: 0+340.000					
	Adjusted Cut	0.28	3.18	2030.79	
	Adjusted Usable	0.28	3.18	2030.79	
	Adjusted Fill	11.16	300.75	2491.65	
					-460.86
Station: 0+360.000					
	Adjusted Cut	0	3.04	2033.83	
	Adjusted Usable	0	3.04	2033.83	
	Adjusted Fill	11.63	226.21	2717.86	
					-684.03
Station: 0+380.000					
	Adjusted Cut	6.31	62.61	2096.44	
	Adjusted Usable	6.31	62.61	2096.44	
	Adjusted Fill	0.19	118.4	2836.26	
					-739.82
Station: 0+400.000					
	Adjusted Cut	6.29	126.01	2222.45	
	Adjusted Usable	6.29	126.01	2222.45	
	Adjusted Fill	0.73	9.19	2845.44	
					-622.99

Station: 0+420.000					
	Adjusted Cut	2.88	91.76	2314.21	
	Adjusted Usable	2.88	91.76	2314.21	
	Adjusted Fill	4.76	54.89	2900.33	
					-586.12
Station: 0+440.000					
	Adjusted Cut	2.91	57.87	2372.08	
	Adjusted Usable	2.91	57.87	2372.08	
	Adjusted Fill	4.76	95.28	2995.62	
					-623.53
Station: 0+460.000					
	Adjusted Cut	3.76	66.62	2438.7	
	Adjusted Usable	3.76	66.62	2438.7	
	Adjusted Fill	2.46	72.21	3067.82	
					-629.12
Station: 0+480.000					
	Adjusted Cut	1.55	53.06	2491.77	
	Adjusted Usable	1.55	53.06	2491.77	
	Adjusted Fill	8.95	114.07	3181.89	
					-690.12
Station: 0+500.000					
	Adjusted Cut	1.52	30.17	2521.94	
	Adjusted Usable	1.52	30.17	2521.94	
	Adjusted Fill	3.21	123.5	3305.39	
					-783.45
Station: 0+520.000					
	Adjusted Cut	0.26	17.03	2538.97	
	Adjusted Usable	0.26	17.03	2538.97	
	Adjusted Fill	13.43	174.86	3480.26	
					-941.29
Station: 0+540.000					
	Adjusted Cut	0.08	3.26	2542.23	
	Adjusted Usable	0.08	3.26	2542.23	
	Adjusted Fill	14.92	294.23	3774.48	
					-1232.25
Station: 0+560.000					
	Adjusted Cut	0.05	1.35	2543.58	
	Adjusted Usable	0.05	1.35	2543.58	

	Adjusted Fill	11.48	263.98	4038.46	
					-1494.88
Station: 0+580.000					
	Adjusted Cut	0.22	2.34	2545.92	
	Adjusted Usable	0.22	2.34	2545.92	
	Adjusted Fill	19.02	298.55	4337.02	
					-1791.09
Station: 0+600.000					
	Adjusted Cut	0	2.17	2548.09	
	Adjusted Usable	0	2.17	2548.09	
	Adjusted Fill	16.65	356.75	4693.76	
					-2145.67
Station: 0+620.000					
	Adjusted Cut	0.17	1.66	2549.75	
	Adjusted Usable	0.17	1.66	2549.75	
	Adjusted Fill	12.13	287.86	4981.62	
					-2431.87
Station: 0+640.000					
	Adjusted Cut	2.56	27.22	2576.97	
	Adjusted Usable	2.56	27.22	2576.97	
	Adjusted Fill	4.06	161.93	5143.55	
					-2566.57
Station: 0+657.239					
	Adjusted Cut	2.91	47.11	2624.08	
	Adjusted Usable	2.91	47.11	2624.08	
	Adjusted Fill	6.23	89.46	5233.01	
					-2608.93
Station: 0+660.000					
	Adjusted Cut	2.62	7.64	2631.72	
	Adjusted Usable	2.62	7.64	2631.72	
	Adjusted Fill	2.94	12.66	5245.67	
					-2613.95
Station: 0+680.000					
	Adjusted Cut	16.81	193.93	2825.65	
	Adjusted Usable	16.81	193.93	2825.65	
	Adjusted Fill	0	30.31	5275.98	
					-2450.33
Station: 0+700.000					

	Adjusted Cut	31.31	480.78	3306.43	
	Adjusted Usable	31.31	480.78	3306.43	
	Adjusted Fill	0.14	1.46	5277.44	
					-1971.01
Station: 0+720.000					
	Adjusted Cut	56.05	869.63	4176.05	
	Adjusted Usable	56.05	869.63	4176.05	
	Adjusted Fill	0	1.5	5278.95	
					-1102.89
Station: 0+740.000					
	Adjusted Cut	63.47	1192.14	5368.2	
	Adjusted Usable	63.47	1192.14	5368.2	
	Adjusted Fill	0.12	1.12	5280.07	
					88.13
Station: 0+760.000					
	Adjusted Cut	39.75	1031.71	6399.91	
	Adjusted Usable	39.75	1031.71	6399.91	
	Adjusted Fill	0.05	1.58	5281.64	
					1118.27
Station: 0+780.000					
	Adjusted Cut	20.69	603.15	7003.06	
	Adjusted Usable	20.69	603.15	7003.06	
	Adjusted Fill	0.34	3.93	5285.57	
					1717.49
Station: 0+800.000					
	Adjusted Cut	8.79	294.8	7297.86	
	Adjusted Usable	8.79	294.8	7297.86	
	Adjusted Fill	0.45	7.89	5293.45	
					2004.4
Station: 0+820.000					
	Adjusted Cut	0.88	99.2	7397.05	
	Adjusted Usable	0.88	99.2	7397.05	
	Adjusted Fill	3.07	34.41	5327.86	
					2069.19
Station: 0+840.000					
	Adjusted Cut	5.94	68.31	7465.36	
	Adjusted Usable	5.94	68.31	7465.36	
	Adjusted Fill	0	29.67	5357.53	
					2107.83

Station: 0+860.000					
	Adjusted Cut	19.85	266.11	7731.47	
	Adjusted Usable	19.85	266.11	7731.47	
	Adjusted Fill	0	0	5357.53	
					2373.94
Station: 0+880.000					
	Adjusted Cut	22.57	431.58	8163.06	
	Adjusted Usable	22.57	431.58	8163.06	
	Adjusted Fill	0	0	5357.53	
					2805.52
Station: 0+900.000					
	Adjusted Cut	27.94	505.08	8668.14	
	Adjusted Usable	27.94	505.08	8668.14	
	Adjusted Fill	0.01	0.12	5357.65	
					3310.49
Station: 0+920.000					
	Adjusted Cut	22.06	499.96	9168.1	
	Adjusted Usable	22.06	499.96	9168.1	
	Adjusted Fill	8.81	88.26	5445.91	
					3722.19
Station: 0+940.000					
	Adjusted Cut	18.9	409.53	9577.63	
	Adjusted Usable	18.9	409.53	9577.63	
	Adjusted Fill	25.41	342.25	5788.16	
					3789.47
Station: 0+960.000					
	Adjusted Cut	11.12	300.14	9877.77	
	Adjusted Usable	11.12	300.14	9877.77	
	Adjusted Fill	0.59	260	6048.16	
					3829.61
Station: 0+980.000					
	Adjusted Cut	3.23	142.08	10019.85	
	Adjusted Usable	3.23	142.08	10019.85	
	Adjusted Fill	26.76	277	6325.16	
					3694.69
Station: 1+000.000					
	Adjusted Cut	2.72	56.17	10076.02	
	Adjusted Usable	2.72	56.17	10076.02	

	Adjusted Fill	6.21	351.82	6676.98	
					3399.04
Station: 1+020.000					
	Adjusted Cut	16.73	193.13	10269.15	
	Adjusted Usable	16.73	193.13	10269.15	
	Adjusted Fill	0.04	66.75	6743.73	
					3525.42
Station: 1+040.000					
	Adjusted Cut	8.22	251.07	10520.22	
	Adjusted Usable	8.22	251.07	10520.22	
	Adjusted Fill	0.14	1.69	6745.42	
					3774.8
Station: 1+058.808					
	Adjusted Cut	1.38	90.48	10610.7	
	Adjusted Usable	1.38	90.48	10610.7	
	Adjusted Fill	1.2	12.68	6758.1	
					3852.6
Station: 1+060.000					
	Adjusted Cut	3.52	2.92	10613.63	
	Adjusted Usable	3.52	2.92	10613.63	
	Adjusted Fill	1.29	1.49	6759.59	
					3854.03
Station: 1+080.000					
	Adjusted Cut	4.18	76.43	10690.05	
	Adjusted Usable	4.18	76.43	10690.05	
	Adjusted Fill	0.05	13.73	6773.32	
					3916.74
Station: 1+100.000					
	Adjusted Cut	5.47	97.05	10787.11	
	Adjusted Usable	5.47	97.05	10787.11	
	Adjusted Fill	0.14	1.93	6775.25	
					4011.86
Station: 1+120.000					
	Adjusted Cut	24.54	305.02	11092.13	
	Adjusted Usable	24.54	305.02	11092.13	
	Adjusted Fill	0.14	2.66	6777.91	
					4314.22
Station: 1+140.000					

	Adjusted Cut	69.4	943.09	12035.21	
	Adjusted Usable	69.4	943.09	12035.21	
	Adjusted Fill	0	1.66	6779.57	
					5255.65
Station: 1+160.000					
	Adjusted Cut	105.58	1746.63	13781.84	
	Adjusted Usable	105.58	1746.63	13781.84	
	Adjusted Fill	0	0	6779.57	
					7002.28
Station: 1+180.000					
	Adjusted Cut	79.36	1835.47	15617.31	
	Adjusted Usable	79.36	1835.47	15617.31	
	Adjusted Fill	0.49	6.82	6786.38	
					8830.93
Station: 1+200.000					
	Adjusted Cut	61.8	1420.12	17037.43	
	Adjusted Usable	61.8	1420.12	17037.43	
	Adjusted Fill	0	6.07	6792.45	
					10244.98
Station: 1+220.000					
	Adjusted Cut	28.57	903.77	17941.21	
	Adjusted Usable	28.57	903.77	17941.21	
	Adjusted Fill	0	0.06	6792.52	
					11148.69
Station: 1+240.000					
	Adjusted Cut	3.86	325.85	18267.06	
	Adjusted Usable	3.86	325.85	18267.06	
	Adjusted Fill	0.68	6.76	6799.28	
					11467.77
Station: 1+260.000					
	Adjusted Cut	1.12	50.58	18317.63	
	Adjusted Usable	1.12	50.58	18317.63	
	Adjusted Fill	2.33	29.17	6828.46	
					11489.18
Station: 1+280.000					
	Adjusted Cut	0.22	13.72	18331.35	
	Adjusted Usable	0.22	13.72	18331.35	
	Adjusted Fill	12.57	148.41	6976.86	
					11354.49

Station: 1+300.000					
	Adjusted Cut	0.12	3.15	18334.5	
	Adjusted Usable	0.12	3.15	18334.5	
	Adjusted Fill	11.31	238.13	7214.99	
					11119.51
Station: 1+320.000					
	Adjusted Cut	0.16	2.91	18337.4	
	Adjusted Usable	0.16	2.91	18337.4	
	Adjusted Fill	12.54	234.34	7449.33	
					10888.07
Station: 1+340.000					
	Adjusted Cut	1.57	17.27	18354.67	
	Adjusted Usable	1.57	17.27	18354.67	
	Adjusted Fill	3.31	158.48	7607.81	
					10746.86
Station: 1+360.000					
	Adjusted Cut	0.68	22.63	18377.3	
	Adjusted Usable	0.68	22.63	18377.3	
	Adjusted Fill	8.36	116.73	7724.54	
					10652.76
Station: 1+380.000					
	Adjusted Cut	0	6.34	18383.64	
	Adjusted Usable	0	6.34	18383.64	
	Adjusted Fill	13.15	215.68	7940.22	
					10443.42
Station: 1+400.000					
	Adjusted Cut	0.12	1.16	18384.81	
	Adjusted Usable	0.12	1.16	18384.81	
	Adjusted Fill	5.77	190.45	8130.67	
					10254.14
Station: 1+420.000					
	Adjusted Cut	6.59	62.06	18446.87	
	Adjusted Usable	6.59	62.06	18446.87	
	Adjusted Fill	0.38	62.1	8192.76	
					10254.1
Station: 1+440.000					
	Adjusted Cut	3.07	96.12	18542.99	
	Adjusted Usable	3.07	96.12	18542.99	

	Adjusted Fill	3.72	41.06	8233.82	
					10309.17
Station: 1+460.000					
	Adjusted Cut	2.41	59.35	18602.35	
	Adjusted Usable	2.41	59.35	18602.35	
	Adjusted Fill	7.96	116.14	8349.97	
					10252.38
Station: 1+462.737					
	Adjusted Cut	3.05	8.49	18610.84	
	Adjusted Usable	3.05	8.49	18610.84	
	Adjusted Fill	7.62	21.21	8371.18	
					10239.66
Station: 1+480.000					
	Adjusted Cut	5.2	79.47	18690.31	
	Adjusted Usable	5.2	79.47	18690.31	
	Adjusted Fill	2.89	88.74	8459.92	
					10230.39
Station: 1+500.000					
	Adjusted Cut	10.45	159.88	18850.19	
	Adjusted Usable	10.45	159.88	18850.19	
	Adjusted Fill	0	27.69	8487.61	
					10362.58
Station: 1+520.000					
	Adjusted Cut	6.83	172.82	19023.01	
	Adjusted Usable	6.83	172.82	19023.01	
	Adjusted Fill	0	0.03	8487.64	
					10535.37
Station: 1+540.000					
	Adjusted Cut	5	117.99	19141	
	Adjusted Usable	5	117.99	19141	
	Adjusted Fill	0.42	4.31	8491.95	
					10649.05
Station: 1+560.000					
	Adjusted Cut	0.08	49.68	19190.68	
	Adjusted Usable	0.08	49.68	19190.68	
	Adjusted Fill	14.54	151.59	8643.54	
					10547.14
Station: 1+580.000					

	Adjusted Cut	0.12	1.85	19192.52	
	Adjusted Usable	0.12	1.85	19192.52	
	Adjusted Fill	10.14	254.45	8897.99	
					10294.54
Station: 1+600.000					
	Adjusted Cut	0	1.13	19193.66	
	Adjusted Usable	0	1.13	19193.66	
	Adjusted Fill	20.29	312.51	9210.49	
					9983.17
Station: 1+620.000					
	Adjusted Cut	0.05	0.55	19194.21	
	Adjusted Usable	0.05	0.55	19194.21	
	Adjusted Fill	19.78	401.82	9612.31	
					9581.9
Station: 1+640.000					
	Adjusted Cut	0	0.52	19194.73	
	Adjusted Usable	0	0.52	19194.73	
	Adjusted Fill	22.32	424.32	10036.63	
					9158.1
Station: 1+660.000					
	Adjusted Cut	0.43	3.96	19198.69	
	Adjusted Usable	0.43	3.96	19198.69	
	Adjusted Fill	11.41	345.78	10382.41	
					8816.27
Station: 1+680.000					
	Adjusted Cut	0.51	8.83	19207.52	
	Adjusted Usable	0.51	8.83	19207.52	
	Adjusted Fill	3.87	156.02	10538.43	
					8669.09
Station: 1+700.000					
	Adjusted Cut	0.15	7.05	19214.57	
	Adjusted Usable	0.15	7.05	19214.57	
	Adjusted Fill	8.1	117.25	10655.68	
					8558.89
Station: 1+720.000					
	Adjusted Cut	0	1.8	19216.36	
	Adjusted Usable	0	1.8	19216.36	
	Adjusted Fill	13.49	209.16	10864.85	
					8351.52

Station: 1+740.000					
	Adjusted Cut	1.44	15.01	19231.38	
	Adjusted Usable	1.44	15.01	19231.38	
	Adjusted Fill	17.1	302.85	11167.7	
					8063.68
Station: 1+760.000					
	Adjusted Cut	0	13.77	19245.14	
	Adjusted Usable	0	13.77	19245.14	
	Adjusted Fill	34.63	525.27	11692.96	
					7552.18
Station: 1+780.000					
	Adjusted Cut	0.03	0.3	19245.45	
	Adjusted Usable	0.03	0.3	19245.45	
	Adjusted Fill	41.14	770.9	12463.86	
					6781.59
Station: 1+800.000					
	Adjusted Cut	0	0.25	19245.7	
	Adjusted Usable	0	0.25	19245.7	
	Adjusted Fill	32.48	744.05	13207.91	
					6037.79
Station: 1+820.000					
	Adjusted Cut	0.04	0.38	19246.08	
	Adjusted Usable	0.04	0.38	19246.08	
	Adjusted Fill	31.83	643.14	13851.05	
					5395.03
Station: 1+840.000					
	Adjusted Cut	0	0.38	19246.47	
	Adjusted Usable	0	0.38	19246.47	
	Adjusted Fill	24.04	558.69	14409.75	
					4836.72
Station: 1+860.000					
	Adjusted Cut	1.14	11.37	19257.83	
	Adjusted Usable	1.14	11.37	19257.83	
	Adjusted Fill	15.17	392.04	14801.79	
					4456.05
Station: 1+880.000					
	Adjusted Cut	4.04	51.73	19309.56	
	Adjusted Usable	4.04	51.73	19309.56	

	Adjusted Fill	2.77	179.4	14981.18	
					4328.38
Station: 1+900.000					
	Adjusted Cut	9.7	137.41	19446.97	
	Adjusted Usable	9.7	137.41	19446.97	
	Adjusted Fill	1.57	42.7	15023.89	
					4423.08
Station: 1+920.000					
	Adjusted Cut	0.01	95.77	19542.74	
	Adjusted Usable	0.01	95.77	19542.74	
	Adjusted Fill	23.21	239.85	15263.73	
					4279.01
Station: 1+940.000					
	Adjusted Cut	20.43	201.64	19744.39	
	Adjusted Usable	20.43	201.64	19744.39	
	Adjusted Fill	6.12	281.94	15545.67	
					4198.71
Station: 1+960.000					
	Adjusted Cut	81.86	1003.96	20748.34	
	Adjusted Usable	81.86	1003.96	20748.34	
	Adjusted Fill	0	57.19	15602.86	
					5145.48
Station: 1+980.000					
	Adjusted Cut	126.95	2109.63	22857.98	
	Adjusted Usable	126.95	2109.63	22857.98	
	Adjusted Fill	0	0.03	15602.89	
					7255.09
Station: 2+000.000					
	Adjusted Cut	110.76	2393.74	25251.71	
	Adjusted Usable	110.76	2393.74	25251.71	
	Adjusted Fill	0	0.02	15602.91	
					9648.8
Station: 2+020.000					
	Adjusted Cut	105.7	2150.15	27401.87	
	Adjusted Usable	105.7	2150.15	27401.87	
	Adjusted Fill	0	0.02	15602.94	
					11798.93
Station: 2+040.000					

