TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING (IOE)
WESTERN REGIONAL CAMPUS
DEPARTMENT OF CIVIL ENGINEERING

Lamachaur-16, Pokhara

A Project Report on BCE Survey Camp- 2081

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PREFACE

The survey camp is a vital part of the civil engineering curriculum, offering a unique opportunity to bridge the gap between theory and practice. As part of the Bachelor of Civil Engineering program, this camp allowed us to explore various survey methods and develop practical skills crucial for our future careers as engineers. Surveying and civil engineering share a close and intimate relation with each other; in fact, the starting of every civil engineering project begins first and foremost with surveying. Through this immersive experience, we not only deepened our understanding but also laid the foundation for applying our knowledge in real-world contexts. Participating in the camp provided invaluable lessons in teamwork, problem-solving, and adapting to unforeseen challenges in the field. It also offered a unique opportunity to learn from the expertise of our instructors and collaborate with fellow students.

This **"BCE SURVEY CAMP - 2081"** report provides the gist of work done on our survey camp through the efforts of our group members. With description of the works carried out, every data taken, every result obtained, several calculations on every site visited are orderly maintained in this report. The photographs and the topographic map of the site, profile and cross - section at appropriate points of road alignment and bridge site survey help in making this report visual and gives any reader a clear idea about the survey.

Every effort has been taken to ensure the accuracy of this report. However, some errors might have occurred. We would greatly appreciate it if readers could bring any such errors to our attention. Additionally, we are grateful for any suggestions or feedback from examiners and readers that could help us improve. This report aims to provide a comprehensive overview of the survey processes, the data collected, and the conclusions drawn from the analysis.

BCE Survey Camp – 2081

Group I

ACKNOWLEDGEMENT

We would like to express our sincere gratitude towards the **Department of Civil Engineering, Institute of Engineering (IOE) Western Regional Campus** for conducting a survey camp to enrich our knowledge of surveying and its application. The opportunity to gain practical experience in the field has greatly enriched our understanding of civil engineering practices.

We would like to thank our teachers, **Er. Brijendra KC**, **Er. Kishor Kumar Bhandari, Subash Chandra Lal Karna, Er. Madan Pokhrel**, **Er. Abhay Kumar Mandal, Er. Sandip Duwadi** and all the working staff and storekeepers for their support, suggestions, management of resources and co-operation throughout the camp. We are grateful for your help during fieldwork including fieldwork instructions, calculations, plotting, report preparation and file maintenance work as well as ideas about solving the problems which arise during the preparation of this report. Additionally, we are thankful to all the locals around the venue for their co-operation. We are equally grateful to our fellow students and team members for their collaboration, teamwork, and dedication during the camp. The shared learning experiences and mutual support significantly contributed to our success. Our cooperation and help were what made us complete the camp beautifully and successfully.

Finally, we would like to thank everyone who helped us directly or indirectly during the duration of survey camp and in the preparation of this report. Their effort and sincerity on the field are always memorable to us.

Group - I

Abstract

This report represents the outcome of a 10-day Survey Camp held in 2081 by the Department of Civil Engineering at Western Regional Campus, Pokhara. The camp, designed in alignment with the curriculum set by Tribhuvan University for the 078-BCE batch, took place from 22nd Baisakh 2081 to 31st Baisakh 2081. The primary aim of the camp was to enhance our theoretical knowledge in Engineering Surveying by applying it in real-world field conditions. Through this hands-on experience, we developed a comprehensive understanding of various survey techniques essential for civil engineering practices.

Here, we have prepared topographical map of the campus premises, plan of road, longitudinal section (L-Section) of road, cross-section of road as well as the longitudinal section (L-Section) of bridge site, cross-section of river, plan with contour of Kali Khola fulfilling all technical requirements.

This experience gave us a unique opportunity to engage in decision-making for planning and executing fieldwork, ultimately enhancing our understanding of topographic mapping and detailed road and bridge site surveys. This Survey Camp provided us with invaluable insights into field practices, allowed us to work collaboratively, applying surveying tools and techniques essential for infrastructural planning, a vital aspect of civil engineering education in Nepal. We have made great efforts and dedication for the preparation of a precise report, however, there still could be some errors. So, any suggestions and advice will be appreciated.

ABBREVATIONS

TBM	Temporary Benchmark
BM	Benchmark
B. S.	Back Sight
I. S.	Intermediate Sight
F. S.	Fore Sight
H. I.	Height of the instrument
T	Top
M	Middle
B	Bottom
BC	Beginning of Curve
MC	Middle of Curve
EC	End of Curve
TS	Total Station
D	Degree
M	Minute
S	Second
CP	Change Point
EDM	Electronic Distance Measurement
FL	Face Left
FR	Face Right
U/S	Upstream
D/S	Downstream

ABBREVATIONS

RD	Road
TREE	Tree
EP	Electrical Pole
GP	Ground Point
m1	Minor station
WT	Water Tap
BT	Boys Toilet
GT	Girls Toilet
M1	Major station
AH	Auditorium Hall
DR	Drainage
TLP	Tanahun-Lamjung Park
RD	Road
WW	Welding Workshop
GEO	Geomatics Block
MECHA	Mechanical Block
SUPA	Sudur Pashchim Park
CIVILD	Civil Department

CAMP WORK SCHEDULE

Project title: Survey Camp 2081

Location: Paschimanchal Campus and Kali Khola

Duration: 22nd Baisakh to 31st Baisakh 2081

Working Time: 6: 00 A.M to 7: 00 P.M

Surveyed By: Group I of BCE078

S. N	Date	Survey Field Work
1	2081/01/21	Orientation and Group Division
2	2081/01/22	Selection of an alignment for the road and detail survey of it
3	2081/01/23	Level Transfer on IP, BC, EC of the road
4	2081/01/24	Detail survey of selected alignment and bridge site survey and reciprocal levelling
5	2081/01/25	Bridge site survey and Road alignment survey completion
6	2081/01/26	Reconnaissance, Station Fixing, Distance and angular measurement and bearing observation for major traverse
7	2081/01/27	Station Fixing, Distance and Angular Measurement and Bearing Observation for Major and Minor Traverse
8	2081/01/28	Two Peg Test, Fly Leveling and RL transfer to the station
9	2081/01/29	Traverse calculation, making grid and Computation
10	2081/01/30	Detailing by Total Station
11	2081/01/31	Detailing by Total Station and Theodolite and closing of camp 2081.

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1. INTRODUCTION

Surveying is the art of determining the relative positions of distinctive features on the surface of the earth or beneath the surface of the earth, by means of measurements of distances, directions and elevations. It is one of the fundamental aspects of civil engineering, providing the essential data required for planning, designing, and executing infrastructure projects.

The object of surveying is the preparation of plans and maps of the areas. Thus, the subject emerges out to be the most important before and during all engineering works like civil engineering works such as designing and construction of highways, water supply systems, irrigation projects, buildings etc. The success of any engineering project is based upon the accurate and complete survey work, an engineer must, therefore, be thoroughly familiar with the principles and different methods of surveying and mapping. This knowledge, combined with an equal understanding of the limits and capabilities of surveying instrumentation and techniques, will enable the engineer to complete the project successfully in the most economical manner in the shortest time possible.

The B.E. Survey Camp 2081 organized by the Department of Civil Engineering, I.O.E, Paschimanchal Campus is a part of the four-year bachelor's degree in civil engineering course in fifth semester, carrying a total of 100 marks. The total duration of the survey camp was 10 days, from 22nd Baisakh to 31st Baisakh 2081.