	Adjusted Cut	85.11	1881.34	29283.21	
	Adjusted Usable	85.11	1881.34	29283.21	
	Adjusted Fill	0	0	15602.94	
					13680.27
Station: 2+060.000					
	Adjusted Cut	87.86	1710.48	30993.69	
	Adjusted Usable	87.86	1710.48	30993.69	
	Adjusted Fill	0	0	15602.94	
					15390.75
Station: 2+080.000					
	Adjusted Cut	17.89	1067.98	32061.67	
	Adjusted Usable	17.89	1067.98	32061.67	
	Adjusted Fill	19	212	15814.93	
					16246.74
Station: 2+100.000					
	Adjusted Cut	10.55	267.39	32329.06	
	Adjusted Usable	10.55	267.39	32329.06	
	Adjusted Fill	114.8	1626.69	17441.62	
					14887.43
Station: 2+120.000					
	Adjusted Cut	4.03	140	32469.05	
	Adjusted Usable	4.03	140	32469.05	
	Adjusted Fill	38.14	1641.82	19083.44	
					13385.61
Station: 2+140.000					
	Adjusted Cut	18.11	221.44	32690.5	
	Adjusted Usable	18.11	221.44	32690.5	
	Adjusted Fill	1.99	401.34	19484.78	
					13205.71
Station: 2+160.000					
	Adjusted Cut	3.9	220.14	32910.64	
	Adjusted Usable	3.9	220.14	32910.64	
	Adjusted Fill	20.09	220.82	19705.6	
					13205.04
Station: 2+180.000					
	Adjusted Cut	0.02	39.21	32949.84	
	Adjusted Usable	0.02	39.21	32949.84	
	Adjusted Fill	41.91	620.06	20325.66	
					12624.19

Station: 2+200.000					
	Adjusted Cut	0	0.2	32950.05	
	Adjusted Usable	0	0.2	32950.05	
	Adjusted Fill	48.38	900.7	21226.35	
					11723.69
Station: 2+220.000					
	Adjusted Cut	0	0	32950.05	
	Adjusted Usable	0	0	32950.05	
	Adjusted Fill	61.45	1072.82	22299.17	
					10650.88
Station: 2+240.000					
	Adjusted Cut	0	0	32950.06	
	Adjusted Usable	0	0	32950.06	
	Adjusted Fill	69.7	1238.08	23537.25	
					9412.81
Station: 2+260.000					
	Adjusted Cut	10.25	103.12	33053.18	
	Adjusted Usable	10.25	103.12	33053.18	
	Adjusted Fill	20.31	843.97	24381.22	
					8671.95
Station: 2+280.000					
	Adjusted Cut	28.31	375.93	33429.11	
	Adjusted Usable	28.31	375.93	33429.11	
	Adjusted Fill	2.03	227.21	24608.43	
					8820.67
Station: 2+300.000					
	Adjusted Cut	42.95	617.77	34046.87	
	Adjusted Usable	42.95	617.77	34046.87	
	Adjusted Fill	0.46	25.47	24633.91	
					9412.97
Station: 2+320.000					
	Adjusted Cut	95.13	1311.96	35358.83	
	Adjusted Usable	95.13	1311.96	35358.83	
	Adjusted Fill	0.25	7.37	24641.28	
					10717.56
Station: 2+340.000					
	Adjusted Cut	147.18	2423.16	37781.99	
	Adjusted Usable	147.18	2423.16	37781.99	

	Adjusted Fill	0	2.45	24643.73	
					13138.26
Station: 2+360.000					
	Adjusted Cut	199.07	3552.98	41334.97	
	Adjusted Usable	199.07	3552.98	41334.97	
	Adjusted Fill	0	0	24643.73	
					16691.24
Station: 2+380.000					
	Adjusted Cut	143.6	3640.92	44975.9	
	Adjusted Usable	143.6	3640.92	44975.9	
	Adjusted Fill	0	0	24643.73	
					20332.17
Station: 2+395.605					
	Adjusted Cut	118.73	2175.51	47151.41	
	Adjusted Usable	118.73	2175.51	47151.41	
	Adjusted Fill	0	0	24643.73	
					22507.68
Station: 2+400.000					
	Adjusted Cut	110.11	546.3	47697.71	
	Adjusted Usable	110.11	546.3	47697.71	
	Adjusted Fill	0	0	24643.73	
					23053.98
Station: 2+420.000					
	Adjusted Cut	115.61	2359.1	50056.81	
	Adjusted Usable	115.61	2359.1	50056.81	
	Adjusted Fill	0.29	3.95	24647.68	
					25409.12
Station: 2+440.000					
	Adjusted Cut	138.8	2481.01	52537.82	
	Adjusted Usable	138.8	2481.01	52537.82	
	Adjusted Fill	0.43	5.93	24653.61	
					27884.21
Station: 2+460.000					
	Adjusted Cut	105.2	2341.64	54879.46	
	Adjusted Usable	105.2	2341.64	54879.46	
	Adjusted Fill	0	3.53	24657.14	
					30222.32
Station: 2+480.000					

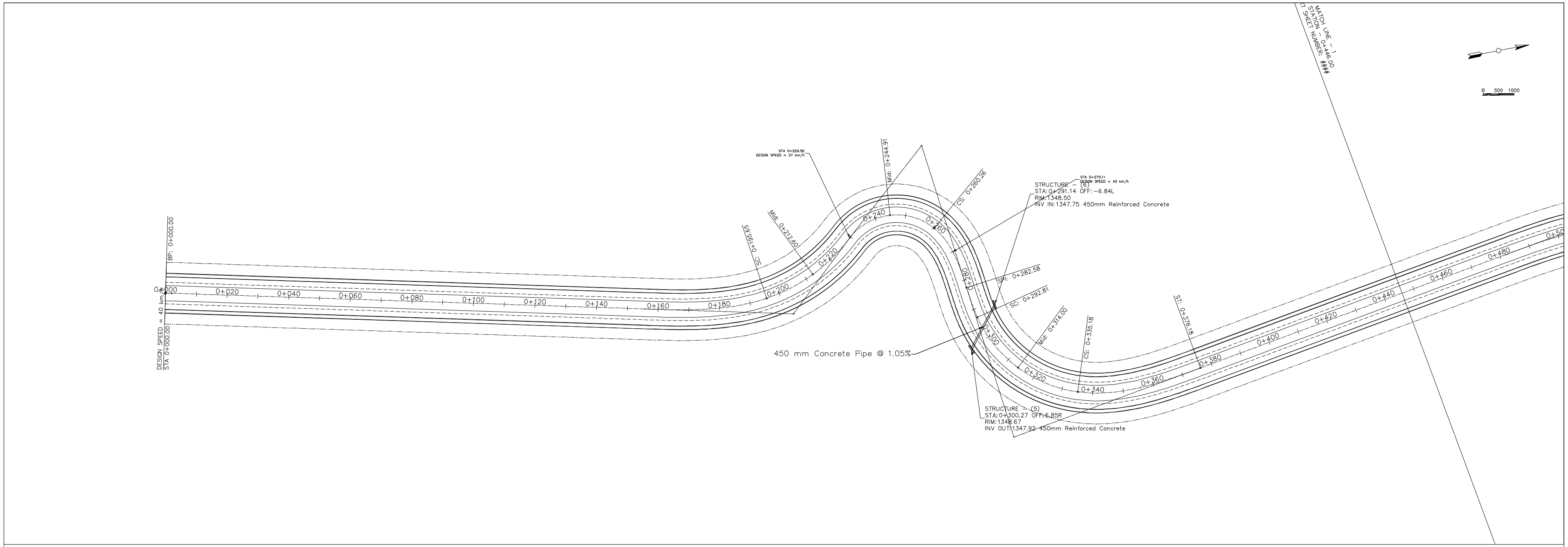
	Adjusted Cut	59.02	1567.89	56447.35	
	Adjusted Usable	59.02	1567.89	56447.35	
	Adjusted Fill	0	0	24657.14	
					31790.22
Station: 2+500.000					
	Adjusted Cut	46.18	1019.11	57466.47	
	Adjusted Usable	46.18	1019.11	57466.47	
	Adjusted Fill	0	0	24657.14	
					32809.33
Station: 2+520.000					
	Adjusted Cut	27.37	731.19	58197.66	
	Adjusted Usable	27.37	731.19	58197.66	
	Adjusted Fill	0	0	24657.14	
					33540.51
Station: 2+540.000					
	Adjusted Cut	3.87	312.42	58510.07	
	Adjusted Usable	3.87	312.42	58510.07	
	Adjusted Fill	32.7	326.96	24984.1	
					33525.97
Station: 2+560.000					
	Adjusted Cut	0	38.74	58548.81	
	Adjusted Usable	0	38.74	58548.81	
	Adjusted Fill	120.43	1531.24	26515.34	
					32033.47
Station: 2+580.000					
	Adjusted Cut	3.11	31.08	58579.89	
	Adjusted Usable	3.11	31.08	58579.89	
	Adjusted Fill	152.24	2726.72	29242.06	
					29337.83
Station: 2+600.000					
	Adjusted Cut	0	31.08	58610.98	
	Adjusted Usable	0	31.08	58610.98	
	Adjusted Fill	161.7	3139.42	32381.48	
					26229.49
Station: 2+620.000					
	Adjusted Cut	0	0	58610.98	
	Adjusted Usable	0	0	58610.98	
	Adjusted Fill	129.49	2873.38	35254.86	
					23356.12

Station: 2+640.000					
	Adjusted Cut	0.52	5.88	58616.85	
	Adjusted Usable	0.52	5.88	58616.85	
	Adjusted Fill	85.36	1993.22	37248.08	
					21368.77
Station: 2+660.000					
	Adjusted Cut	36.08	367.27	58984.12	
	Adjusted Usable	36.08	367.27	58984.12	
	Adjusted Fill	0	726.65	37974.74	
					21009.39
Station: 2+680.000					
	Adjusted Cut	64.81	983.7	59967.83	
	Adjusted Usable	64.81	983.7	59967.83	
	Adjusted Fill	0	0.07	37974.81	
					21993.02
Station: 2+700.000					
	Adjusted Cut	57.22	1286.09	61253.92	
	Adjusted Usable	57.22	1286.09	61253.92	
	Adjusted Fill	0	0	37974.81	
					23279.11
Station: 2+720.000					
	Adjusted Cut	57.78	1183.53	62437.45	
	Adjusted Usable	57.78	1183.53	62437.45	
	Adjusted Fill	0	0	37974.81	
					24462.64
Station: 2+740.000					
	Adjusted Cut	58.56	1169.09	63606.54	
	Adjusted Usable	58.56	1169.09	63606.54	
	Adjusted Fill	0.27	2.99	37977.8	
					25628.74
Station: 2+760.000					
	Adjusted Cut	40.1	986.58	64593.11	
	Adjusted Usable	40.1	986.58	64593.11	
	Adjusted Fill	0.32	5.93	37983.73	
					26609.39
Station: 2+770.686					
	Adjusted Cut	0	214.26	64807.37	
	Adjusted Usable	0	214.26	64807.37	

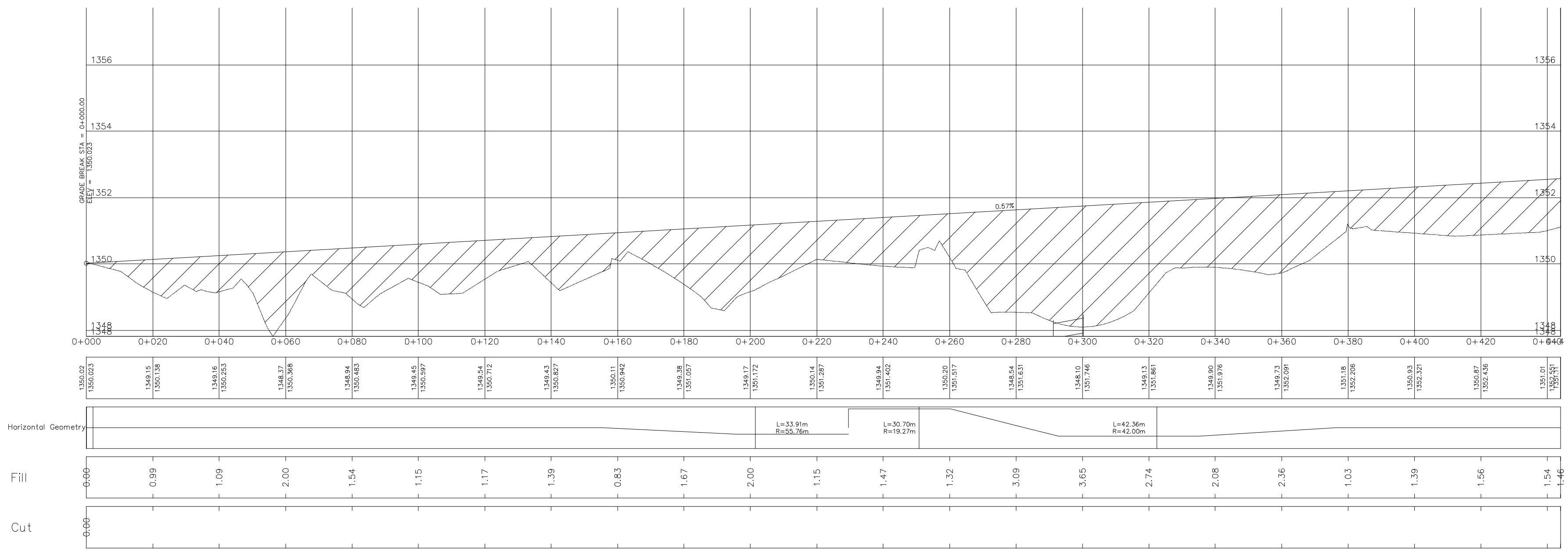
	Adjusted Fill	0	1.72	37985.45	
					26821.93

DRAWINGS

(PROFILE, SECTION AND
MASS HAUL)



Alignment - 1 PROFILE



	0+000	0+020	0+040	0+060	0+080	0+100	0+120	0+140	0+160	0+180	0+200	0+220	0+240	0+260	0+280	0+300	0+320	0+340	0+360	0+380	0+400	0+420	0+446
Existing	1350.02	1349.15	1349.16	1348.37	1348.94	1349.45	1349.54	1349.43	1350.11	1349.38	1349.17	1350.14	1349.94	1350.20	1348.54	1348.10	1349.13	1349.90	1349.73	1351.18	1350.93	1350.87	1351.01
Design	1350.023	1350.138	1350.253	1350.368	1350.483	1350.597	1350.712	1350.827	1350.942	1351.057	1351.172	1351.287	1351.402	1351.517	1351.631	1351.746	1351.861	1351.976	1352.091	1352.206	1352.321	1352.436	1352.551
Fill	0.00	0.99	1.09	2.00	1.54	1.15	1.17	1.39	0.83	1.67	2.00	1.15	1.47	1.32	3.09	3.65	2.74	2.08	2.36	1.03	1.39	1.56	1.54 / 1.46
Cut	0.00																						

LEGEND

PLAN:

- ALIGNMENT
- EPS
- SIDE DRAIN
- RIGHT OF WAY

PROFILE:

- DESIGN PROFILE
- EXISTING GROUND
- CUT/FILL

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

PREPARED BY:
Garima Maharjan (075BCE056)
Gaurav Khadka (075BCE058)
Hari Shreesh (075BCE062)
Isha Shrestha (075BCE065)
Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

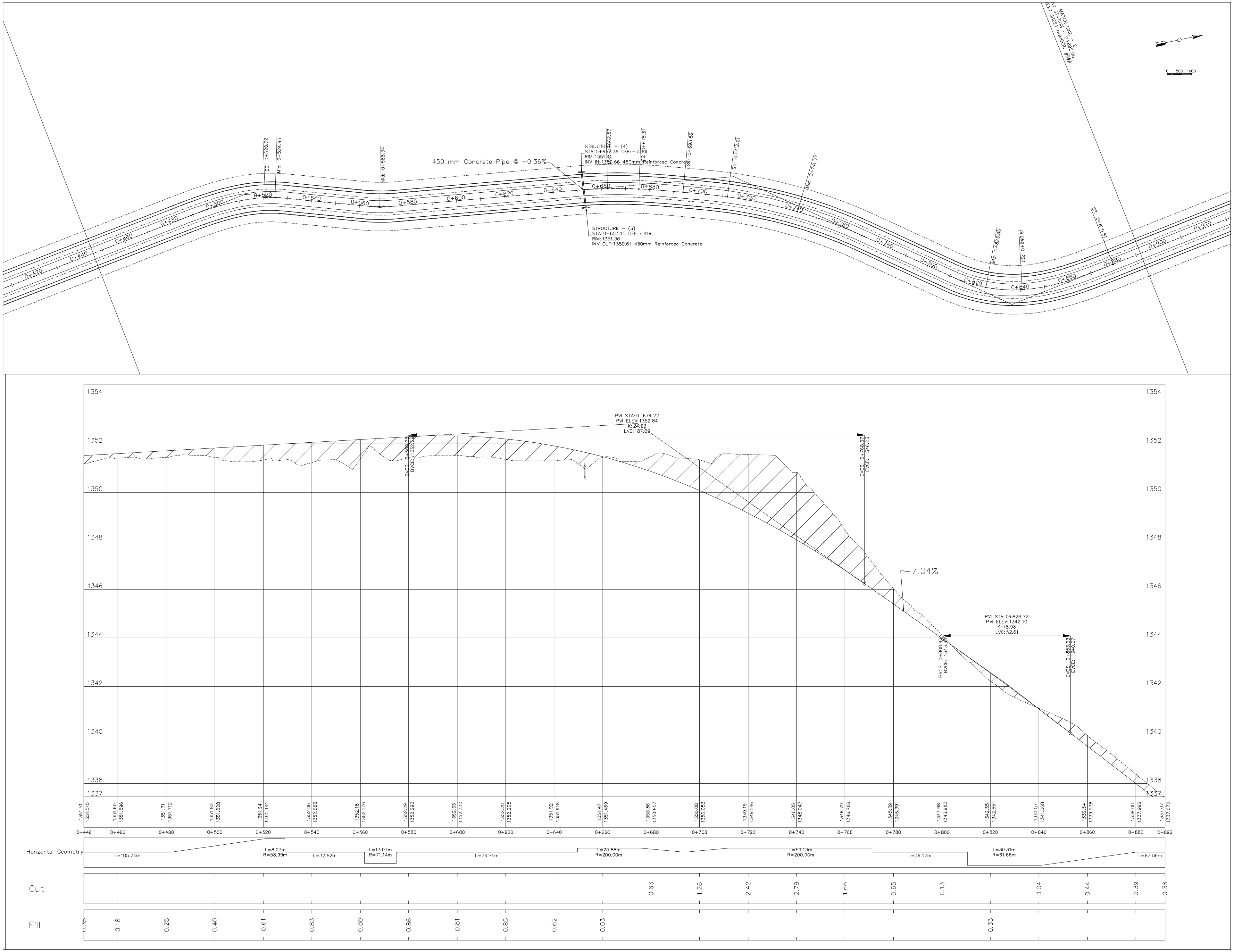
PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

CHAINAGE: 0+000 TO 0+446.00

SHEET NO.: 1 OF 7

DRAWING TITLE:
PLAN AND PROFILE VIEW

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
DRAWING NO.: 1
SCALE
PLAN: 1:1000 PROFILE: 1:1000



LEGEND	
PLAN:	
	ALIGNMENT
	EPS
	SIDE DRAIN
	RIGHT OF WAY
PROFILE:	
	DESIGN PROFILE
	EXISTING GROUND
	CUT/FILL

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
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Contact Number 1: 9860659984
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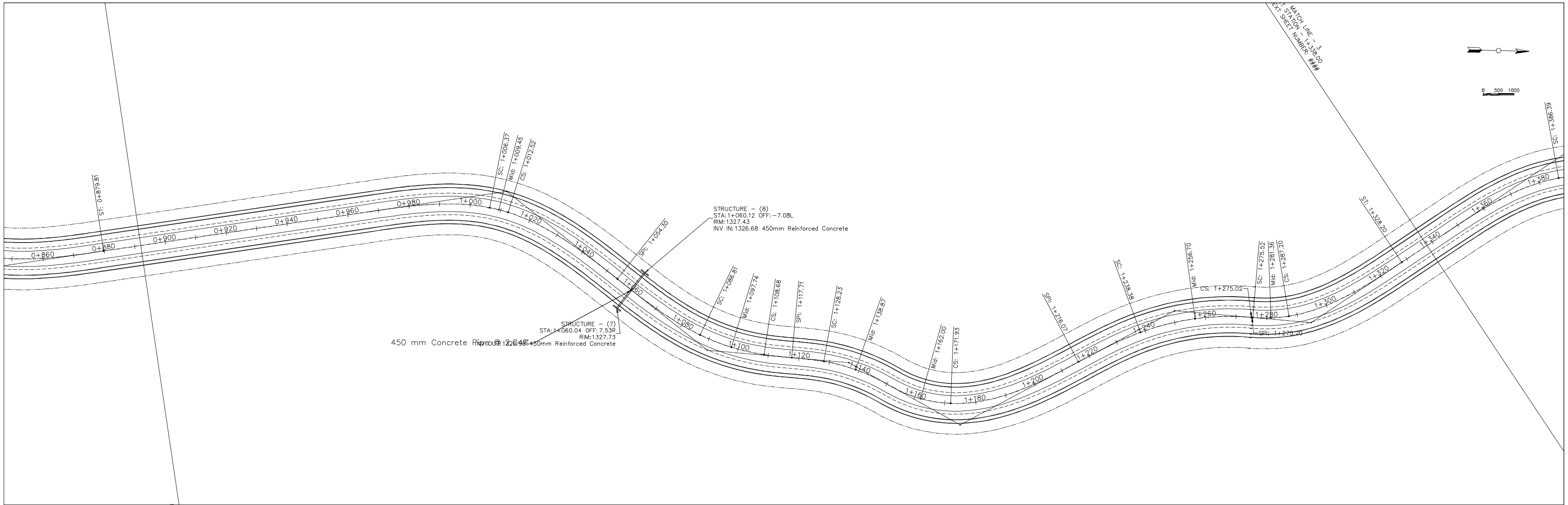
PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

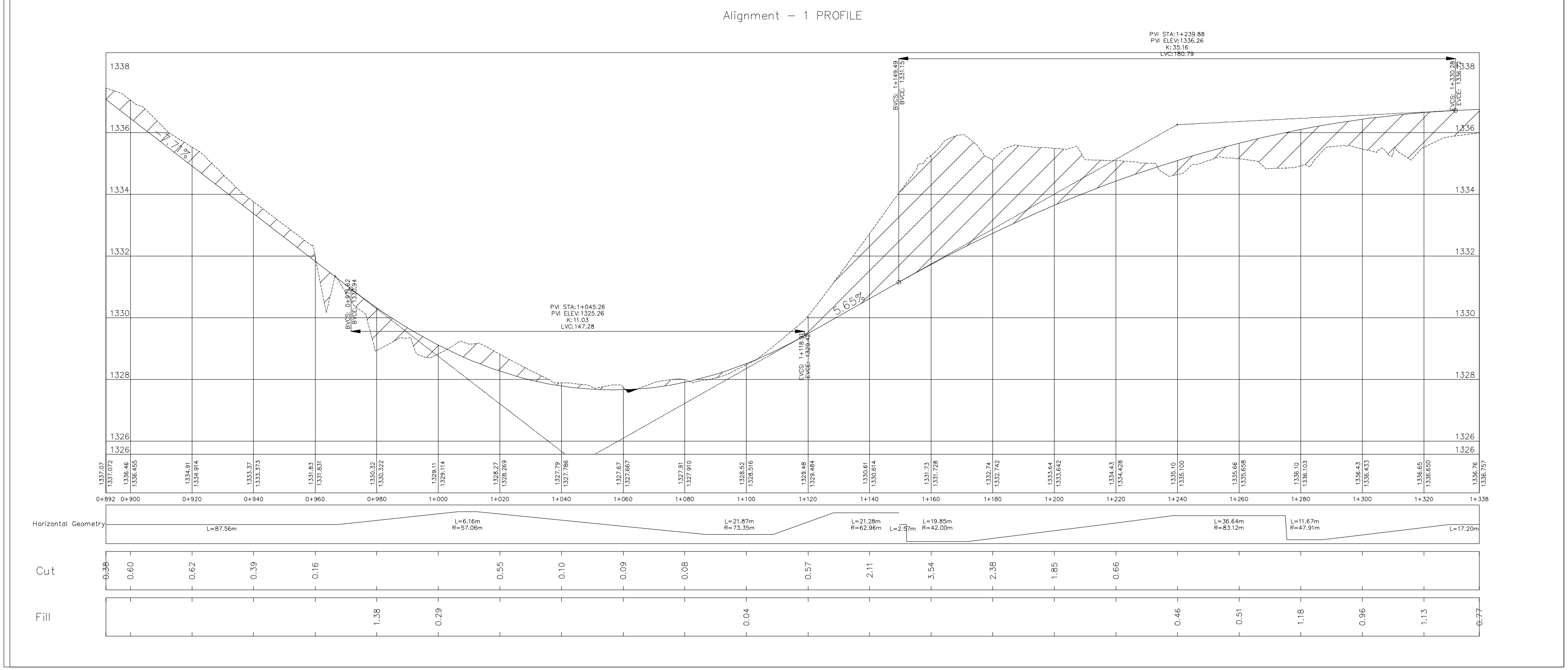
CHAINAGE: 0+446.00 TO 0+892.00

SHEET NO.: 2 OF 7

DRAWING TITLE:
PLAN AND PROFILE VIEW

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE
PLAN: 1:1000 PROFILE: 1:1000
DRAWING NO.: 2





Chainage	Existing	Design	Cut	Fill
0+892	1337.07	1337.072	0.38	
0+900	1336.46	1336.455	0.60	
0+920	1334.91	1334.914	0.62	
0+940	1333.37	1333.373	0.39	
0+960	1331.83	1331.831	0.16	
0+980	1330.32	1330.322		1.38
1+000	1329.11	1329.114		0.29
1+020	1328.27	1328.269	0.55	
1+040	1327.79	1327.786	0.10	
1+060	1327.67	1327.667	0.09	
1+080	1327.91	1327.910	0.08	
1+100	1328.52	1328.516		0.04
1+120	1329.48	1329.484	0.57	
1+140	1330.61	1330.614	2.11	
1+160	1331.73	1331.728	3.54	
1+180	1332.74	1332.742	2.38	
1+200	1333.64	1333.642	1.85	
1+220	1334.43	1334.428	0.66	
1+240	1335.10	1335.100		0.46
1+260	1335.66	1335.658		0.51
1+280	1336.10	1336.103		1.18
1+300	1336.43	1336.433		0.96
1+320	1336.65	1336.650		1.13
1+338	1336.76	1336.757		0.77

LEGEND

PLAN:

- ALIGNMENT
- EPS
- SIDE DRAIN
- RIGHT OF WAY

PROFILE:

- DESIGN PROFILE
- EXISTING GROUND
- CUT/FILL

GENERAL NOTES

No.	Revision/Issue	Date

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INSTITUTE OF ENGINEERING
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Contact Number 1: 9860659984
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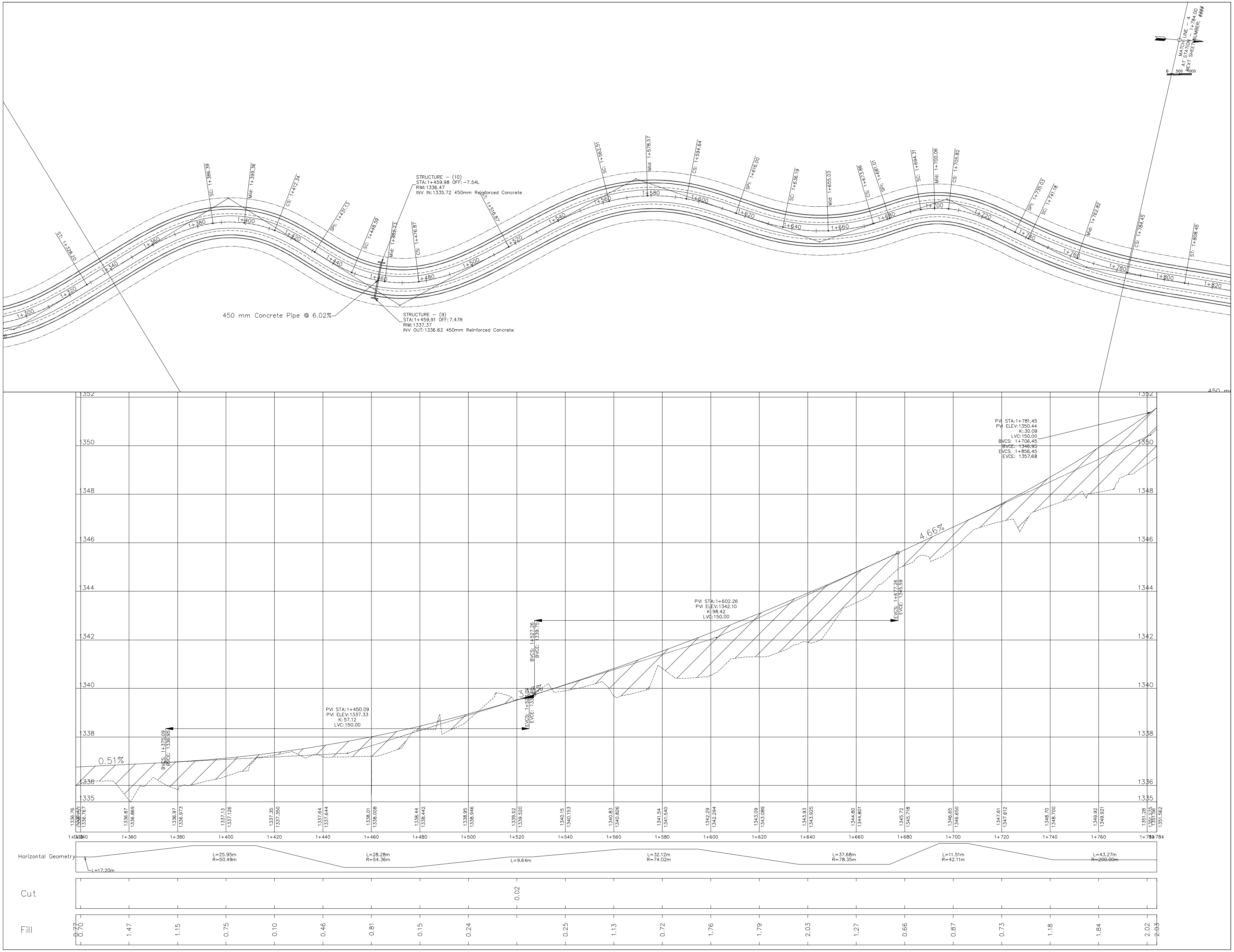
PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

CHAINAGE: 0+892.00 TO 1+338.00

SHEET NO.: 3 OF 7

DRAWING TITLE:
PLAN AND PROFILE VIEW

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
DRAWING NO.: 3
SCALE
PLAN: 1:1000 PROFILE: 1:1000



LEGEND

PLAN:

	ALIGNMENT
	EPS
	SIDE DRAIN
	RIGHT OF WAY

PROFILE:

	DESIGN PROFILE
	EXISTING GROUND
	CUT/FILL

GENERAL NOTES

No.	Revision/Issue	Date

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INSTITUTE OF ENGINEERING
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Contact Number 1: 9860659984
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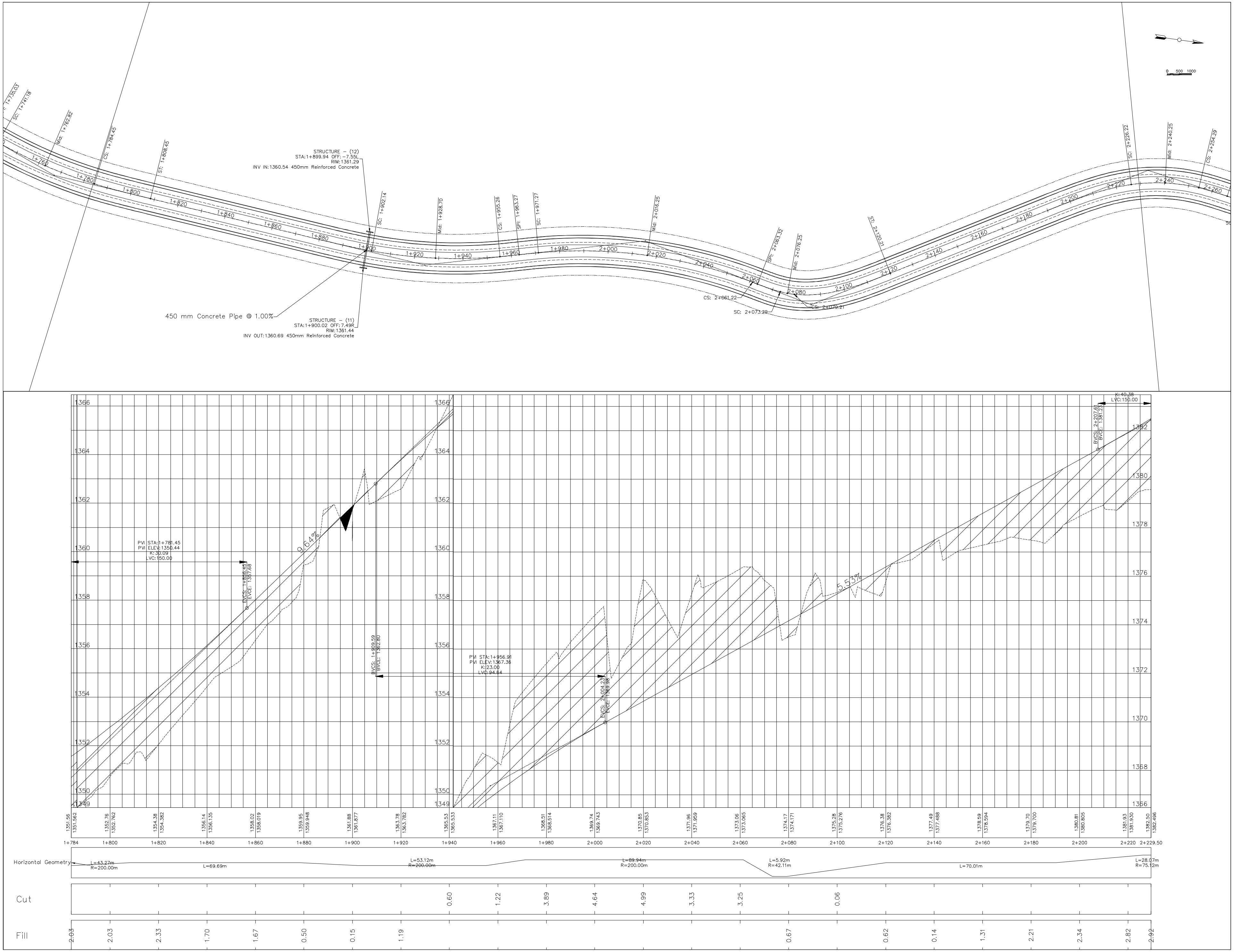
PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

CHAINAGE: 1+338.00 TO 1+784.00

SHEET NO.: 4 OF 7

DRAWING TITLE:
PLAN AND PROFILE VIEW

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
DRAWING NO.: 4
SCALE
PLAN: 1:1000 PROFILE: 1:1000



LEGEND

PLAN:

- ALIGNMENT
- EPS
- SIDE DRAIN
- RIGHT OF WAY

PROFILE:

- DESIGN PROFILE
- EXISTING GROUND
- CUT/FILL

GENERAL NOTES

No.	Revision/Issue	Date

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Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

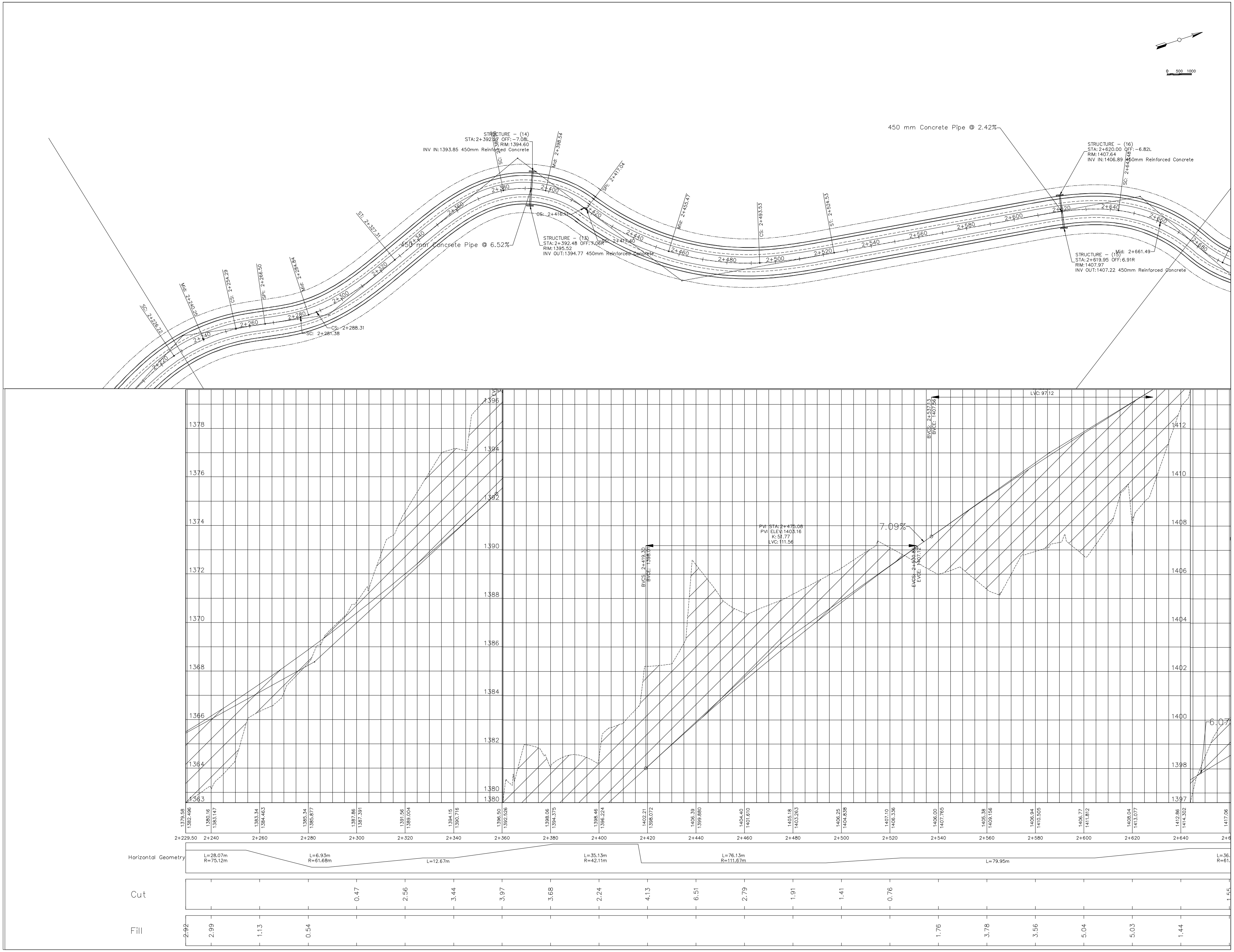
CHAINAGE: 1+784.00 TO 2+229.50

SHEET NO.: 5 OF 7

DRAWING TITLE:
PLAN AND PROFILE VIEW

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE
PLAN: 1:1000 PROFILE: 1:1000