This report summarizes the work conducted by Group No. I / Group No. 9 during the survey camp, detailing the techniques and procedures used for data collection, error adjustment, and calculations. In addition to discussing the technical aspects, the report provides an overview of the results obtained and their significance. The hands-on experience gained during this camp has enhanced our understanding of real-world surveying techniques, bridging the gap between theory and practice in civil engineering.

According to the work done during the camp, our major survey tasks are:

1. Topographical survey

2. Road alignment survey

3. Bridge Site survey

1.1 Objectives of Survey Camping

The survey camp helped to equip us with practical knowledge of various surveying techniques essential for field engineers. We were trained to handle different survey instruments, understand their functions, and work efficiently in teams, promoting coordination and teamwork. The camp also provided insights into methodologies, practical surveying concepts, and problem-solving strategies. We learned how to systematically collect field data, accurately compute and manipulate it, and present the results in clear, diagrammatic, and tabular forms for effective communication and analysis.

The survey camping was conducted to fulfil the following main objectives:

- To prepare the topographic map of particular area within Western Regional Campus Premises.
- To prepare a detailed plan of road and hence, to compute earthwork calculation including L-section and X- section.
- To identify the proper site for bridge construction, prepare contour map of river including its L- section and X-section.

1.2 Location and Accessibility:

Our survey was conducted inside the premises of Western Regional Campus, at kali khola and the road alongside the river.

Western Regional Campus is situated in Pokhara Metropolitan-16, Lamachaur Kaski which is in the North-West region of Pokhara valley. It takes about 30 min from Prithivi chowk to Pashchimanchal by city bus.

Kali khola lies in the Northern part of the campus and famous Mahendra as well as Chamere cave, Batulechaur. It is a tributary of Seti Gandaki River runs through Armala, Bhalam and Batulechaur of Pokhara Metropolitan. The trail path to Kali Khola from campus is about 30 minutes long and can be easily accessed by any transportation.

1.3 Project Area

Fig -1.1 Western Regional Campus Premises (source: Google earth)

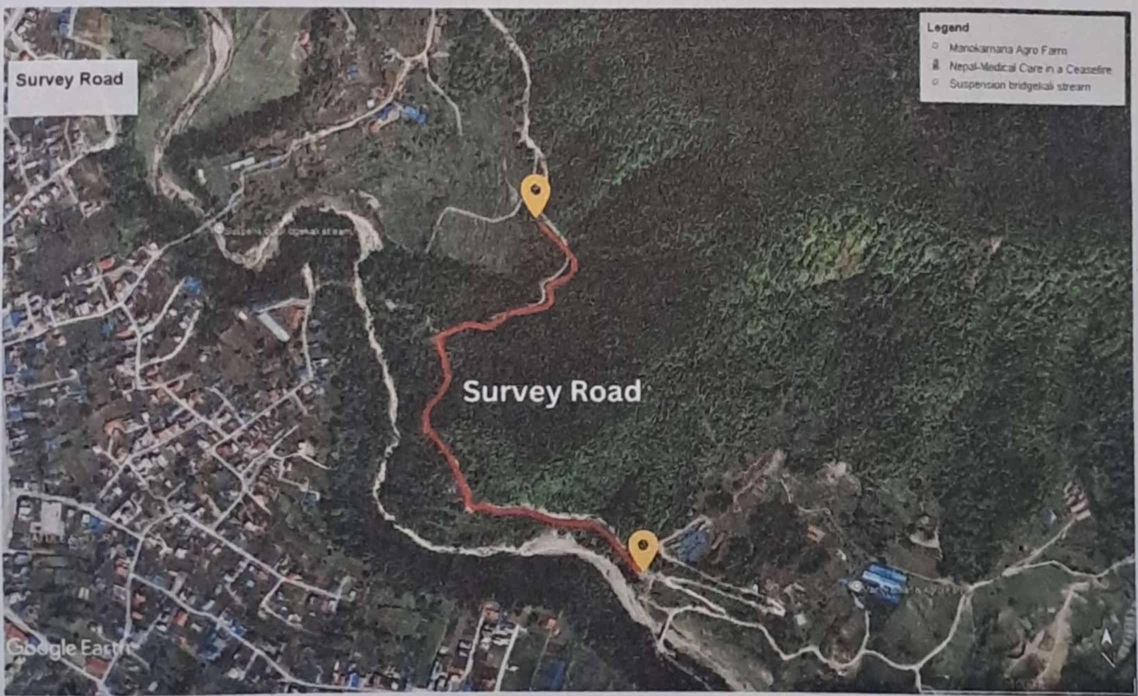


Fig – 1.2 Survey Road (Source: Google earth)

Fig – 1.3 Bridge Site Location (Source: Google earth)

1.4 Topography and Geology

Pokhara is in the central part of Nepal, in the western region of the country, and lies within the Pokhara Valley. The city is situated below the Annapurna and Machhapuchhre mountain ranges, with the Himalayas providing a stunning northern backdrop.

Latitude: 28°15' N
Longitude: 83°58' E

The terrain consists of both alluvial plains and undulating hilly regions, with some areas experiencing steep slopes due to the surrounding foothills of the Himalayas. Geology plays a critical role in construction, maintenance, and the safety of infrastructure in Pokhara, especially given its susceptibility to landslides and erosion during the monsoon season.

1.5 Temperature, Climate and Vegetation

According to the Central Bureau of Statistics, the annual temperature variation and rainfall in Pokhara are as follows:

1. Temperature:
    a. Max. 35°C to Min. 22°C in summer
    b. Max. 20°C to Min. 5°C in winter
2. Rainfall: Pokhara receives one of the highest annual rainfalls in Nepal, with around 150 inches during the monsoon season (summer). There is minimal rainfall in winter, with occasional drizzles.
3. Major Crops Grown: Paddy, maize, wheat, and millet are commonly cultivated in the fertile plains of Pokhara Valley.
4. Types of Vegetation Found: Pokhara is home to a rich variety of vegetation, including tropical and subtropical species.
    a. Trees: Sal, Peepal, Sirish, and Bamboo are widely found in the region.
    b. Vegetation: The valley supports dense forests with a mix of tall trees, shrubs, and herbs, especially in the lower hill areas.

1.6 Limitations

1. Weather Conditions: Adverse weather like rain or extreme heat can affect measurements and the ability to conduct surveys efficiently.
2. Terrain Difficulties: Uneven or obstructed terrain can lead to errors in measurements and data collection.
3. Equipment Malfunctions: Survey instruments may face calibration issues or breakdowns, impacting accuracy.
4. Time Constraints: Limited time to conduct detailed surveys can affect data quality and thoroughness.

2.TOPOGRAPHICAL SURVEY

2.1 Introduction

The surveys which are carried out to depict the topography of the mountainous terrain, rivers, water bodies, wooded areas and other cultural details such as roads, railways, townships etc., are called topographical surveys. It is the process of determining the positions of existing features of the locality by means of conventional signs on a topographical map. Topographic surveys are three-dimensional. They provide the techniques of plane surveying and other special techniques to establish both horizontal and vertical control.

Hence, it establishes both horizontal and vertical control, allowing for accurate positioning and measurement. Additionally, it determines the contours of the terrain, providing crucial information about elevation changes. Beyond this, it identifies and maps out specific details, including natural features such as rivers, streams, and lakes, as well as man-made structures like roads, houses, and trees.

2.2 Objectives

→To prepare the topographic map of the given area with horizontal and vertical control at required accuracy.

→To draw contour lines.

2.3 Brief Description of the Area

The topographical survey was performed inside the premises of Western Regional Campus, Pokhara. The major traverse runs through the whole campus area. The minor traverse was run within the major traverse through the plot of the given map, which covers Civil Block, Geomatics Block, Mechanical Block, TCC Park, Applied Science Block, Workshops, Store, Thermodynamics Lab, Auditorium Hall, Canteen Premises etc. The main buildings are:

i. Civil Block
ii. Geomatics Block
iii. Applied Science Block
iv. Mechanical Block
v. Workshops
vi. Store
vii. Thermodynamics Lab
viii. Auditorium Hall
ix. Canteen Premises

2.4 Technical Specifications

- Reconnaissance survey of the area to be surveyed: A closed traverse (major and minor) was formed around the premises of the area by fixing or marking appropriate no. of stations. During the selection of traverse stations, the leg ratio i.e. the ratio of length of the longest traverse leg to the length of the smallest leg should be less than or equal to 2:1 for major traverse and 3:1 for the minor traverse. References were taken for the major and minor traverses.
- Two-way measurement of the traverse legs: Discrepancy (Accuracy of two-way measurement in the case of major & minor traverse) is 1:2000.
- Determination of horizontal angles between stations: The difference between the mean angles as well as the difference in each angle observation should be within 10 seconds.
- Determination of RL of traverse stations by fly levelling from the given B.M: Two peg tests were carried out to determine if the level required permanent adjustment. Balancing of back sight and fore sight is necessary for the elimination of different types of errors including collimation error. Fly leveling was carried out from the given arbitrary T.B.M.1 (near Boys Hostel) to T.B.M. 2 (near Girls Hostel) and similarly from T.B.M.2 (near Girls Hostel) to T.B.M.3 (near WRC gate). The collimation error should be less than 1:10000. The permissible error of fly levelling is $\pm 25\sqrt{K}$ mm, where K is the distance of the levelling passed in kilometer.
- Balance the traverse. The permissible angular error for the sum of interior angles of the traverse should be less than $\pm 1\sqrt{n}$ minute for Major Traverse and $\pm 1.5\sqrt{n}$ minutes for Minor Traverse (n = no of traverse station). For Major and Minor traverse, the relative closing error should be less than 1: 2000 and 1: 1000 respectively.
- Detailing or the detail survey of the plot by Total Station: The details were extracted from T.S. Conventional symbols were used to denote the detailing along with the contours of 0.5m contour interval in the same scale.
- Plotting of the traverse stations by co-ordinate method: An appropriate scale was adopted, i.e.1:1000 for the major traverse and 1:500 for minor traverse and all the details like trees, buildings, parks, roads, etc. were represented with conventional symbols and figures.

2.5 Equipment and Accessories:

Following instruments were used to carry out the topographical survey:

1) Total Station
2) Pegs
3) Ranging Rods
4) Tripod Stands
5) Hammer
6) Measuring Tapes
7) Theodolite
8) Field book
9) Markers, Pens
10) Prisms, Prism Holders, Clampers
11) Level Machine

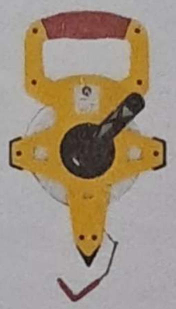


Fig- 2.1 Measuring tape

Fig – 2.2 Levelling Staff

Fig- 2.3 Ranging rods

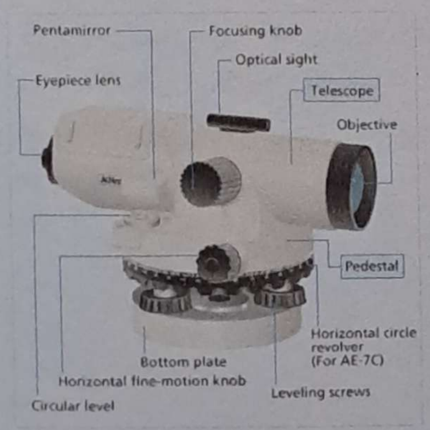


Fig- 2.4 Level Machine

Fig – 2.5 Total Station Set ups

Source : haodiok.en, istockphoto.com

2.6 Methodology

The methodology of surveying is based on the principle of surveying. They are as follows:

i. Working from whole to part.

ii. Independent check.

iii. Consistency of work.

iv. Accuracy required

The different methodologies were used in surveying to solve the problems arising in the field. These methodologies are as follows:

2.6.1 Reconnaissance

Reconnaissance, or Recce, refers to the preliminary inspection of an area prior to starting the detailed survey. Its purpose is to establish survey stations and make a general plan for the network of chain lines. For this reason, a reconnaissance survey was conducted to thoroughly inspect the given area of Western Regional Campus.

During the reconnaissance, both major and minor traverse control points were identified to form a closed traverse around the perimeter of the site. The selection of these control points requires consideration of several factors:

- Adjacent stations should be clearly inter-visible and cover the entire area with the minimum number of stations possible. Additionally, the traverse station layout should ensure that the ratio between the longest and shortest traverse legs remains less than 2:1 for major traverse and 3:1 for minor traverse.

- Steep slopes and rough terrain should be avoided wherever possible, as they may lead to inaccuracies in measurement.

- The stations should offer sufficient flat surface for setting up the tripod of the surveying instrument.

These considerations were ensured so that the reconnaissance survey provided a strong foundation for the detailed survey that followed.

2.6.2 Selection and marking of station sites

Location should be such that the basic principle of surveying, i.e. working from whole to part gets implemented. While the selection, station leg ratio should be maintained at **2:1** for major traverse and **3:1** for minor traverse. After finalizing the sites for the location of traverse station, their position is marked on the ground. The station mark should be of permanent nature, so that the same station can be use in future also, if required.

2.6.3 Traversing

For horizontal control, linear measurement was done using total station. Readings were taken in both forward and backward directions. Both discrepancy and precision were checked to fall within limit for each traverse leg. At each traverse station one set of two face horizontal angle (interior) between forward stations were observed using total station. Mean of two readings was adopted as horizontal angle between two traverse legs. We have used closed traverse for major stations and open linked traverse for minor stations. To provide vertical controls in topographic maps, the elevation of the M3 was known and RL was transferred to other points to complete the topography of the area.

Major Traverse:

The major stations were named as M1, M2,…M8 and so on along with CP1 and CP2 and there were altogether 10 major stations.

To check the correction of traverse angles, the angular disclosure was found out

The angular disclosure = sum of interior angles - {(2n-4) × 90}

This angular disclosure must be within the permissible limit $\pm\sqrt{(n)}$ minutes. Where n = number of sides. Then, it is equally distributed to get correct angles.

Minor traverse:

The minor traverse had 8 control stations that enclose the required area of detailing. The stations were named as m1, m2,…..,m8. The leg ratio of maximum traverse leg to minimum traverse leg was maintained within 3:1. The precision in length between the forward measurements and the backward measurements of all the traverse legs was within 1:3000.

For minor traverses, the whole circle bearings were found out and corrected by using the Bowditch's rule. Then, independent coordinates were calculated starting from one known coordinate.

2.6.4 Levelling

Leveling is an art of determining relative altitudes of points on the surface of the earth or beneath the surface of the earth. It is used to find the elevation of given points with respect to a given or assumed datum and to establish points at a given elevation or at different elevations with respect to a given or assumed datum.