DRAWING NO.: 5



LEGEND

PLAN:

- ALIGNMENT
- EPS
- SIDE DRAIN
- RIGHT OF WAY

PROFILE:

- DESIGN PROFILE
- EXISTING GROUND
- CUT/FILL

GENERAL NOTES

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DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

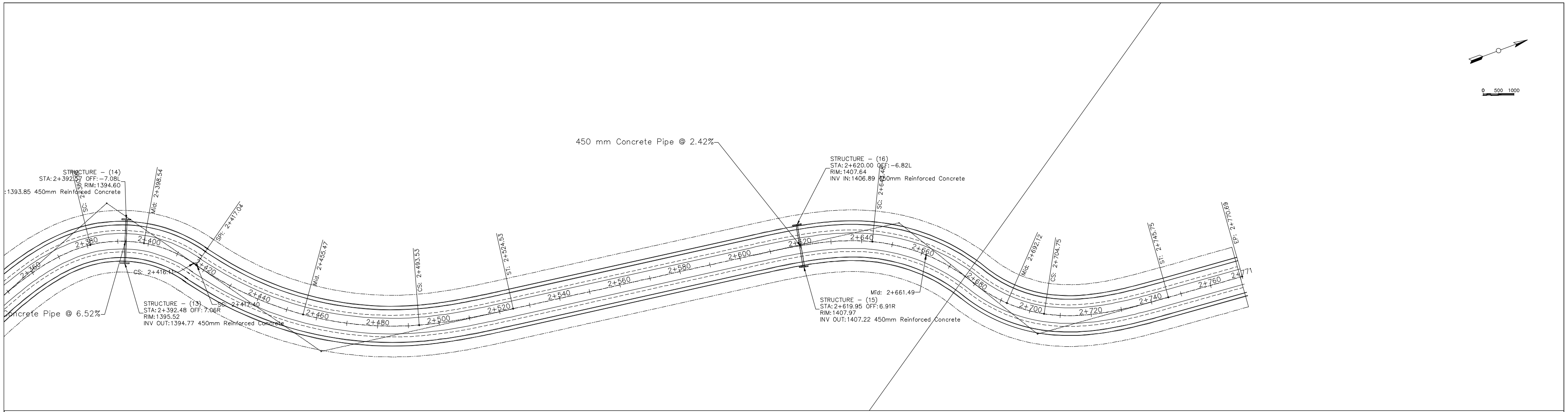
CHAINAGE: 2+229.50 TO 2+676.00

SHEET NO.: 6 OF 7

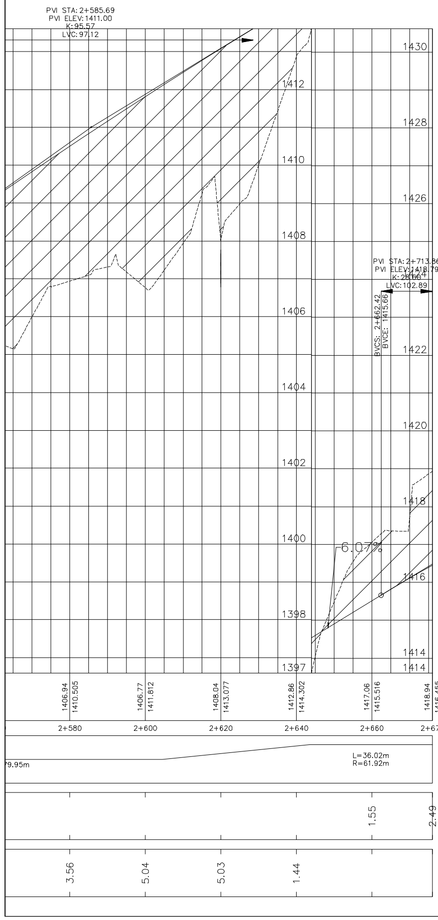
DRAWING TITLE:
PLAN AND PROFILE VIEW

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE
PLAN: 1:1000 PROFILE: 1:1000

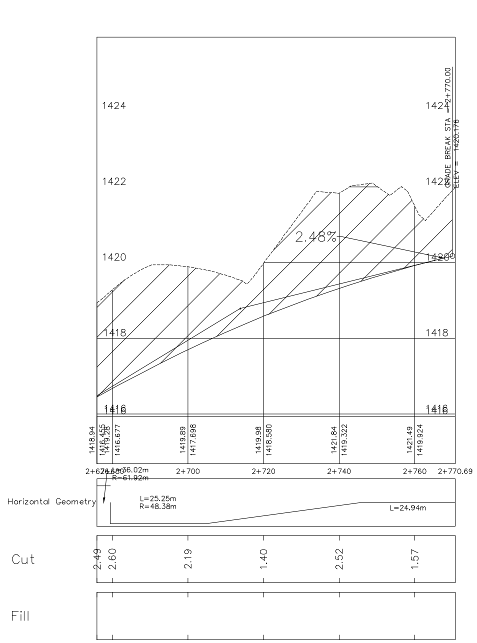
DRAWING NO.: 6



Alignment – 1 PROFILE



Alignment – 1 PROFILE



LEGEND

PLAN:

- ALIGNMENT
- EPS
- SIDE DRAIN
- RIGHT OF WAY

PROFILE:

- DESIGN PROFILE
- EXISTING GROUND
- CUT/FILL

GENERAL NOTES

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Contact Number 2: 9865010749

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(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

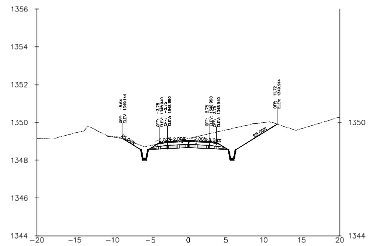
CHAINAGE: 2+676.00 TO 2+770.69

SHEET NO.: 7 OF 7

DRAWING TITLE:
PLAN AND PROFILE VIEW

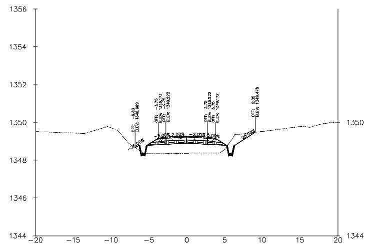
CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE
PLAN: 1:1000 PROFILE: 1:1000
DRAWING NO.: 7

0+020.00



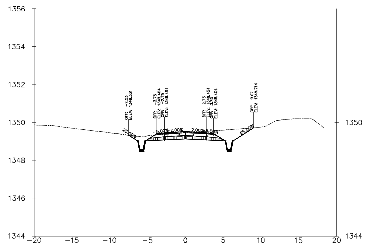
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.43	1349.26	1348.77	1349.15	1349.60	1350.00	1349.68
PROPOSED ELEVATIONS		1349.23	1348.63	1349.15	1348.63	1349.48	

0+060.00



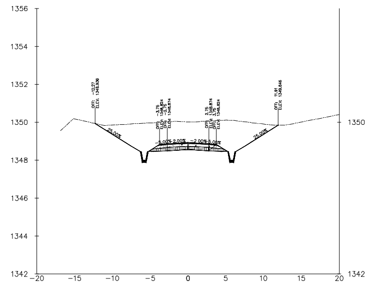
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.44	1349.72	1348.34	1348.37	1348.56	1349.53	1349.78
PROPOSED ELEVATIONS			1348.86	1348.37	1348.86		

0+100.00



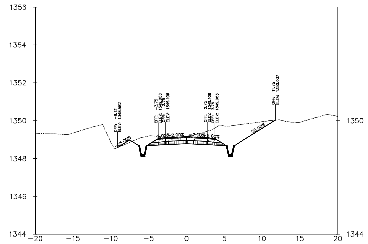
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.70	1349.45	1349.29	1349.45	1349.60	1349.76	1350.20
PROPOSED ELEVATIONS			1349.09	1349.45	1349.09		

0+000.00



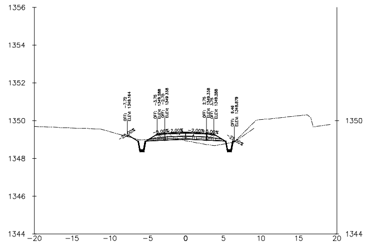
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1350.18	1349.85	1349.97	1350.02	1350.12	1349.90	1350.02
PROPOSED ELEVATIONS		1349.37		1350.02	1348.51	1349.37	

0+040.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.35	1348.85	1349.18	1349.16	1349.72	1349.95	1349.92
PROPOSED ELEVATIONS			1348.74	1349.16	1348.74	1349.60	

0+080.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.61	1349.42	1349.00	1348.94	1348.76	1350.06	1350.26
PROPOSED ELEVATIONS			1348.98	1348.94	1348.98		

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

SUB BASE

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
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(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

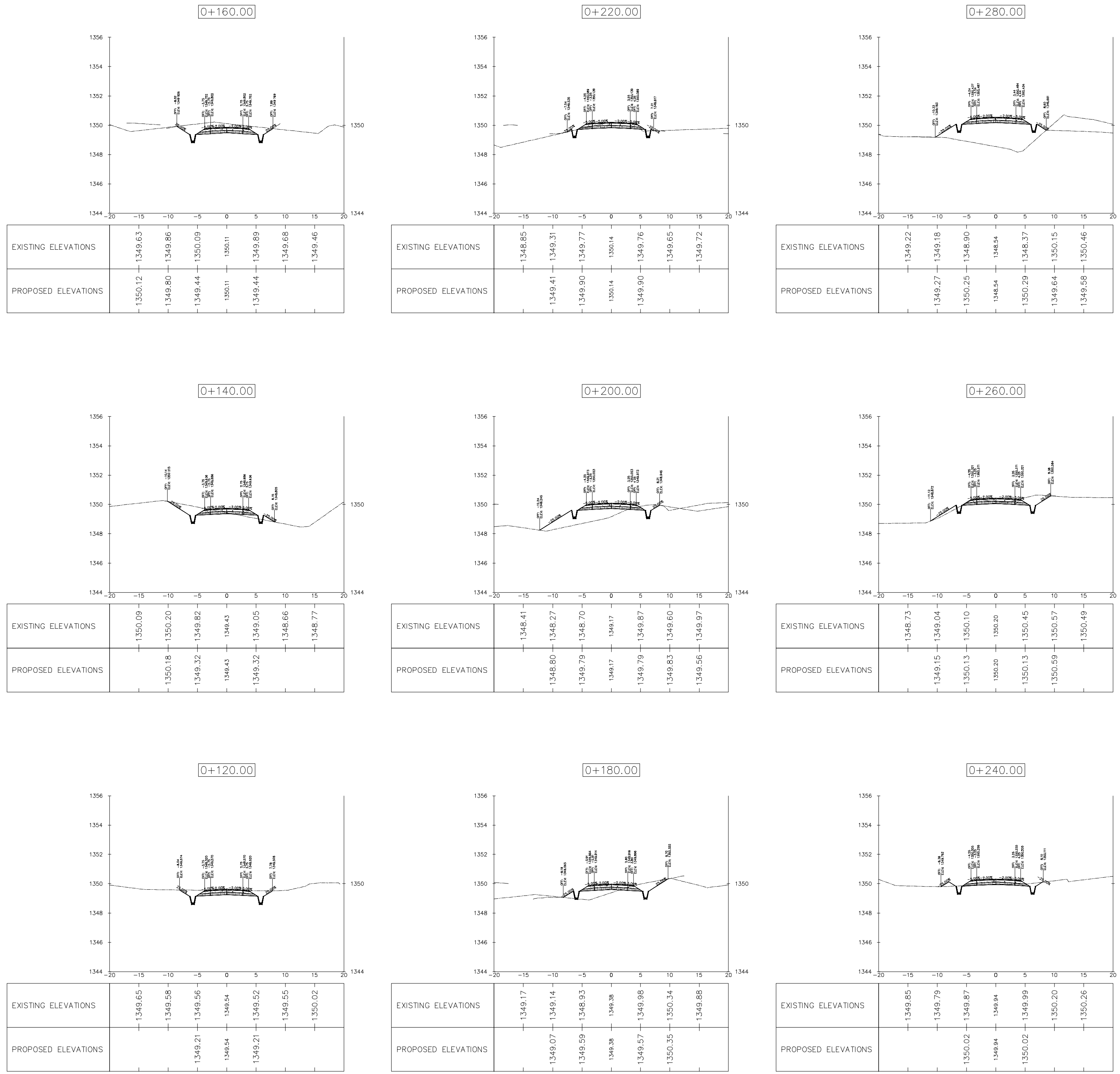
DRAWING TITLE:
CROSS SECTION VIEWS

CHECKED BY:

PREPARED DATE:

CHECKED DATE:

SCALE: 1:250



LEGEND

- EXISTING GROUND
- SIDE DRAIN
- SURFACE DRESSING
- BASE
- SUB BASE

GENERAL NOTES

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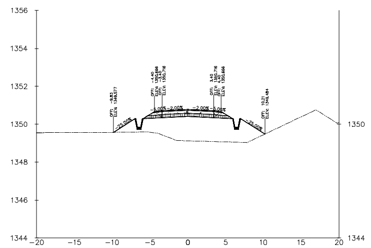
DRAWING TITLE:
CROSS SECTION VIEWS

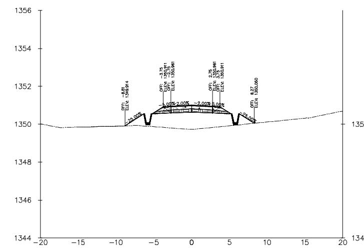
CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE: 1:250

0+320.00



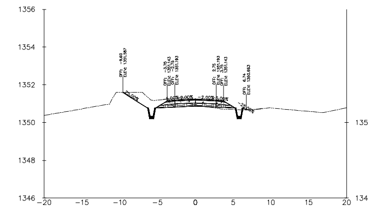
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.56	1349.58	1349.58	1349.13	1349.07	1349.45	1350.39
PROPOSED ELEVATIONS			1350.52	1349.13	1350.52	1349.54	

0+360.00



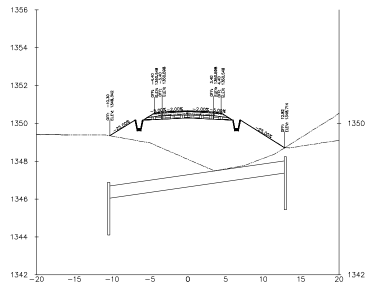
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.85	1349.90	1349.87	1349.73	1349.92	1350.12	1350.32
PROPOSED ELEVATIONS		1349.90	1350.60	1349.73	1350.60		

0+400.00



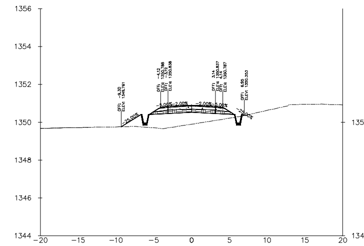
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1350.72	1351.59	1351.18	1350.93	1350.69	1350.77	1350.59
PROPOSED ELEVATIONS			1350.83	1350.93	1350.83		

0+299.58



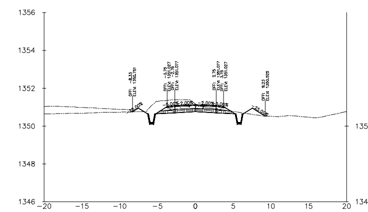
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.39	1349.32	1348.96	1348.10	1347.60	1348.16	1349.26
PROPOSED ELEVATIONS		1349.42	1350.40	1348.10	1350.40	1349.42	1348.80

0+340.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.71	1349.76	1349.70	1349.90	1350.21	1350.62	1350.95
PROPOSED ELEVATIONS	1349.71		1350.57	1349.90	1350.57		

0+380.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1350.69	1350.74	1351.31	1351.18	1350.77	1350.51	1350.46
PROPOSED ELEVATIONS	1350.98	1350.88	1350.71	1351.18	1350.71		

LEGEND

EXISTING GROUND
SIDE DRAIN
SURFACE DRESSING
BASE
SUB BASE

GENERAL NOTES

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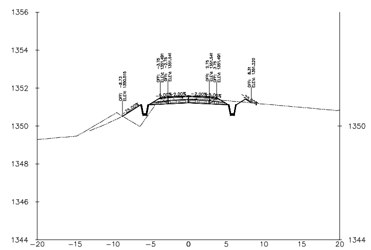
DRAWING TITLE:
CROSS SECTION VIEWS

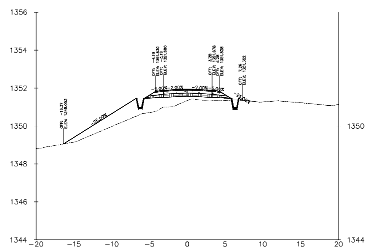
CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE: 1:250

0+460.00



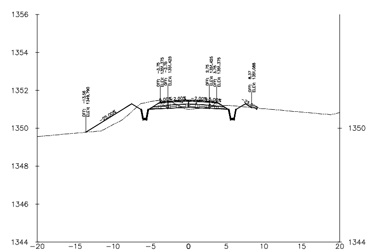
EXISTING ELEVATIONS	1349.46	1350.59	1350.78	1351.41	1351.34	1351.16	1350.98
PROPOSED ELEVATIONS		1350.27	1351.18	1351.41	1351.18		

0+520.00



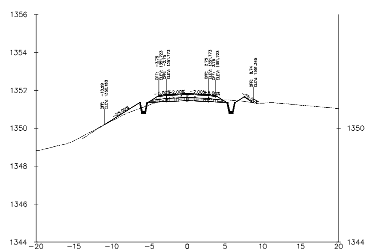
EXISTING ELEVATIONS	1349.15	1349.97	1350.72	1351.33	1351.35	1351.27	1351.22
PROPOSED ELEVATIONS	1349.40	1350.65	1351.63	1351.33	1351.65		

0+440.00



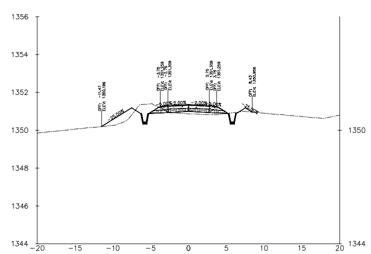
EXISTING ELEVATIONS	1349.74	1350.18	1351.40	1351.01	1351.21	1351.03	1350.85
PROPOSED ELEVATIONS		1350.68	1351.06	1351.01	1351.06		

0+500.00



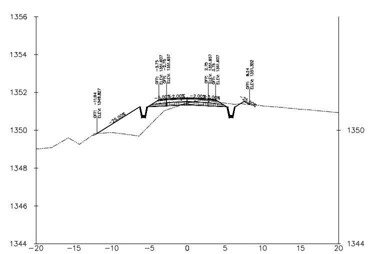
EXISTING ELEVATIONS	1349.34	1350.39	1351.24	1351.43	1351.49	1351.33	1351.22
PROPOSED ELEVATIONS		1350.43	1351.41	1351.43	1351.41		

0+420.00



EXISTING ELEVATIONS	1350.05	1350.26	1351.39	1350.87	1350.88	1350.90	1350.72
PROPOSED ELEVATIONS		1350.56	1350.95	1350.87	1350.95		

0+480.00



EXISTING ELEVATIONS	1349.43	1349.88	1350.26	1351.43	1351.43	1351.29	1351.11
PROPOSED ELEVATIONS		1350.31	1351.29	1351.43	1351.29		

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

SUB BASE

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR

Asst. Prof. Roshan Karki

PREPARED BY:

Garima Maharjan (075BCE056)

Gaurav Khadka (075BCE058)

Hari Shreesh (075BCE062)

Isha Shrestha (075BCE065)

Niraj Adhikari (075BCE088)

Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984

Contact Number 2: 9865010749

PROJECT TITLE:

DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION (DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

DRAWING TITLE:

CROSS SECTION VIEWS

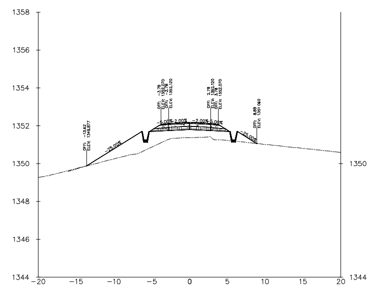
CHECKED BY:

PREPARED DATE:

CHECKED DATE:

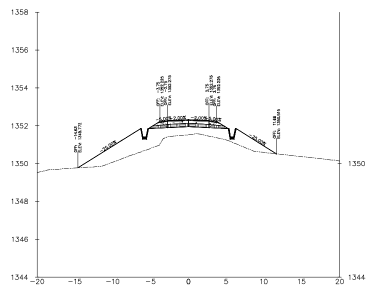
SCALE: 1:250

0+560.00



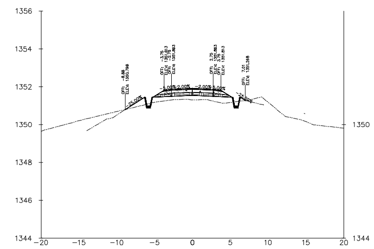
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.74	1350.25	1350.87	1351.37	1351.22	1351.01	1350.80
PROPOSED ELEVATIONS	1349.71	1350.78	1351.76	1351.37	1351.76		

0+600.00



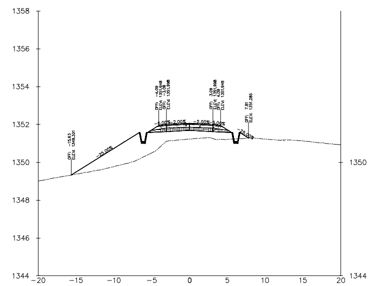
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.76	1350.07	1350.81	1351.52	1351.26	1350.59	1350.37
PROPOSED ELEVATIONS		1350.93	1351.91	1351.52	1351.91	1350.93	

0+640.00



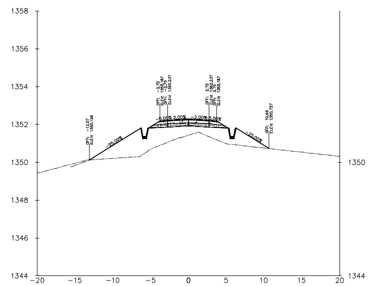
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1350.20	1350.69	1351.17	1351.30	1351.17	1351.18	1350.15
PROPOSED ELEVATIONS		1350.50	1351.50	1351.30	1351.50		

0+540.00



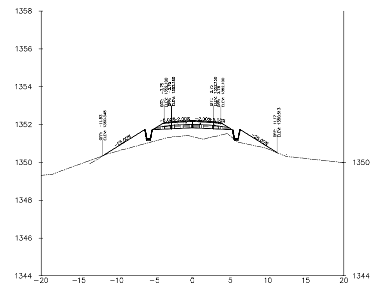
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.38	1349.77	1350.50	1351.23	1351.21	1351.23	1351.13
PROPOSED ELEVATIONS	1349.49	1350.74	1351.72	1351.23	1351.72		

0+580.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.95	1350.21	1350.69	1351.43	1350.99	1350.76	1350.54
PROPOSED ELEVATIONS	1349.83	1350.89	1351.87	1351.43	1351.87	1350.89	

0+620.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.88	1350.58	1351.12	1351.36	1351.39	1350.71	1350.20
PROPOSED ELEVATIONS		1350.81	1351.79	1351.36	1351.79	1350.81	

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

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GENERAL NOTES

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INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

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Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

DRAWING TITLE:
CROSS SECTION VIEWS

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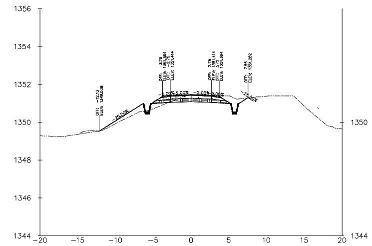
CHECKED DATE:

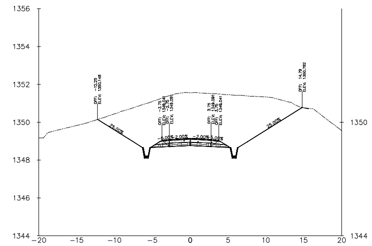
SCALE: 1:250

0+660.00



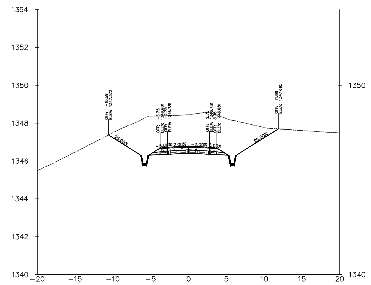
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.36	1349.92	1350.71	1351.44	1351.39	1351.38	1350.86
PROPOSED ELEVATIONS		1350.07	1351.05	1351.44	1351.05		

0+720.00



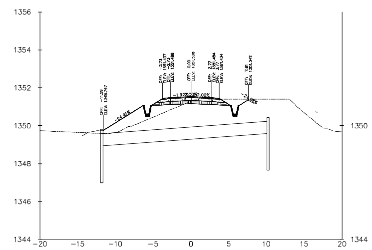
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.83	1350.44	1351.10	1351.56	1351.46	1351.33	1350.76
PROPOSED ELEVATIONS		1349.59	1348.73	1351.56	1348.73	1349.59	1350.76

0+760.00



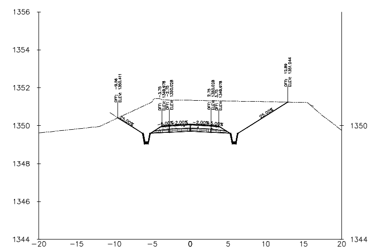
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1346.47	1347.49	1348.38	1348.44	1348.24	1347.77	1347.61
PROPOSED ELEVATIONS		1347.23	1346.37	1348.44	1346.37	1347.23	

0+657.24



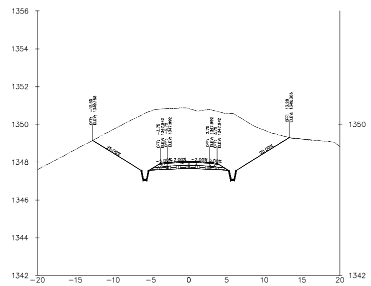
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.65	1349.64	1350.45	1351.29	1351.40	1351.40	1350.69
PROPOSED ELEVATIONS		1350.14	1351.12	1351.29	1351.13		

0+700.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1349.83	1350.33	1351.30	1351.34	1351.30	1351.27	1351.23
PROPOSED ELEVATIONS		1350.53	1349.67	1351.34	1349.67	1350.52	

0+740.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1348.67	1349.73	1350.71	1350.84	1350.59	1349.69	1349.22
PROPOSED ELEVATIONS		1348.49	1347.63	1350.84	1347.63	1348.49	1349.22

LEGEND

- EXISTING GROUND
- SIDE DRAIN
- SURFACE DRESSING
- BASE
- SUB BASE

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INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

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Gaurav Khadka (075BCE058)
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Isha Shrestha (075BCE065)
Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

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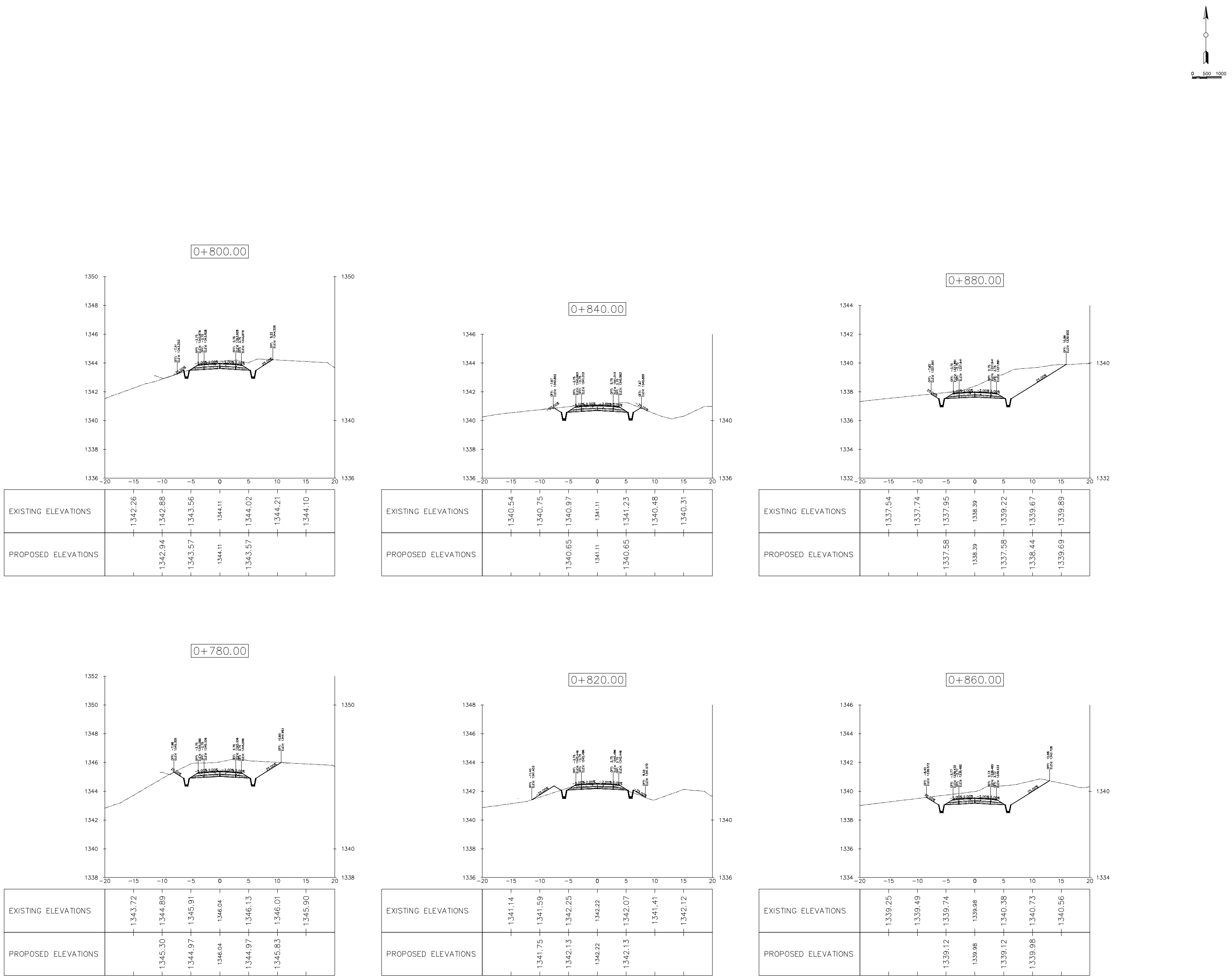

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

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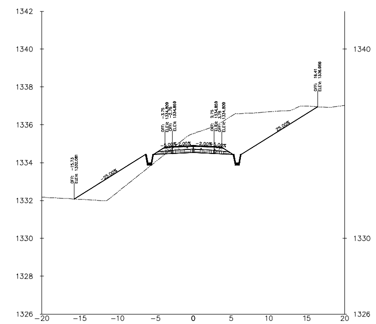
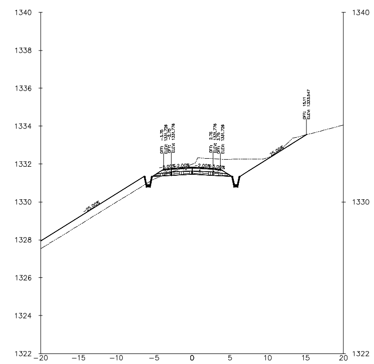
SCALE: 1:250

0+920.00



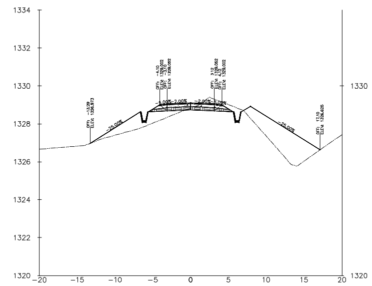
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1332.06	1332.45	1334.04	1335.53	1336.45	1336.69	1336.98
PROPOSED ELEVATIONS	1332.26	1333.51	1334.50	1335.53	1334.50	1335.35	1336.60

0+960.00



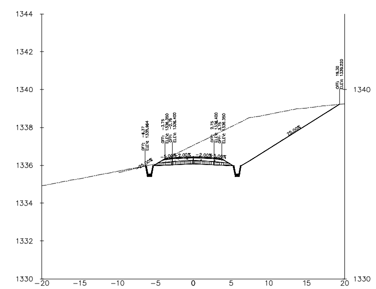
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1328.76	1329.99	1331.21	1331.99	1332.26	1332.34	1333.54
PROPOSED ELEVATIONS			1331.41	1331.99	1331.41	1332.27	1333.52

1+000.00



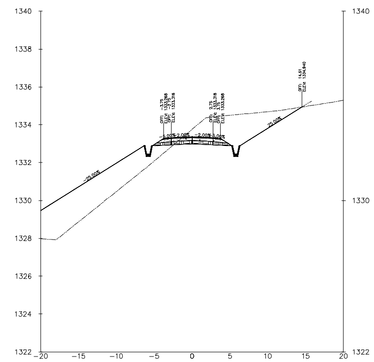
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1326.83	1327.40	1328.04	1328.83	1329.01	1327.35	1326.03
PROPOSED ELEVATIONS		1327.79	1328.78	1328.83	1328.78		

0+900.00



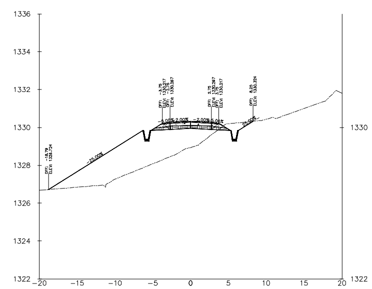
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1335.30	1335.68	1336.04	1337.06	1338.04	1338.69	1339.03
PROPOSED ELEVATIONS			1336.04	1337.06	1336.04	1336.89	1338.14

0+940.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1328.87	1330.47	1332.08	1333.76	1334.50	1334.69	1334.97
PROPOSED ELEVATIONS	1330.72	1331.97	1332.96	1333.76	1332.96	1333.81	1335.06

0+980.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1326.85	1327.27	1328.08	1328.94	1330.20	1330.44	1331.00
PROPOSED ELEVATIONS	1327.67	1328.92	1329.90	1328.94	1329.90		

LEGEND

- EXISTING GROUND
- SIDE DRAIN
- SURFACE DRESSING
- BASE
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INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
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Contact Number 1: 9860659984
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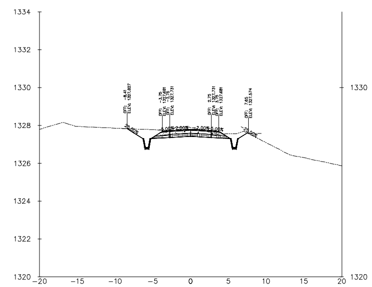
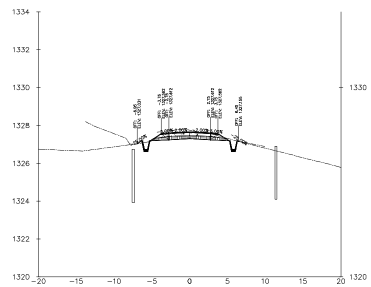
SCALE: 1:250

1+040.00



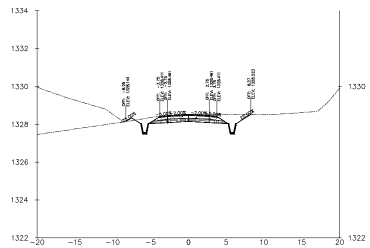
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1327.95	1327.86	1327.77	1327.89	1327.56	1327.09	1326.29
PROPOSED ELEVATIONS			1327.37	1327.89	1327.37		

1+060.00



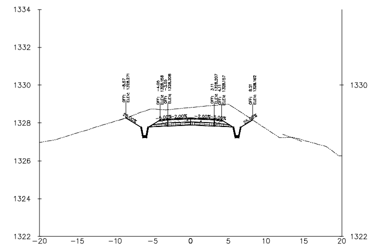
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1326.66	1326.87	1327.20	1327.76	1327.32	1326.80	1326.29
PROPOSED ELEVATIONS		1327.57	1327.25	1327.76	1327.25		

1+100.00



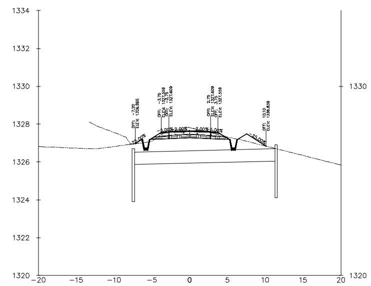
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1327.75	1328.04	1328.36	1328.48	1328.51	1328.53	1328.62
PROPOSED ELEVATIONS	1329.27	1328.53	1328.10	1328.48	1328.10		

1+020.00



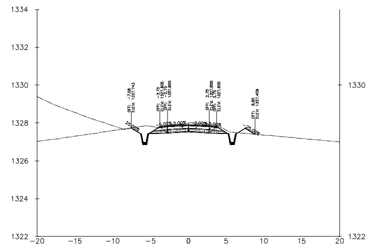
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1327.48	1328.09	1328.74	1328.82	1329.00	1327.69	1327.09
PROPOSED ELEVATIONS			1327.92	1328.82	1327.93		

1+058.81



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1326.73	1326.82	1327.11	1327.82	1327.31	1326.85	1326.35
PROPOSED ELEVATIONS		1327.56	1327.25	1327.82	1327.25	1326.86	

1+080.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1327.30	1327.60	1327.82	1327.99	1327.63	1327.37	1327.18
PROPOSED ELEVATIONS	1328.55	1327.86	1327.49	1327.99	1327.49		

LEGEND

- EXISTING GROUND
- SIDE DRAIN
- SURFACE DRESSING
- BASE
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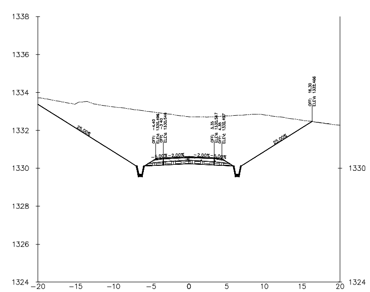
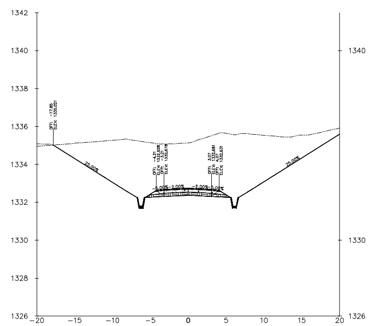
1+140.00



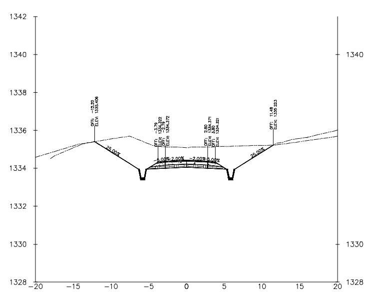
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1333.41	1333.24	1332.98	1332.73	1332.76	1332.82	1332.54
PROPOSED ELEVATIONS	1332.13	1330.88	1330.35	1332.73	1330.33	1330.89	1332.14