Temporary adjustments of Level:

The temporary adjustments for a level consist of the following:

a) Setting up the level: The operation of setting up includes fixing the instrument on the stand and leveling the instrument approximately.

b) Leveling up: Accurate leveling is done with the help of foot screws and with reference to the plate levels. The purpose of leveling is to make the vertical axis truly vertical. It is done by adjusting the screws.

c) Removal of parallax: Parallax is a condition when the image formed by the objective is not in the plane of the cross hairs. Parallax is eliminated by focusing the eyepiece for distinct vision of the cross hairs and by focusing the objective to bring the image of the object in the plane of cross hairs.

Permanent adjustments of Level:

To check for the permanent adjustments of level two-peg test method should be performed. Two staff were placed at A and B of known length (about 30 m). First the instrument was set up on the line near B and both staff readings (Top, Middle, and Bottom) were taken. Then, the instrument was set up at the middle C on the line and again both staff readings on A and B were taken. Then computation was done to check whether the adjustment was within the required accuracy or not.

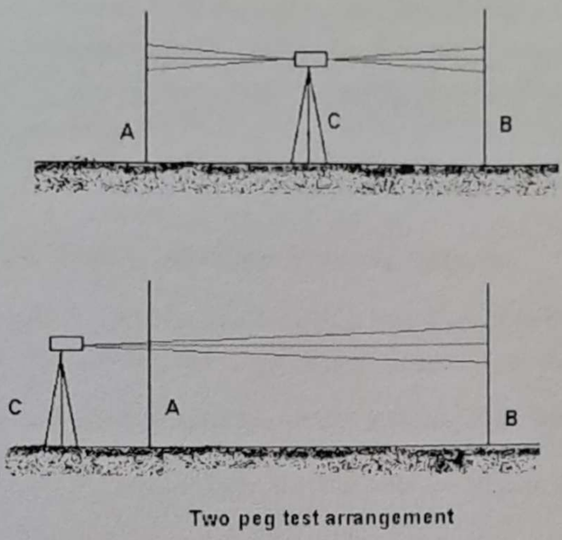


Fig – 2.6 Two peg test arrangement

Booking of reducing levels:

There are two methods of booking and reducing the elevation of points from the observed staff reading:

1. Height of the Instrument method

   Arithmetic Check: $\sum$B.S. – $\sum$F.S. = Last R.L. – First R.L.

2. Rise and Fall method

   Arithmetic Check: $\sum$B.S. – $\sum$F.S. = $\sum$Rise –$\sum$Fall = Last R.L. – First R.L.

Among the two methods, the Rise and Fall method was used.

Fly Leveling:

Fly Levelling was performed from Boys Hostel Gate (TBM1) to Koika Park (TBM2). Then fly levelling was performed back to TBM1. As error was permissible then we proceeded towards the Main Gate of Campus (TBM3) and fly levelling back to TBM2. And again error was within permissible range.

Level transfer to the major and minor traverse stations:

The R. L of the temporary benchmark was then transferred to the control stations of the major and minor traverse. The closing error was found to be within the permissible limits.

The misclosure was adjusted in each leg of the leveling path by using the following formula:

Permissible error $= \pm 25\sqrt{k}$ *mm.* Where k is the total perimeter in Km.

Actual Error (e) $= \Sigma BS - \Sigma F.S. =$ *Last R.L. – First R.L.*

Correction i^{th} *leg*= - (e x (L1 + L2 +.... + Li)/P

Where L1, L2, Li Length of 1st 2nd, ... i^{th} leg.

P is perimeter

Relative Precision= 1/(p/e)

Hence, the RL of the given temporary benchmark was used, and it was transferred to Major and minor stations. The closing error was calculated. The permissible limit was found. Closing error was within the permissible limit, so the correction of RL was carried out.

2.6.5 Detailing

Detailing means locating and plotting relief in a topographic map. Detailing can be done by either plane table surveying or tachometric surveying or by total station. We performed detailing by total station, detailing by tachometry and tangential method while taking details during the camp.

2.6.6 Total Station

A total station is an electronic/optimal instrument used in modern surveying and building construction. It is a combination of an electronic theodolite and an electronic distance meter (EDM). It is also an integrated microprocessor, electronic data collector and storage systems. The instrument is used to measure sloping distance of object to the instrument, horizontal angles and vertical angles. This Microprocessor unit enables the computation of data collected to further calculate the horizontal distance, co- 18 ordinates of a point and reduced level of point. Data collected from the total station can be downloaded into computer/laptops for further processing of information.

Uses of total station:

a. Used by land surveyors and civil engineers, either to record features as in topographic surveying or to set out features such as roads, houses or boundaries.

b. Used by archaeologists to record excavations.

c. Used by police, crime scene investigators, private accident, Reconstructionist and insurance companies to take measurements of scenes.

Features of Total Station

i) Distance measurements

ii) Angle measurements

iii) Co-ordinate calculations

iv) Data processing

iv) Display

v) Electronic book

vi) Power supply

vii) Reflector or prism

2.6.7 Balancing of Traverse

There are two methods of balancing traverse: - **1. Bowditch's method 2. Transit method**

Here, we use Bowditch's method of balancing the traverse.

In this method, the total error in the latitude and departure is distributed in proportion to the lengths of the sides. It is mostly used to balance a traverse where linear and angular measurements are of equal precision.

This rule says:

Correction to latitude (or departure) of any side =

*(Total error in latitude (or departure) *length of that side) / Perimeter of traverse*

2.6.8 Computation and plotting

For the calculations as well as plotting, we applied the coordinate method (latitude and departure method). In this method, two terms latitude and departure are used for calculation. The latitude of a survey line may be defined as its coordinate length measured parallel to an assumed meridian direction. The latitude (L) of a line is positive when measured towards north, and termed Northing and it is negative when measured towards south, and termed Southing. The departure (D) of a line is positive when measured towards east, and termed Easting and it is negative when measured towards south, and termed Westing.

The latitude and departures of each control station can be calculated using the relation:
$Latitude = L \cos \theta$

$Departure = L \sin \theta$

Where, L=distance of the traverse legs θ =Reduced bearing

If a closed traverse is plotted according to the field measurements, the end of the traverse will not coincide exactly with the starting point. Such an error is known as closing error.

Mathematically, *closing error (e)* $= \sqrt{(\Sigma L)2 + (\Sigma D) 2}$

The *relative error of closure = e / p.*

The error (e) in a closed traverse due to bearing may be determined by comparing the two bearings of the last line as observed at the first and last stations of traverse.

Plotting of Major and Minor traverse:

The bearing of the one of the stations with another adjacent station was found out by resection method. The bearing of other traverse legs was obtained from the help of bearing of preceding line and the included angle at the station. All the bearings were entered in whole circle bearing.

Bearing of a line = (bearing of previous line +included angle) ± (180) or (540)

If Θ is the bearing of line (CP1, say), and l be the length of the line and if co-ordinate of the control point (CP1) is known, then the co-ordinate of the point 'A' can be calculated as follows:

X-coordinate of A=x-coordinate of control point (CP1) +L*sin Θ

Y-coordinate of A=y-coordinate of control point (CP2) +L*cos Θ

R.L or z-coordinate of A=R.L of point (CP1) +H. I ± V-Height of signal.

Where, H. I=Height of instrument, V=vertical distance

After computing the co-ordinate of each of the control points, they were made ready to plot. Recorded data were established in MS-Excel and the drawing was prepared after all the calculations of the coordinated of each control point were done. Full size drawing sheets i.e. A2 sizes were divided into gridlines of 5cm square. Major traverses were plotted to 1:1000 scales. The plotted traverse was made at the center of the sheet with the help of least co-ordinates and highest co- ordinates. Minor Traverse was plotted in a similar way to scale 1:500 over which later detailing by tachometry was done.

2.6.9 Contouring

A contour is defined as an imaginary line passing through the points of equal elevation. Thus, contour lines on a plan illustrate the configuration of the ground. The method of representing the relief of the ground by the help of contour is called contouring. The vertical distance between two consecutive contours is called contour interval. Every 5th contour which is 5 times of the contour interval is the index contour which is generally darkened in the contour and is known as Index Contour. The least horizontal distance between two consecutive contours is called the horizontal equivalent.

Methods of contouring: There are two ways of contouring. They are namely:

1. The Direct method

2. The Indirect method

1. The direct method:

In this direct method, equal elevated points are joined. For this, firstly the points with the same elevations are found out by setting out the instrument at a point and by hit and trial method of searching the points which gives the same required staff reading.

2. The indirect method:

In this method, some suitable guide points are selected and surveyed, the guide points need not necessarily be on the contours. There are some of the indirect methods of locating the ground points:

i. By squares ii. By cross-sections iii. By tachometric method

Contour Interpolation:

The process of drawing contours proportionately between the plotted ground points or in between the contours is called interpolation of the contours. Interpolation of contours between points is done assuming that the slope of ground between two points is uniform. It may be done by anyone of following methods:

* Estimation

* Arithmetic calculation

* Graphical method

Contouring was drawn using an indirect method of contouring. The contour lines had an interval of 0.5m.

Contour Characteristics:

- Two contour lines do not intersect each other except in the case of overhanging cliff.
- A contour line must close onto itself and not necessarily within the limits of a map.
- Contours of different elevations do not unite to form one contour except in the case of a vertical cliff.
- Two contour lines do not unite to form one except in the case of perpendicular cliff.
- Contours drawn closer depict a steep slope and if drawn apart, represent a gentle slope.
- Contours equally spaced depict a uniform slope. When contours are parallel, equidistant and straight, these represent an inclined plane surface.
- A set of ring contours with higher values inside depict a hill whereas a set of ring contours with lower values inside depict a pond or a depression without an outlet.
- When contours cross a ridge or V-shaped valley, they form sharp V-shapes across them. Contours represent a ridge line, if the concavity of higher value contour lies towards the next lower value contour and on the other hand these represent a valley if the concavity of the lower value contour lies toward the higher value contours.
- The same contour must appear on both sides of a ridge or a valley.
- Contours do not have sharp turnings.

2.7 Comments and Conclusion

The site for survey camping was the campus area of Western Regional Campus, Pokhara. The pattern was very suitable because all the facilities for engineering work were available with the good environment of doing work. Drawing was plotted on a full-size sheet i.e. A2. The given Topography survey camp work was finished within the given span of time. The topographic map of the given area was prepared in the same scale i.e. 1:1000 for major traverse and 1:500 for minor traverse. There were some obstructions while doing the work due to the errors within the instruments, obstruction due to trees. However, the final work was completed within the allocated time. It helped us practice the theoretically acquired topographical survey knowledge in the field effectively.

3. ROAD ALIGNMENT SURVEY

3.1 Introduction

A road is an identifiable route, way or path between two or more places. Roads are typically smoothed, paved, or otherwise prepared to allow easy travel; though they need not be, and historically many roads were simply recognizable routes without any formal construction or maintenance. The road needs to pass through positive obligatory points. Positive obligatory points include cities, schools, markets and negative obligatory points include temples, national parks and wildlife conservation areas. The road must not pass through such negative obligatory points.

Before the construction of the road, a preliminary survey is done. Road alignment is the preliminary stage of road construction. Selection of Intersection Points (IP) is the foundation of construction of the road. After that cross section, longitudinal section and formation level are required.

3.2 Objectives of Road Alignment Survey

The following are objectives of carrying out road alignment survey:
1. To set out curve with appropriate radius and deflection angle.
2. To prepare a plan, cross-section and L-section of the road.

3.3 Location of Area

The site for the road alignment survey is located left of Kali khola bridge to Bhalam village which is almost 30 minutes' walk from the campus area where the topographic survey was carried out. The place was accessible by a motorable bridge from Dip / Batulechaur area.

3.4 Brief description of area

Road alignment survey includes the works to run a road between two terminals. This specific job is essential for an engineer combating with the hilly topography of Nepal. The maximum allowable gradient is **12%**. There are several rises and falls along the route needing lots of cutting and filling.

3.5 Hydrology and Geology

The site is surrounded by ups and downs, which is covered with some vegetation. The road had to go along a damp route that was much undulated. There were no large boulders or rocks of any kind along the proposed site. There are several places where culvert or cause way can exist. The soil is not uniform throughout the whole length of the road. Although the road alignment has certain ups and downs. Finally, the starting and ending point of the road has some elevation difference.

3.6 Technical Specifications (Norms)

Road alignment selection was carried out of the road corridor considering permissible gradient, obligatory points, bridge site and geometry of tentative horizontal. The road setting horizontal curve, cross sectional detail in 2.5m and 5m interval was taken and longitudinal profile were prepared.

While performing the road alignment survey, the following norms were strictly followed:

- If the external deflection angle at the I.P. of the road was less than 4°, curves was not considered.
- Simple horizontal curves had to be laid out where the road changed its direction.
- Marking three points on the curve - the beginning of the curve, the middle point of the curve and the end of the curve along the center line of the road. the curve had to be chosen such that it was convenient and safe.
- The radius of the curve was not less than 15m.
- The gradient of the road was maintained below 12 %.
- The deflection angle should be not greater than 90°.
- Two successive curves must be not overlapped.
- Profile Leveling was carried out for longitudinal section along the center line at 20m interval, at abrupt change point and at all the curve point BC, MC and EC.
- L-Section of the road was plotted on a scale of 1:1000 horizontally and 1:100 vertically.
- The cross section of the road was plotted on a scale of 1:100 (both vertical and horizontal).
- The amount of cutting and filling required for the road construction was determined from the L-Section and the cross sections.

3.7 Equipments & Accessories

The following are the instruments used during the road alignment survey in the field:

- Tripod Stand
- Auto Level Machine
- Levelling Staffs
- Ranging Rods
- Measuring Tape
- Pegs
- Marker Pen
- Theodolite
- Hammer
- Field Book

3.8 Methodology

The alignment of road includes several ways and procedures that need to be carried out. The following are the listed methodology:

3.8.1 Fixing of stations

By visual inspection and self-judgment, the appropriate location for the stations to be placed was decided, which was basically done by inspecting where the road had turned. The stations were named IP0, IP1, and IP2 and so on.

3.8.2 Measurement of Lengths and Deflection Angles

The distances between the IP's were measured with the help of measuring tape by ranging between IP's. One set of horizontal angles was measured for the deflection angle. The face left reading was observed, and the deflection angles were calculated. As the traverse formed as open traverse, no angular correction could be made. So as far as possible, both the linear measurements as well as the angular measurements were observed carefully and precisely.

3.8.3 Horizontal Alignment

Horizontal alignment was done for fixing the road direction in horizontal plane. For this, the bearing of the initial line connecting two initial stations was measured using a compass. The interior angles were observed using theodolite at each IP and then deflection angles were calculated.