1+180.00



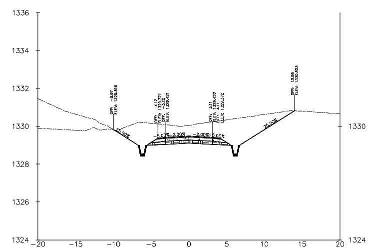
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1335.11	1335.27	1335.14	1335.12	1335.64	1335.54	1335.54
PROPOSED ELEVATIONS	1334.31	1333.06	1332.43	1335.12	1332.40	1333.10	1334.35

1+220.00



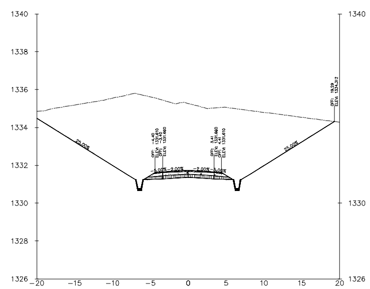
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1335.19	1335.54	1335.29	1335.09	1335.16	1335.21	1335.40
PROPOSED ELEVATIONS	1335.08	1334.86	1334.02	1335.09	1334.02	1334.85	1335.58

1+120.00



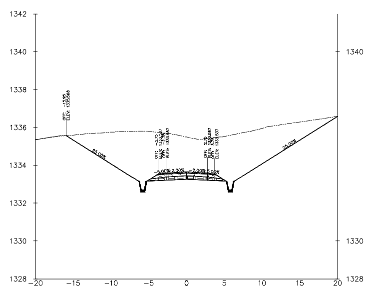
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1329.79	1329.82	1330.16	1330.06	1330.34	1330.63	1330.80
PROPOSED ELEVATIONS	1330.63	1329.82	1329.15	1330.06	1329.15	1329.83	

1+160.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1335.19	1335.55	1335.62	1335.27	1335.06	1334.80	1334.54
PROPOSED ELEVATIONS	1333.25		1331.46	1335.27	1331.46	1331.99	1333.24

1+200.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1335.60	1335.75	1335.79	1335.49	1335.52	1335.95	1336.29
PROPOSED ELEVATIONS	1335.33	1334.08	1333.22	1335.49	1333.22	1334.08	1335.33

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

SUB BASE

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

PREPARED BY:
Garima Maharjan (075BCE056)
Gaurav Khadka (075BCE058)
Hari Shreesh (075BCE062)
Isha Shrestha (075BCE065)
Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

DRAWING TITLE:
CROSS SECTION VIEWS

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PREPARED DATE:

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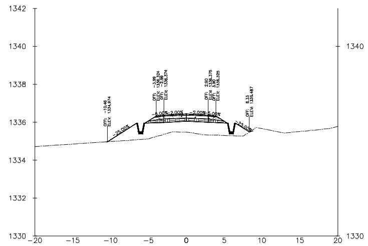
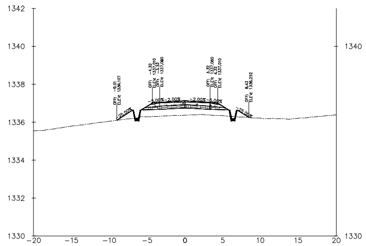
SCALE: 1:250

1+300.00



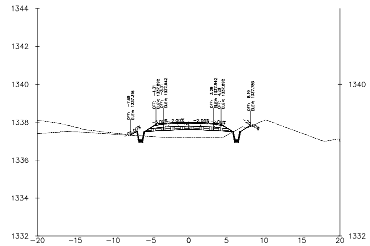
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1334.85	1334.99	1335.13	1335.47	1335.31	1335.66	1335.52
PROPOSED ELEVATIONS		1335.09	1336.07	1335.47	1336.05		

1+400.00



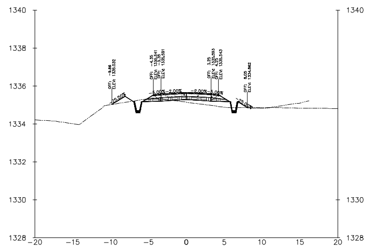
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1335.79	1336.05	1336.29	1336.38	1336.34	1336.21	1336.21
PROPOSED ELEVATIONS			1336.84	1336.38	1336.84		

1+460.00



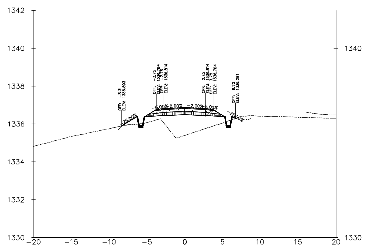
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1337.50	1337.37	1337.25	1337.20	1337.30	1338.10	1337.42
PROPOSED ELEVATIONS	1337.74	1337.44	1337.72	1337.20	1337.71		

1+260.00



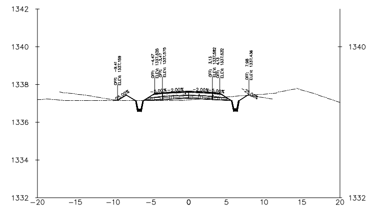
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1334.02	1335.02	1335.35	1335.15	1334.88	1334.86	1334.85
PROPOSED ELEVATIONS			1335.38	1335.15	1335.36	1334.83	1335.11

1+360.00



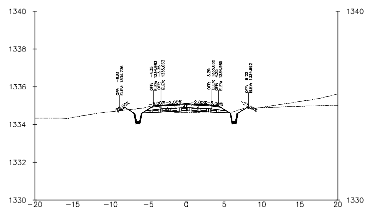
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1335.34	1335.75	1336.07	1335.39	1336.06	1336.41	1336.36
PROPOSED ELEVATIONS			1336.45	1335.39	1336.45		

1+440.00



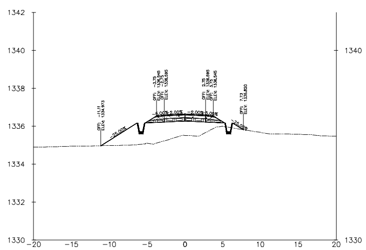
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1337.16	1337.16	1337.16	1337.19	1337.34	1337.50	1337.71
PROPOSED ELEVATIONS	1337.51	1337.20	1337.39	1337.19	1337.31	1337.30	

1+240.00



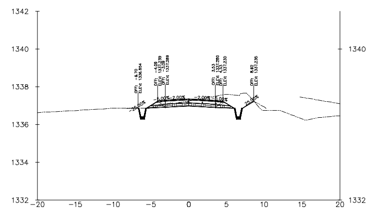
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1334.37	1334.68	1334.95	1334.64	1334.66	1334.89	1334.97
PROPOSED ELEVATIONS			1334.82	1334.64	1334.80	1334.90	1335.23

1+320.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1334.94	1334.98	1335.10	1335.52	1336.00	1335.67	1335.58
PROPOSED ELEVATIONS		1335.25	1336.23	1335.52	1336.23		

1+420.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1336.75	1336.85	1336.90	1337.25	1337.60	1336.75	1336.30
PROPOSED ELEVATIONS			1337.01	1337.25	1337.11	1336.93	1337.44

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

SUB BASE

GENERAL NOTES

No.	Revision/Issue	Date

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INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

PREPARED BY:
Garima Maharjan (075BCE056)
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Hari Shreesh (075BCE062)
Isha Shrestha (075BCE065)
Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION (DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

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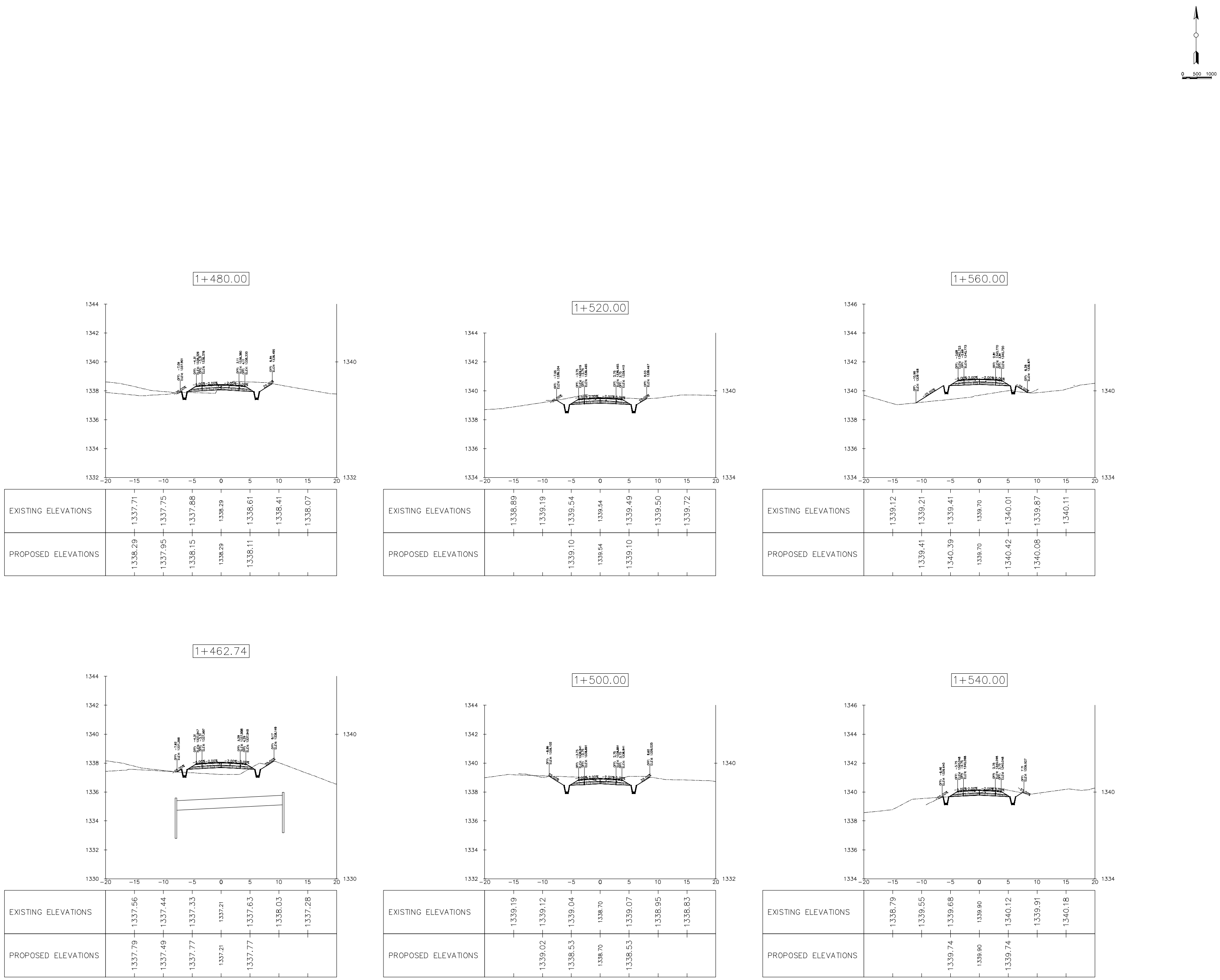

LEGEND

- EXISTING GROUND
- SIDE DRAIN
- SURFACE DRESSING
- BASE
- SUB BASE

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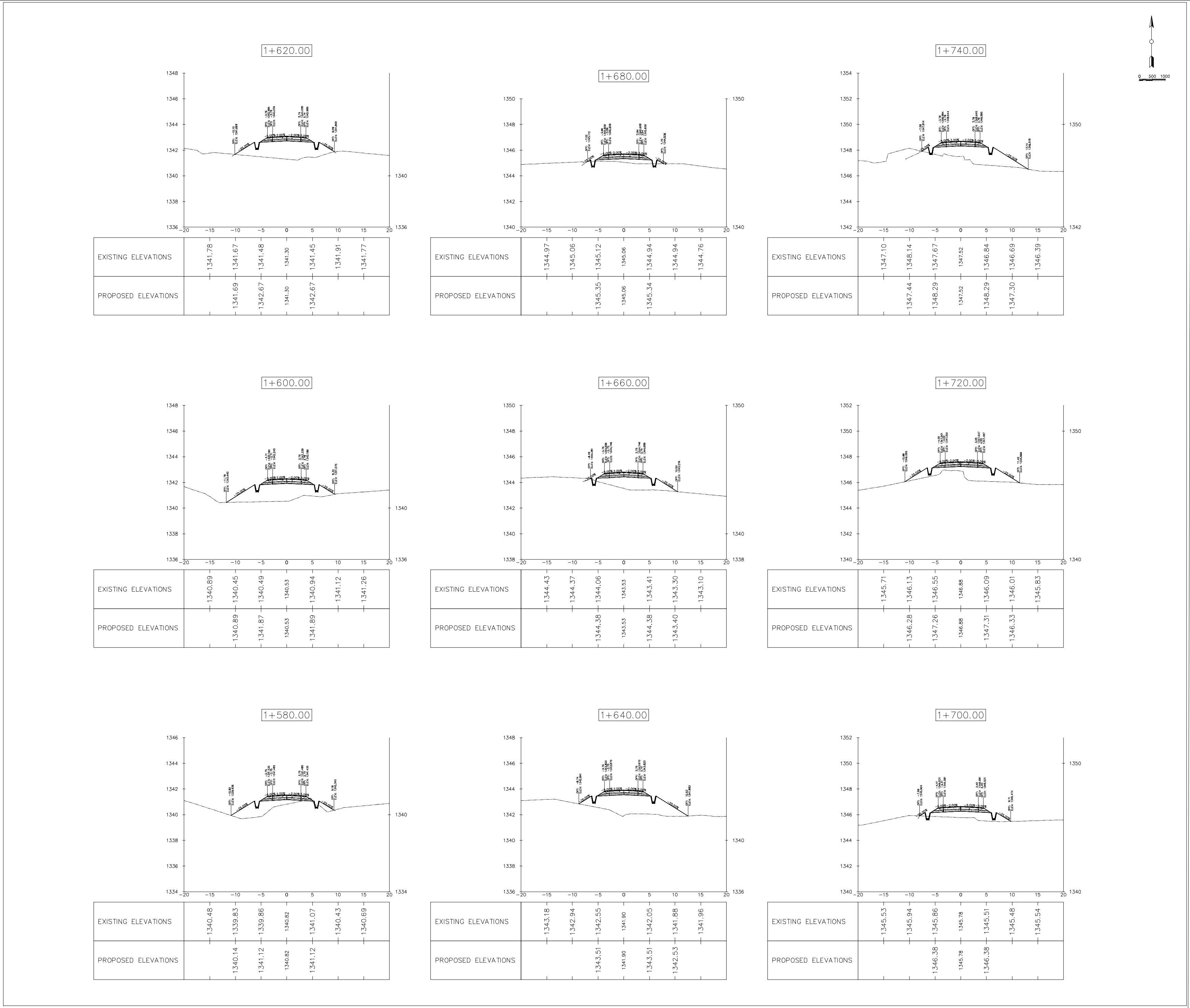

LEGEND

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SIDE DRAIN
SURFACE DRESSING
BASE
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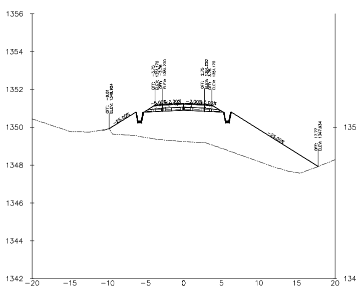
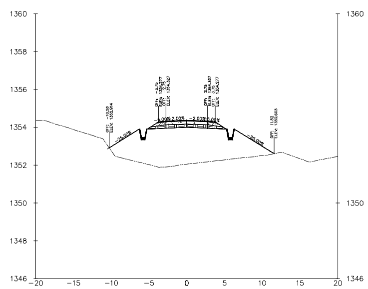
1+780.00



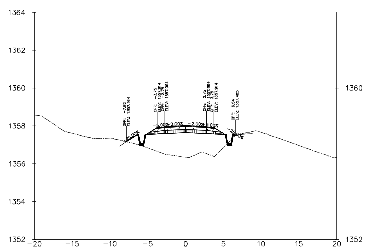
EXISTING ELEVATIONS	1349.78	1349.92	1349.46	1349.25	1348.89	1348.18	1347.60
PROPOSED ELEVATIONS		1349.90	1350.86	1349.25	1350.86	1349.88	1348.63

1+820.00



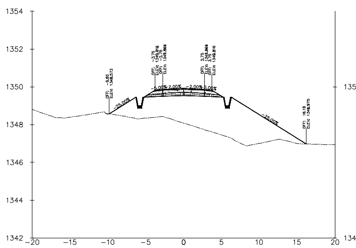
EXISTING ELEVATIONS	1353.88	1352.75	1352.03	1352.06	1352.28	1352.50	1352.34
PROPOSED ELEVATIONS		1352.98	1353.96	1352.06	1353.96	1352.98	

1+860.00



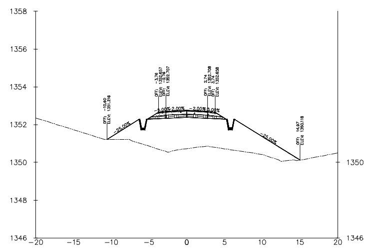
EXISTING ELEVATIONS	1357.61	1357.36	1356.84	1356.35	1356.86	1357.67	1356.96
PROPOSED ELEVATIONS			1357.60	1356.35	1357.60		

1+760.00



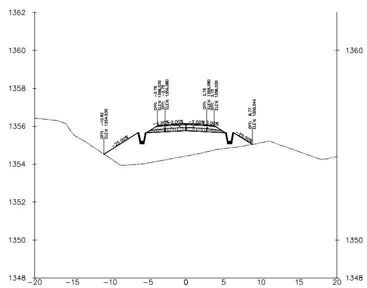
EXISTING ELEVATIONS	1348.39	1348.58	1348.35	1348.08	1347.46	1347.01	1347.00
PROPOSED ELEVATIONS		1348.56	1349.50	1348.08	1349.50	1348.52	1347.27

1+800.00



EXISTING ELEVATIONS	1351.73	1351.22	1350.86	1350.73	1350.72	1350.42	1350.12
PROPOSED ELEVATIONS		1351.37	1352.35	1350.73	1352.34	1351.36	

1+840.00



EXISTING ELEVATIONS	1355.63	1354.31	1354.06	1354.43	1354.82	1355.14	1354.65
PROPOSED ELEVATIONS		1354.74	1355.72	1354.43	1355.72		

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

SUB BASE

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INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

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Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION (DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

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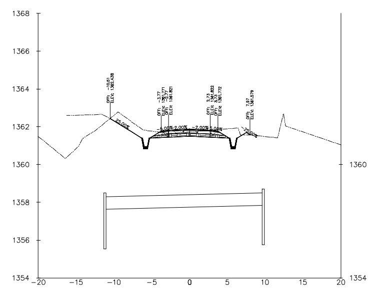
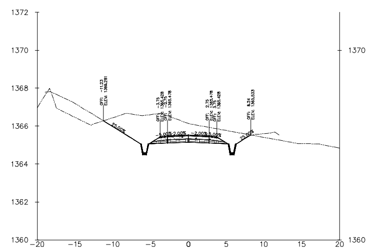
SCALE: 1:250

1+900.00



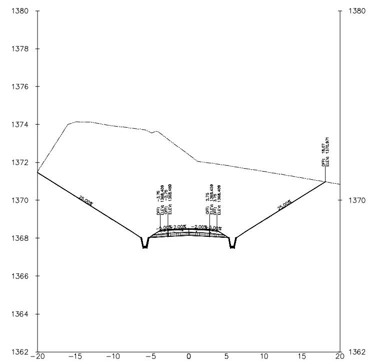
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1360.85	1362.61	1361.77	1361.73	1361.89	1361.49	1361.72
PROPOSED ELEVATIONS	1362.61	1362.31	1361.46	1361.73	1361.45		