Deflection angle = 180^0 - *observed angle*

If the deflection angle is positive the deflection is towards the right and if the deflection angle is negative the deflection is towards the left. The radius was assumed according to the deflection angle. Then the tangent length, Beginning of the Curve (BC), End of the Curve (EC), apex distance along with their chainage were found by using the following formulae,

Tangent length (T) = $R \times \tan(\Delta/2)$

Length of curve (L.C) = $\Pi \times R \times \Delta/180$

Apex distance = $R \times (1/(\cos(\Delta/2)-1)$

Chainage of BC = Chainage of IP – T

Chainage of MC = Chainage of BC +LC/2

Chainage of EC = Chainage of MC + LC/2 = Chainage of BC + LC

The BC and EC points were located along the line by measuring the tangent length from the apex and the points were marked distinctly. The radius was chosen such that the tangent does not overlap. The apex was fixed at the length of apex distance from IP along the line bisecting the interior angle.

3.8.4 Vertical Alignment

The vertical profile of the Road alignment is known by the vertical alignment. In the L-section of the Road alignment, vertical alignment was plotted with maximum gradient of 12 %. According to Nepal Road Standard, Gradient of the Road cannot be taken more than 12 %. In the vertical alignment, we set the vertical curve with proper design. The vertical curve may be either a summit curve or valley curve. While setting the vertical alignment, it should keep in mind whether cutting and filling were balanced or not.

3.8.5 Leveling

The method of fly leveling was applied in transferring the level from the given B.M. to all the I. Ps, beginnings, mid points and ends of the curves as well as to the points along the center line of the road where the cross sections were taken. After completing the work of one-way fly leveling on the entire length of the road, check leveling was continued back to the B.M. making a closed loop for check and adjustment. The difference in the R.L. of the B.M. before and after forming the loops should be less than $25\sqrt{k}$ mm, where k is the loop distance in km.

3.8.6 L-section & Cross Section

Nature of the ground, the variation in the elevations of the different points along the length of road need to be known for the construction of the road. For this L-Section of the road is required. In order to obtain the data for L-Section, staff readings were taken at points at about 20m intervals along the centerline of the road with the help of a level by the method of fly leveling. Thus, after performing the necessary calculations, the level was transferred to all those points with respect to the R.L. of the given B.M. Then finally the L-Section of the road was plotted on a graph paper on a vertical scale of 1:100 and a horizontal scale of 1:1000. The staff readings at BC, EC and apex were also taken. The RL of each point was calculated. Cross sections at different points are drawn perpendicular to the longitudinal section of the road on either side of its centerline to present the lateral outline of the ground. Cross sections are also equally useful in determining the amount of cut and fill required for the road construction. Cross sections were taken at 20m intervals along the centerline of the road and at points where there was a sharp change in the elevation. While doing so, the horizontal distances of the different points from the centerline were measured with the help of a tape and the vertical heights with a measuring staff. The R.L. was transferred to all the points by performing the necessary calculations and finally, the cross sections at different sections were plotted on a graph paper on a scale of both vertical and 1:100 horizontal.

3.8.7 Calculation and Plotting

After the work of taking the data was completed, all the necessary calculations were done and tabulated to compute the Chainage of the different distinct points of the road using the following relation:

Length of Tangent = $R \tan(\Delta/2)$

Where, R= radius of simple circular curve

Δ = deflection angle

Apex distance = $R\left(\sec\left(\frac{\Delta}{2}\right) - 1\right)$

Mid ordinate = $R\left(1 - \cos\left(\frac{\Delta}{2}\right)\right)$

Length of curve = $\frac{\pi R \Delta}{180}$

Chainage of beginning of curve, T1=Chainage of I.P.-Tangent length

*Chainage of midpoint of curve, M=Chainage of T1-1/2*curve*

Chainage of end of curve, T2= Chainage of T1+Curve length

Similarly, Chainage of an I.P. = Chainage of previous I.P. +I.P. to distance

The R.L. of the different points was computed using the rise and fall method.

Hence, with the required calculation data regarding the road site in hand, the plan was plotted on a scale of 1:500, L-Section on a graph paper on a scale of 1:1000 horizontal and 1:100 vertical and the cross section at different points also on a graph paper on a scale of 1:100(both vertical and horizontal). All the data, calculations (in a tabulated form) and the drawing of the necessary plan, longitudinal section and the cross section of the road are presented here with this report.

3.8.8 Cut and Fill Analysis

In road construction, the terms "cut", and "fill" refer to the processes of earthwork that involve the removal of material from higher ground (cut) and placing it into lower ground (fill) to create a stable road surface. This balancing of earth ensures that the road aligns with the designed gradient and minimizes the environmental and economic impacts of construction.

Cut Process

The cut refers to the excavation of soil, rock, or other materials from areas that are at higher elevations than the proposed road level. This process is essential when the natural terrain is higher than the road's design elevation. The goal is to reduce the ground level to meet the required road profile. Excavated material from the cut is often reused in the fill areas, reducing the need for importing additional material.

Fill Process

The fill involves placing the cut material into areas that are lower than the desired road level. These depressions, valleys, or uneven surfaces are filled with excavated material to create a uniform gradient that aligns with the road's design specifications. Proper compaction of the fill material is critical to prevent future settlement and ensure the stability of the roadbed.

3.9 Structures

The main structures provided for road constructions are retaining structures, cross drain, side-drain, bio-engineering structures etc. Retaining structures are provided where the slope is critical. Gabion structure, dry masonry structures are the example. The camber of the road is made perfectly by putting 4% of stage for gravel road to avoid any collection of water on it. The maximum gradient of the road is about 11.5% and the minimum gradient of road is about 2% to facilitate the flow of drainage to specified direction. A longitudinal drain is provided on the side of the road. Retaining walls are provided in required places. Construction of hill roads involves many special structures. These may include a wide range of structures which are used to retain soil mass, to increase stability of road embankment slopes as well as natural hill slopes, to accommodate road bed in steep slope, to penetrate deep through mountain pass and so on. The following types of structures are used normally on the hill road:

i. Retaining structures

ii. Drainage structures

iii. Slope protection structures

Retaining Structures: A retaining structure is usually a wall constructed for the purpose of supporting or retaining a vertical or nearly vertical earth bank, which in turn may support vertical loads along with the self-weight of it. It provides adequate stability to the road way and to the slope. Retaining walls are constructed on the valley side on the roadway and also on the cut hillside to prevent slide towards the roadway.

Types of retaining wall are: • Gravity walls • Semi gravity walls • Cantilever walls • Crib walls • Counter fort walls • Breast walls • Buttressed walls • Reinforced wall

3.10 Comments and Conclusion

Despite various challenges, our group successfully completed both the fieldwork and office tasks on time. In the field, we spent time discussing the road route and designing curves, which yielded positive results. Throughout, we remained diligent, aiming for error-free data and calculations. This road alignment survey boosted our confidence in designing roads on difficult terrain, considering factors like economy, convenience, and usability. Such experience will greatly aid us in future design and construction projects, and we hope for more frequent, practical field trips in the future.

4. BRIDGE SITE SURVEY

4.1 Introduction

A bridge is a structure built to span a physical obstacle without blocking the way underneath. It is constructed for the purpose of providing passage over the obstacle, which is usually something that is otherwise difficult or impossible to cross. The primary aim of bridge site survey is to gather essential data to inform the design, feasibility, and construction of the bridge. The bridge site survey included determination of the length of the bridge axis by triangulation, determination of R.L. of a station by reciprocal levelling, contouring, and drawing L-section and cross-sections of the river.

4.2 Location

The site for the bridge site survey was selected in Kali Khola which was about thirty minutes' walk away from Western Regional Campus. The site consists of mild vegetation including cultivated land and scarcely available houses.