1+940.00



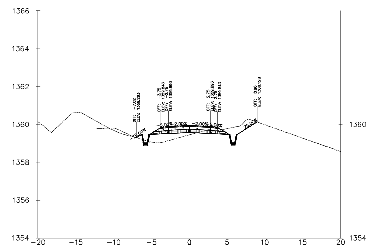
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1366.46	1366.44	1366.61	1366.14	1365.77	1365.40	1365.08
PROPOSED ELEVATIONS	1367.19	1365.97	1365.12	1366.14	1365.12	1365.60	

1+980.00



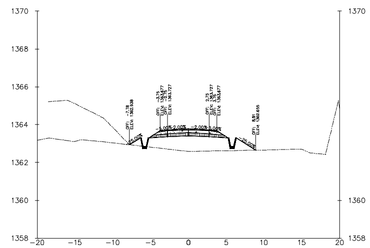
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1374.13	1373.93	1373.58	1372.40	1371.84	1371.51	1371.18
PROPOSED ELEVATIONS	1370.20	1368.95	1368.10	1372.40	1368.10	1368.95	1370.20

1+880.00



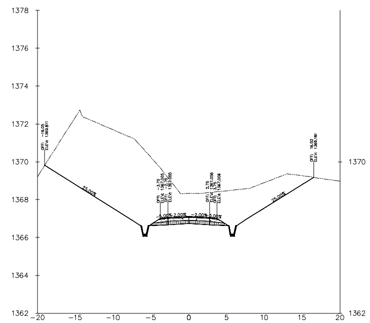
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1360.62	1359.69	1359.06	1359.45	1359.78	1359.98	1359.27
PROPOSED ELEVATIONS		1359.80	1359.53	1359.45	1359.53		

1+920.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1363.11	1363.04	1362.81	1362.59	1362.62	1362.66	1362.69
PROPOSED ELEVATIONS	1365.10	1363.85	1363.36	1362.59	1363.36		

1+960.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1372.35	1371.69	1370.23	1368.33	1368.47	1368.90	1369.27
PROPOSED ELEVATIONS	1368.80	1367.55	1366.69	1368.33	1366.69	1367.55	1368.80

LEGEND

- EXISTING GROUND
- SIDE DRAIN
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INSTITUTE OF ENGINEERING
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DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

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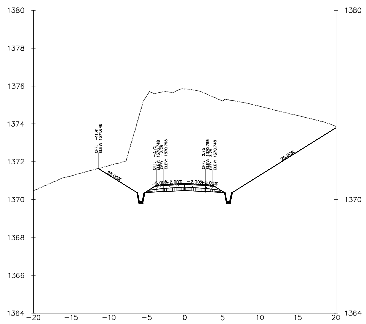
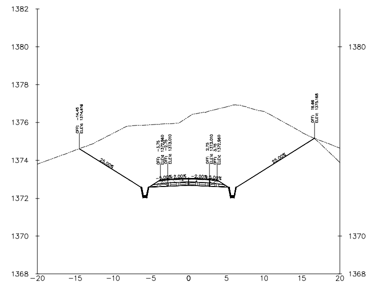
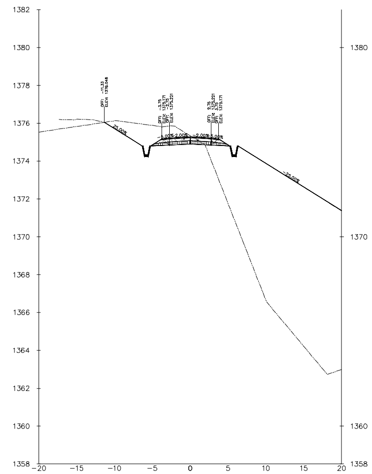


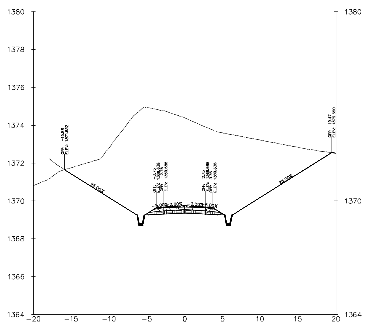
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1371.26	1371.80	1375.49	1375.85	1375.22	1374.92	1374.44
PROPOSED ELEVATIONS		1371.29	1370.44	1375.85	1370.44	1371.29	1372.54



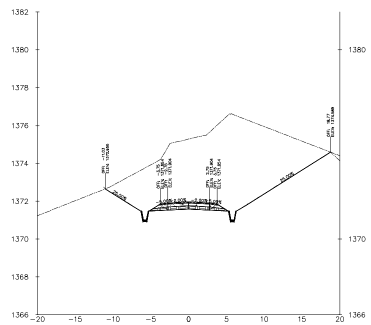
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1374.54	1375.43	1375.88	1376.31	1376.83	1376.58	1375.48
PROPOSED ELEVATIONS		1373.50	1372.65	1376.31	1372.65	1373.50	1374.75



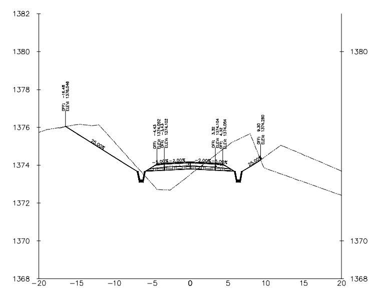
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1375.83	1376.13	1375.88	1375.34	1371.76	1366.65	1364.21
PROPOSED ELEVATIONS	1376.21	1375.72	1374.86	1375.34	1374.86	1373.88	1372.63



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1371.76	1372.81	1374.93	1374.39	1373.60	1373.22	1372.83
PROPOSED ELEVATIONS	1371.43	1370.18	1369.33	1374.39	1369.33	1370.18	1371.43



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1372.03	1372.84	1373.93	1375.28	1376.48	1375.94	1375.17
PROPOSED ELEVATIONS		1372.40	1371.54	1375.28	1371.54	1372.40	1373.65



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1376.14	1375.22	1373.00	1373.50	1375.05	1373.83	1373.12
PROPOSED ELEVATIONS	1375.68	1374.43	1373.91	1373.50	1373.88	1374.48	1374.54

LEGEND

- EXISTING GROUND
- SIDE DRAIN
- SURFACE DRESSING
- BASE
- SUB BASE

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

PREPARED BY:
Garima Maharjan (075BCE056)
Gaurav Khadka (075BCE058)
Hari Shreesh (075BCE062)
Isha Shrestha (075BCE065)
Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

DRAWING TITLE:
CROSS SECTION VIEWS

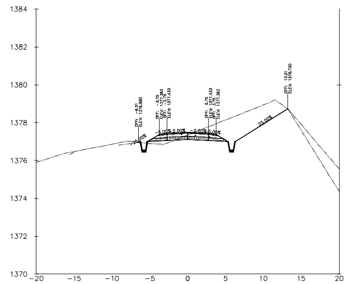
CHECKED BY:

PREPARED DATE:

CHECKED DATE:

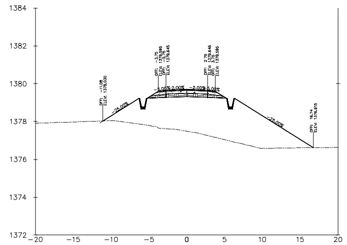
SCALE: 1:250

2+140.00



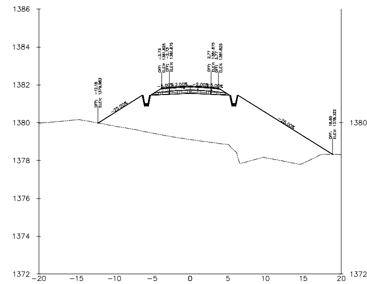
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1376.48	1376.86	1376.89	1377.35	1378.14	1378.94	1377.90
PROPOSED ELEVATIONS			1377.07	1377.35	1377.07	1377.93	1377.58

2+180.00



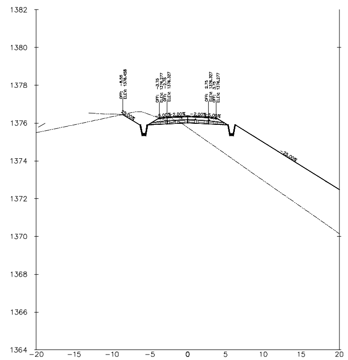
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1377.98	1378.05	1377.79	1377.49	1377.04	1376.59	1376.61
PROPOSED ELEVATIONS		1378.30	1379.28	1377.49	1379.28	1378.30	1377.05

2+220.00



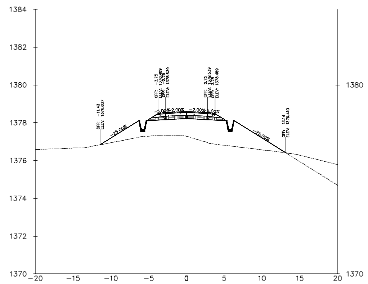
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1380.15	1379.83	1379.45	1379.11	1378.84	1378.15	1377.86
PROPOSED ELEVATIONS		1380.53	1381.51	1379.11	1381.52	1380.53	1379.28

2+120.00



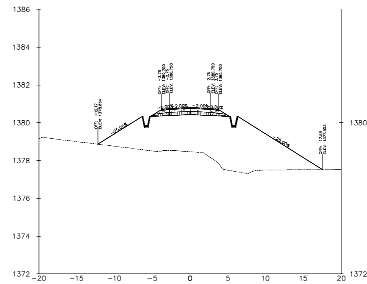
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1375.91	1376.33	1376.44	1375.76	1374.36	1372.96	1371.55
PROPOSED ELEVATIONS		1376.48	1375.96	1375.76	1375.96	1374.98	1373.73

2+160.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1376.65	1376.95	1377.30	1377.28	1376.81	1376.57	1376.28
PROPOSED ELEVATIONS		1377.19	1378.18	1377.28	1378.18	1377.19	1375.94

2+200.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1379.00	1378.76	1378.51	1378.47	1377.49	1377.50	1377.51
PROPOSED ELEVATIONS		1379.41	1380.39	1378.47	1380.39	1379.41	1378.16

LEGEND

EXISTING GROUND
SIDE DRAIN
SURFACE DRESSING
BASE
SUB BASE

GENERAL NOTES

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

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PREPARED BY:
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Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

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(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

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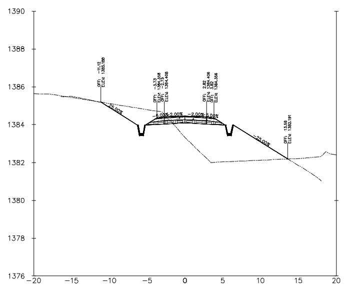
PREPARED DATE:

CHECKED DATE:

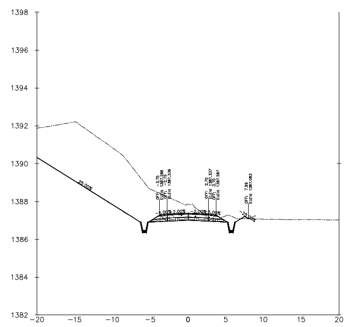
SCALE: 1:250

2+260.00



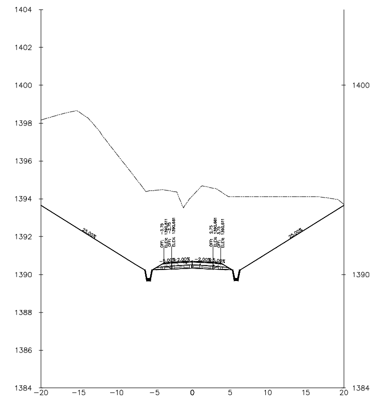
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1385.44	1385.12	1384.80	1383.34	1382.03	1382.13	1382.22
PROPOSED ELEVATIONS	1385.50	1384.91	1384.04	1383.34	1384.06	1383.08	1381.85

2+300.00



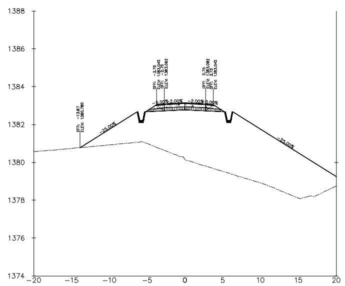
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1392.21	1390.83	1388.65	1387.86	1387.25	1387.07	1387.05
PROPOSED ELEVATIONS	1389.08	1387.83	1386.97	1387.86	1386.96		

2+340.00



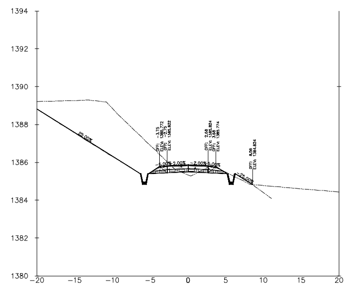
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1398.60	1396.37	1394.45	1394.15	1394.11	1394.12	1394.12
PROPOSED ELEVATIONS	1392.41	1391.16	1390.30	1394.15	1390.30	1391.16	1392.41

2+240.00



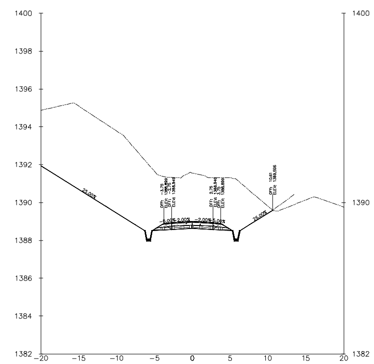
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1380.74	1380.92	1380.99	1380.16	1379.52	1378.91	1378.11
PROPOSED ELEVATIONS		1381.75	1382.73	1380.16	1382.73	1381.75	1380.50

2+280.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1389.27	1388.84	1386.89	1385.34	1385.48	1384.77	1384.60
PROPOSED ELEVATIONS	1387.55	1386.31	1385.46	1385.34	1385.44	1384.40	

2+320.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1395.09	1393.78	1391.64	1391.56	1391.30	1389.80	1390.14
PROPOSED ELEVATIONS	1390.69	1389.44	1388.59	1391.56	1388.59	1389.44	

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

SUB BASE

GENERAL NOTES

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR

Asst. Prof. Roshan Karki

PREPARED BY:

Garima Maharjan (075BCE056)

Gaurav Khadka (075BCE058)

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Isha Shrestha (075BCE065)

Niraj Adhikari (075BCE088)

Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:

DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

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CROSS SECTION VIEWS

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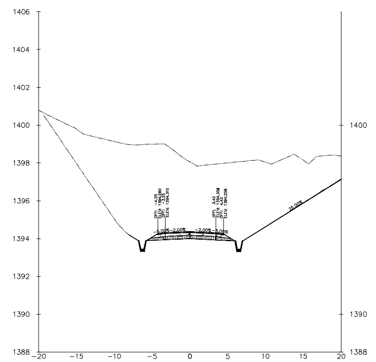
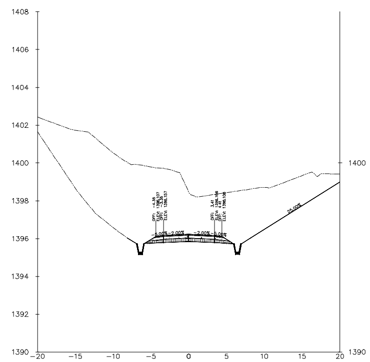
SCALE: 1:250

2+380.00



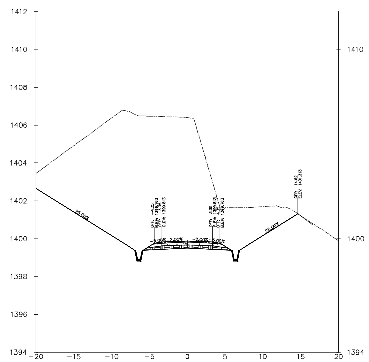
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1399.79	1399.14	1399.00	1398.06	1398.01	1398.04	1398.14
PROPOSED ELEVATIONS	1397.97	1395.04	1394.07	1398.06	1394.11	1394.64	1395.90

2+400.00



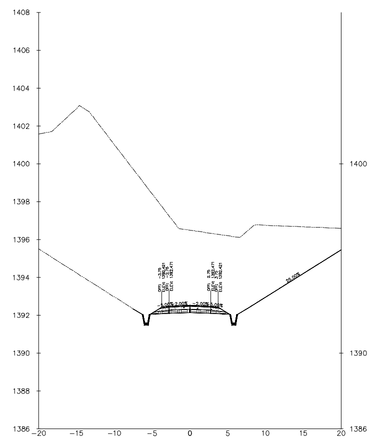
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1401.74	1400.55	1399.79	1398.46	1398.43	1398.71	1399.33
PROPOSED ELEVATIONS	1398.66	1396.59	1395.94	1398.46	1395.96		

2+440.00



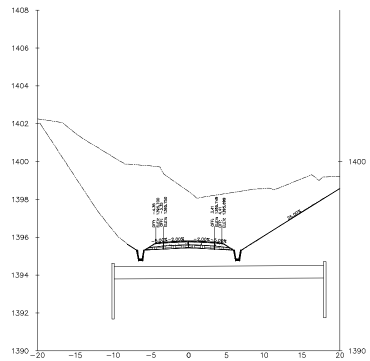
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1404.92	1406.38	1406.47	1406.39	1401.63	1401.69	1401.21
PROPOSED ELEVATIONS	1401.41	1400.16	1399.60	1406.39	1399.60	1400.16	1401.20

2+360.00



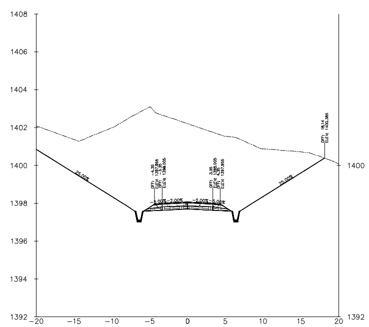
	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1402.93	1401.02	1398.41	1396.50	1396.20	1396.75	1396.68
PROPOSED ELEVATIONS	1394.24	1392.97	1392.11	1396.50	1392.11	1392.97	1394.22

2+395.60



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1401.50	1400.25	1399.77	1398.42	1398.32	1398.58	1399.10
PROPOSED ELEVATIONS	1399.18	1396.36	1395.51	1398.42	1395.57	1396.08	1397.37

2+420.00



	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1401.37	1402.00	1403.09	1402.21	1401.55	1400.88	1400.71
PROPOSED ELEVATIONS	1399.61	1398.35	1397.79	1402.21	1397.79	1398.35	1399.60

LEGEND

- EXISTING GROUND
- SIDE DRAIN
- SURFACE DRESSING
- BASE
- SUB BASE

GENERAL NOTES

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INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

PREPARED BY:
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Gaurav Khadka (075BCE058)
Hari Shreesh (075BCE062)
Isha Shrestha (075BCE065)
Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