4.3 Objectives of the survey

The objectives of the bridge site survey are as follows:

- To exercise the reciprocal levelling for RL transfer in bridge axis.
- To perform triangulation method for measuring the bridge axis and detailing 200m upstream and 100m downstream.
- To prepare longitudinal and cross- sections of the river at the required upstream and downstream of the river.
- To determine the feasibility of the bridge construction.
- To acquire technical knowledge on software like AutoCAD, Excel, SWDTM, etc.

4.4 Norms (Technical specifications)

The following norms were followed while performing the bridge site survey:

- Control point fixing as well as determining the length of the bridge axis was done by the method of triangulation. While forming triangles, proper care was taken such that the triangles were well conditioned, i.e. none of the angles of triangle were greater than 120° or less than 30°.
- In triangulation, distance of Base Line was measured in an accuracy of 1:2000
- The triangulation angle was measured on two sets of readings one at face left and another at face right and the difference between the mean angles of two sets of readings had to be within a 10′′.
- Transferring the level from one bank to another bank was done by the method of reciprocal leveling.
- The contour map of the bridge site was prepared indicating contour lines at suitable interval (contour interval = 1 m).
- To plot the longitudinal section of the river; data was taken along the riverbed up to 200m upstream and 100m downstream. The plot for the longitudinal section along the flow line was done on a scale of **1:100** for vertical and **1:500** for horizontal. And for the cross section use scale of **1:100** for vertical and **1:500** for horizontal.

4.5 Equipments and accessories

The equipments used in the survey are as follows:

1. Theodolite
2. Leveling Staffs
3. Ranging rods
4. Measuring Tapes 50m
5. Leveling instruments
6. Compass
7. Marker

4.6 Methodology

The various methods performed during the bridge site survey are given below:

4.6.1 Site Selection

A poor bridge location makes it susceptible to damage and a host of other problems. Therefore, the location for a bridge is as important as the characteristics of the bridge itself. Selecting a good bridge site involves several factors like environmental and geological concerns, hydrology and hydraulics, preliminary engineering and roadway alignment. The specific requirements for the selection of the site for bridge are as follows:

- ➔ Straight reach i.e. no meandering and stable bank of the river so that there is no chance of changing the course of the river.
- ➔ Narrow width of the river. The RL of the axis is higher than the high flood level of the river.
- ➔ Sites should be accessible to the road and utilized by most pedestrians.
- ➔ Social and economic criteria should be met to enhance the people of that society/ area.
- ➔ Should have suitable space for providing bridge abutment as well as other necessary structures to have ease and efficient joining with the existing road alignment without sharp curve or bend.

The site was selected taking the above points into consideration.

4.6.2 Triangulation

Triangulation surveying is the tracing and measurement of a series or network of triangles to determine distances and relative positions of points spread over an area, by measuring the length of one side of each triangle and deducing its angles and length of other two sides by observation from this baseline.

Triangulation is preferred for hills and undulating areas, since it is easy to establish stations at reasonable distances apart, with inter-visibility. In plane and crowded areas, it is not suitable as the inter-visibility of stations is affected.

During the survey, distances between stations on the same sides of river i.e. base lines were measured with tape precisely. Then the interconnecting triangles were formed, and angles were measured with theodolite with two sets of observations. The bridge axis length or span was calculated by solving the triangles using the sine rule.

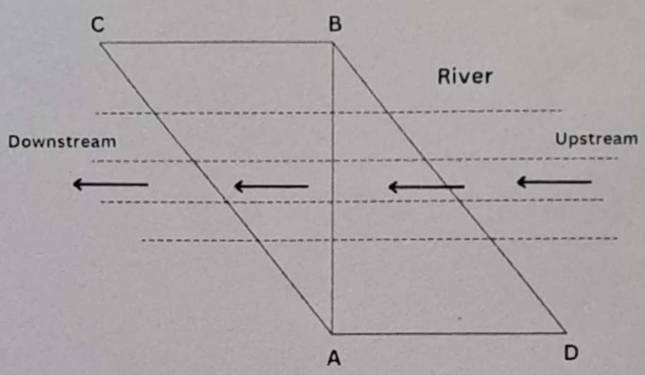


Fig- 4.1 Triangulation os bridge site survey

4.6.3 Longitudinal section of river

The longitudinal section of the river is required to give an idea about the bed slope, nature of riverbed, and variation of the elevation of the different points along the length of the river. Keeping the instrument in the control station on the riverbank, the staff readings were taken at different points along the center line of the river at an interval of 25m up to 200m upstream and 100 m downstream of the river. The elevations of the control points being known previously, the RLs of different points at the center lines was calculated using the tachometric formulas. Finally, the L- section (profile) of the riverbed was plotted on the graph paper with the scale of 1:100 along vertical and 1:500 along horizontal.

4.6.4 Cross section of river

Cross section runs at the right angle to the longitudinal section on either side. The cross section of the river at the particular point is the profile of the lateral from the central line of the river. The cross sections are used to calculate the discharge and volume of water at any section.

The Cross sections were taken at the interval of about 25m extending upto 200m upstream and 100m downstream of the river from the bridge axis. Staff readings of the points along the line perpendicular to the flow of the river were taken from the station points and the elevation of the points was calculated using tachometric formulas. Finally, the cross sections were drawn on the graph paper.

4.6.5 Levelling

Levelling is needed for transferring R.L. from B.M. to control points. R.L. was transferred to the triangular station from the B.M. by fly levelling by taking the back sight-reading to the benchmark which should be within the given accuracy. The R.L. was transferred to the opposite bank of the river by reciprocal levelling.

Reciprocal Levelling

When it is necessary to carry out leveling across a river, ravine or any obstacle requiring a long sight between two points so situated that no place for level can be found from which the lengths of foresight and back sight will be even approximately equal, special method, i.e. reciprocal leveling must be used to obtain accuracy and to eliminate the error in instrument adjustment, combined effect of earth's curvature and the refraction of the atmosphere and the variation average refraction.

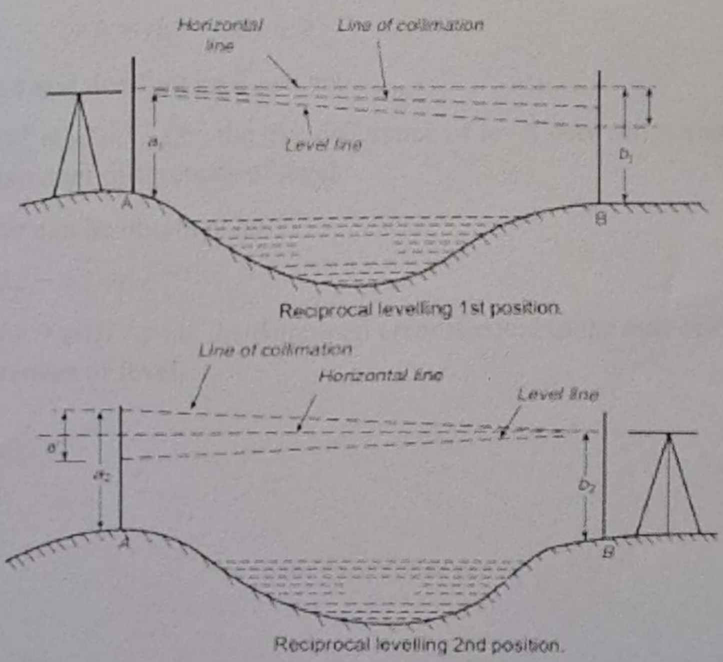


Fig- 4.2 Reciprocal Levelling

Source: A textbook of Survey and Levelling, R.Agor

Computation:

Let h = true difference of level between A and B

e = combined error due to refraction, curvature and imperfect adjustment of the line of collimation.