DRAWING TITLE:
CROSS SECTION VIEWS

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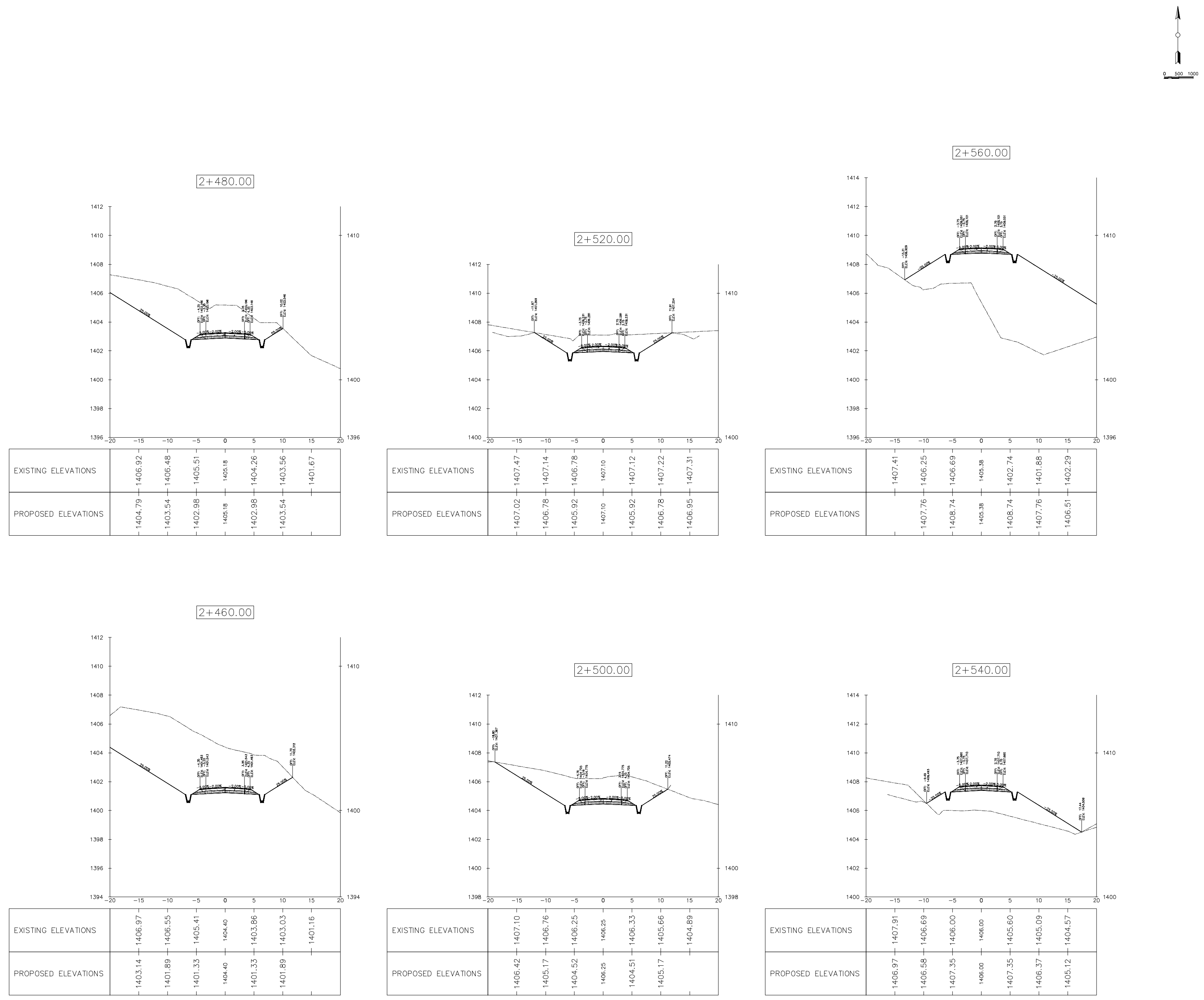
SCALE: 1:250



LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

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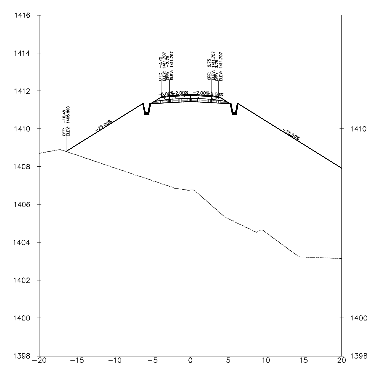
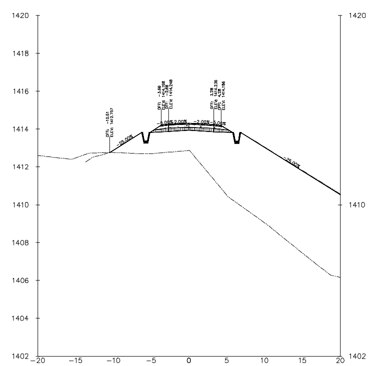
2+600.00



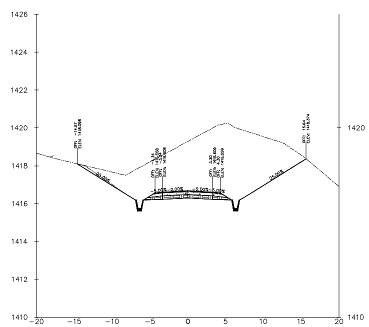
Offset	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1408.60	1407.93	1407.26	1406.77	1405.25	1404.51	1403.22
PROPOSED ELEVATIONS	1409.16	1410.41	1411.39	1406.77	1411.39	1410.41	1409.16

2+640.00



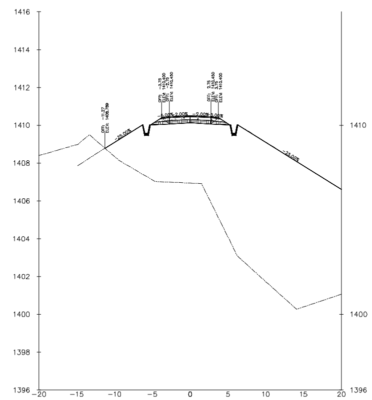
Offset	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1412.47	1412.76	1412.70	1412.86	1410.50	1409.05	1407.44
PROPOSED ELEVATIONS		1412.88	1413.86	1412.86	1414.01	1413.05	1411.81

2+680.00



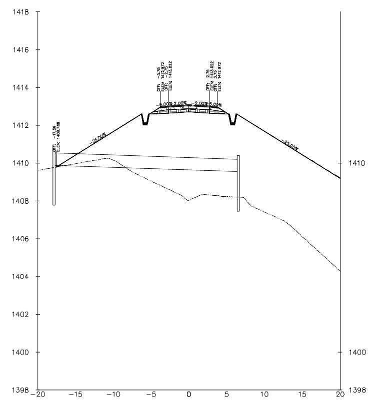
Offset	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1418.14	1417.67	1418.20	1419.28	1420.23	1419.54	1418.57
PROPOSED ELEVATIONS		1417.00	1416.39	1419.28	1416.38	1416.97	1418.22

2+580.00



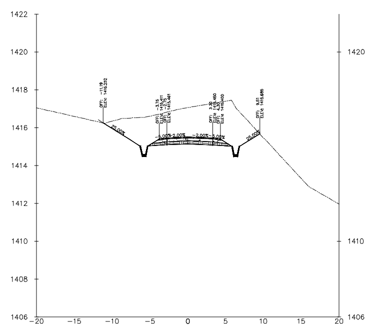
Offset	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1408.98	1408.35	1407.11	1406.94	1404.09	1401.73	1400.39
PROPOSED ELEVATIONS		1409.11	1410.09	1406.94	1410.09	1409.11	1407.86

2+620.00



Offset	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1409.97	1410.15	1409.05	1408.04	1408.23	1407.41	1406.11
PROPOSED ELEVATIONS	1410.43	1411.68	1412.66	1408.04	1412.66	1411.69	1410.45

2+660.00



Offset	-15	-10	-5	0	5	10	15
EXISTING ELEVATIONS	1416.60	1416.34	1416.61	1417.06	1417.40	1415.47	1413.32
PROPOSED ELEVATIONS		1415.96	1415.10	1417.06	1415.23		

LEGEND

- EXISTING GROUND
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INSTITUTE OF ENGINEERING
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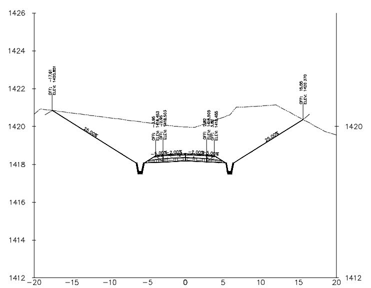
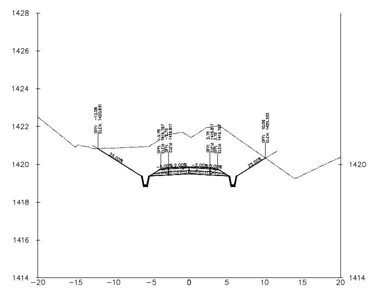
SCALE: 1:250

2+720.00



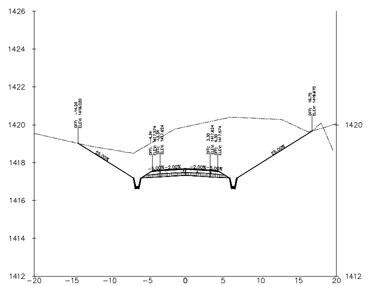
EXISTING ELEVATIONS	1420.72	1420.46	1420.20	1419.98	1420.50	1421.09	1420.49
PROPOSED ELEVATIONS	1420.20	1418.95	1418.19	1419.98	1418.16	1418.98	1420.23

2+760.00



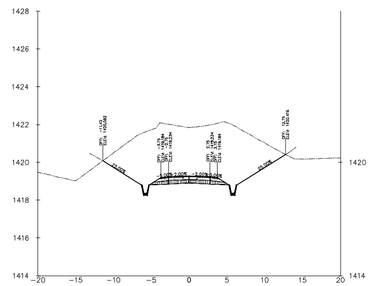
EXISTING ELEVATIONS	1420.93	1420.87	1421.02	1421.49	1421.76	1420.36	1419.44
PROPOSED ELEVATIONS		1420.31	1419.45	1421.49	1419.45	1420.31	

2+700.00



EXISTING ELEVATIONS	1419.09	1418.70	1418.93	1419.89	1420.32	1420.33	1419.86
PROPOSED ELEVATIONS		1417.97	1417.41	1419.89	1417.40	1417.98	1419.23

2+740.00



EXISTING ELEVATIONS	1419.03	1420.50	1421.73	1421.84	1422.10	1421.02	1420.18
PROPOSED ELEVATIONS		1419.73	1418.87	1421.84	1418.87	1419.73	

LEGEND

EXISTING GROUND

SIDE DRAIN

SURFACE DRESSING

BASE

SUB BASE

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
PULCHWOK CAMPUS, LALITPUR

PROJECT SUPERVISOR
Asst. Prof. Roshan Karki

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Gaurav Khadka (075BCE058)
Hari Shreesh (075BCE062)
Isha Shrestha (075BCE065)
Niraj Adhikari (075BCE088)
Prashant Adhikari (075BCE103)

Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

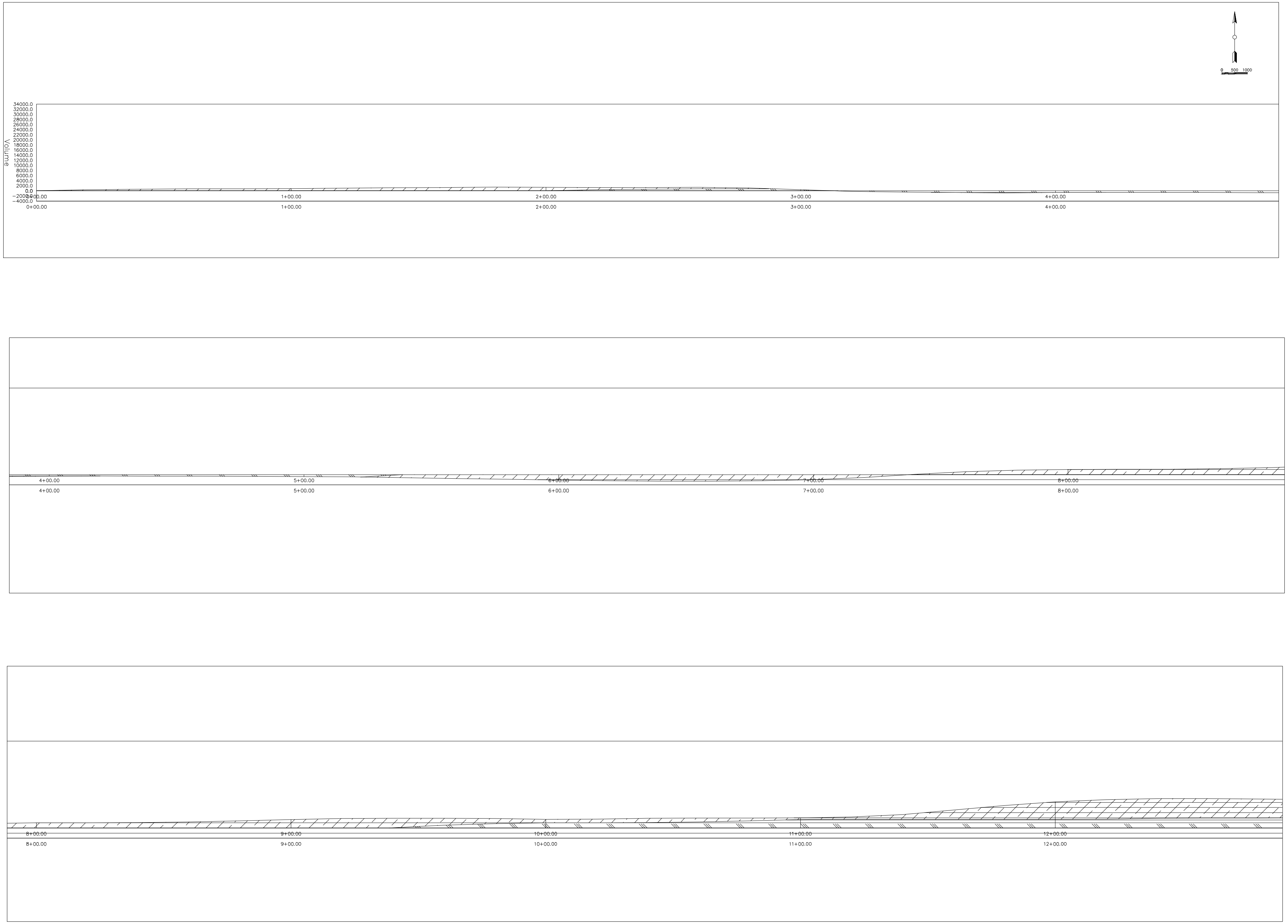
DRAWING TITLE:
CROSS SECTION VIEWS

CHECKED BY:

PREPARED DATE:

CHECKED DATE:

SCALE: 1:250



LEGEND

FREE HAUL AREA

OVER HAUL AREA

GENERAL NOTES

No.	Revision/Issue	Date

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PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

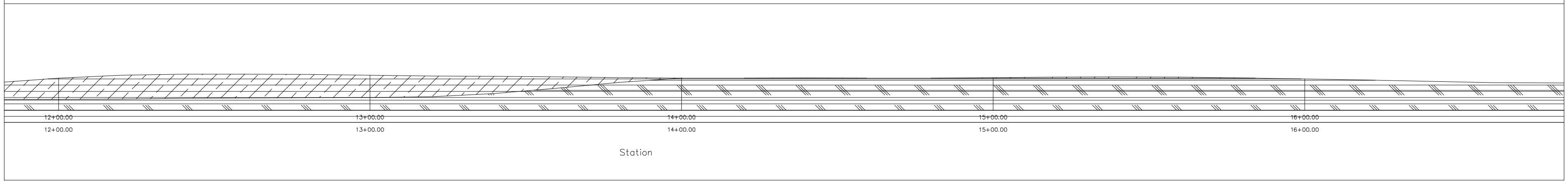
CHAINAGE: 0+00.00 TO 12+00.00

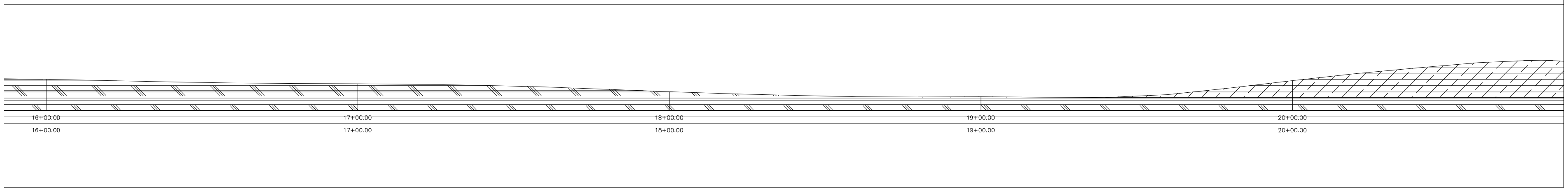
SHEET NO.: 1 OF 3

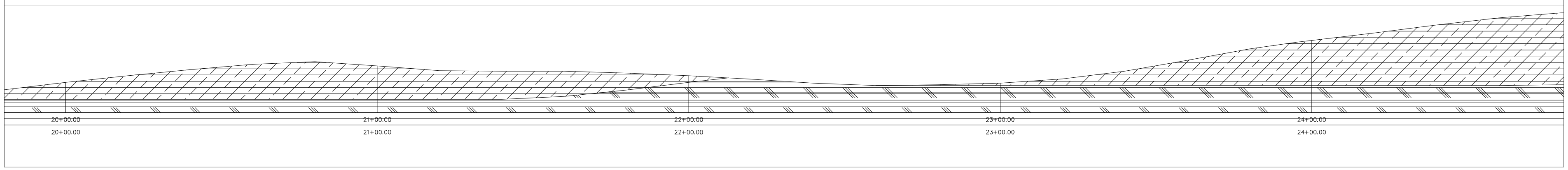
DRAWING TITLE:
MASS HAUL DIAGRAM

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
DRAWING NO.: 1
SCALE: 1:500

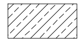
Alignment – 1 Mass Haul Diagram

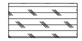






LEGEND


FREE HAUL AREA


OVER HAUL AREA

GENERAL NOTES

No.	Revision/Issue	Date

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Contact Number 1: 9860659984
Contact Number 2: 9865010749

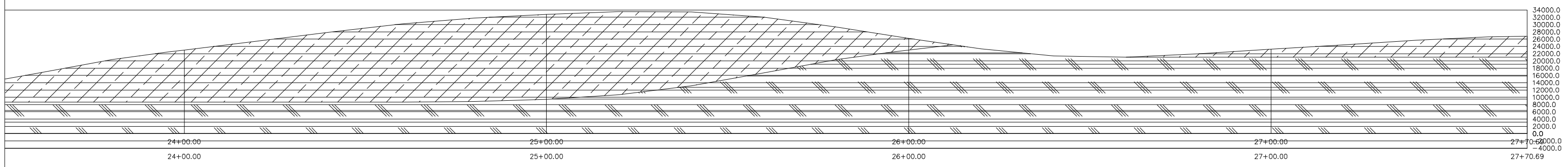
PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

CHAINAGE: 12+00.00 TO 24+00.00

SHEET NO.: 2 OF 3

DRAWING TITLE:
MASS HAUL DIAGRAM

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE: 1:500
DRAWING NO.: 2



LEGEND

FREE HAUL AREA

OVER HAUL AREA

GENERAL NOTES

No.	Revision/Issue	Date

TRIBHUVAN UNIVERSITY
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Contact Number 1: 9860659984
Contact Number 2: 9865010749

PROJECT TITLE:
DETAILED ENGINEERING SURVEY, DESIGN AND COST ESTIMATION OF CHHALING ROAD SECTION
(DHUNGEDHARA TO MACCHHENARAYAN TEMPLE)

CHAINAGE: 24+00.00 TO 27+70.69

SHEET NO.: 3 OF 3

DRAWING TITLE:
MASS HAUL DIAGRAM

CHECKED BY:
PREPARED DATE:
CHECKED DATE:
SCALE: 1:500
DRAWING NO.: 3