First Position of the level:

The correct reading on staff $B = b1 - e$

The correct reading on staff $A = a1$.

Assuming A to be higher than B, the true difference of level $h = (b1 - e) - a1$

$$or\ h = (b1 - a1) - e$$

Second position of the level:

The correct reading on staff $B = b2$

The correct reading on staff $A = a2 - e$

The true difference in level $h = b2 - (a2 - e)$

$$or\ h = (b2 - a2) + e$$

Adding above Eqns and dividing by 2, we get

$h = (b1 - a1) + (b2 - a2)) / 2$ i.e., the true difference of level between A and B is equal to the mean of the two apparent differences of level.

The combined error can be obtained by

$(b1 - a1) - e = (b2 - a2) + e$

$e = (b1 - a1) - (b2 - a2)) / 2$ i.e. the combined error is equal to the half of the difference of the apparent differences of level.

4.6.6 Tacheometry and Computation

Tacheometry is a branch of angular surveying in which the horizontal and vertical distances of points are obtained by optical means. Though it has less accuracy, it is faster and more convenient than the measurements by tape or chain. It is very suitable for steep or broken ground, deep ravines, and stretches of water or swam where taping is impossible.

The objective of the tacheometric survey is to prepare contoured maps or plans with both horizontal and vertical controls. For the survey of high accuracy, it provides a check on the distances measured by tape. The formula for the horizontal distance is,

$D = K \times S \times \cos^2\theta + C \times \cos\theta$

Where S = Staff intercept = T - B

K = Multiplying constant = 100

C = additive factor = 0 (For analytical lens).

θ = Vertical Angle

The formula for the vertical distance is,

$V = D \times \sin\theta$

Where, D = Horizontal distance

θ = Vertical Angle

Thus, knowing the V value, reduced level (R. L.) of instrument station, Height of instrument (H. I.) and central wire reading (h) the R. L. of any point under observation can be calculated as:

R. L. of point = R. L. of instrument station + H. I. ± V- h

4.6.7 Plotting

The longitudinal section and the cross section were plotted on the respective scales after the completion of calculations. By taking an A1 grid sheet, control stations were plotted accurately. Then all hard details as well as contours were plotted with reference to the control stations by the method of angle and distances.

4.7 Comments and Conclusion

The bridge axis was determined after carefully evaluating all the necessary requirements for selecting an appropriate site. During the site selection process, various factors such as geological, socio-economic, and topographical aspects were thoroughly considered, leading to the choice of the optimal location. An inspection of the area confirmed that there were no springs, streams, or sewers discharging into the river 200 meters upstream and 100 meters downstream of the chosen axis. The river flow appeared stable, with no risk of altering its course throughout the bridge's design lifespan.

5.COLUMN LAYOUT PLAN

The plan which contains column size & position is called a column layout plan. The column layout plan is very important for a Structure. Because without column layout it's impossible to locate the actual location of the structure.

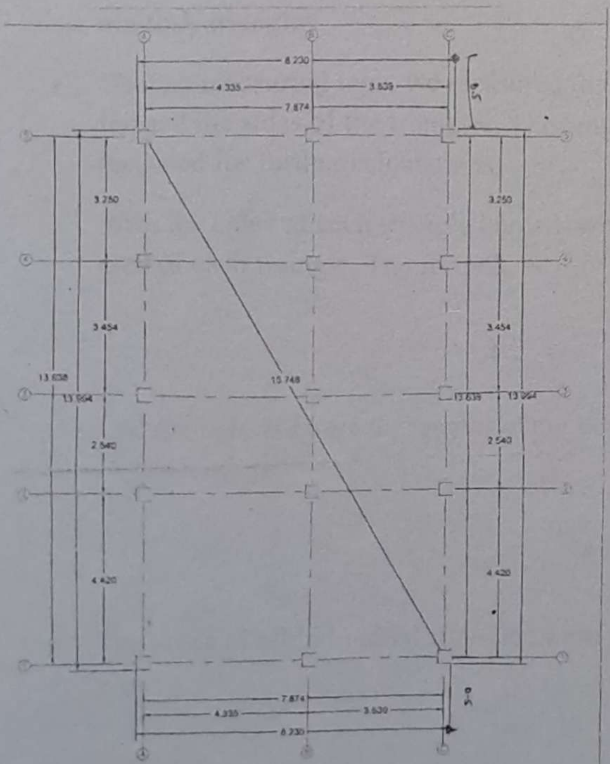
Methodology

The column layout plan was provided to us as a sample for practical implementation. To execute the plan on the ground, we used basic tools like threads, a hammer, measuring tape and nails. The process began with determining the exact locations for the columns according to the layout, ensuring that the distances and angles matched the plan specifications.

We established reference points on the ground by driving nails into the soil at the designated column locations. The thread was stretched between these points to mark the axes of the columns. Care was taken to maintain the accuracy of the grid, ensuring all lines were straight and formed right angles at intersections. A hammer was used to secure the nails firmly into the ground, providing stable anchor points for the thread.

Conclusion

This method allowed us to visualize the column positions effectively and check the alignment, dimensions, and spacing on-site. The simplicity of the tools and the clear visibility of the thread grid made it easy to verify the plan's accuracy before any further work.



COLUMN LAYOUT PLAN

Fig – 5.1 Column Layout Plan Sample

6.AREA CALCULATION USING TRIANGULATION

6.1 Introduction

Area measurement surveys, also known as land or property surveys, are conducted to determine the area or size of a piece of land. These surveys are important for various purposes including property transactions, land development, zoning compliance, and resource management.

Triangulation is a widely used technique in surveying for calculating areas, especially when dealing with irregularly shaped plots. The area is divided into multiple triangles, and the total area is obtained by summing the areas of these individual triangles.

6.2 Objective

The primary objective of this task was to calculate the total area of the assigned plot by dividing it into triangles and applying mathematical formulas to determine the areas of these triangles.

6.3 Methodology

- The boundaries of the given area were visually inspected and key corner points of the plot were identified. These points were marked on the ground, forming the vertices of multiple triangles.
- Using a measuring tape, we measured the distances between the marked points, which formed the sides of the triangles. The length of all sides of each triangle was carefully recorded for further calculations.
- With the sides of each triangle known, we applied Heron's formula to calculate the area of each triangle. The formula is:

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

where a, b, and c are the lengths of the sides of the triangle, and s is the semi-perimeter, calculated as:

$$s = \frac{a+b+c}{2}$$

- The areas of all individual triangles were summed to determine the total area of the plot.

Here, semi perimeter $(s) = (a+b+c)/2$

Area of triangle $(A) = \sqrt{s\,(s-a)*(s-b)*(s-c)}$

So, the total area of plot in m^2 = Sum of area of all triangles

= 625.187 m^2

Total Area in R-A-P-D = 1 ropani 3 aana 2 paisa 2 daam.

6.5 Result and Conclusion

Hence, the area of the given plot was found to be 625.187 m^2 or 1 ropani 3 aana 2 paisa 2 daam.

The area of the plot was calculated by dividing it into triangles and applying Heron's formula to each triangle. After summing the areas of the triangles, we obtained the total area of the given plot. This method allowed us to calculate the area with accuracy, considering the irregular shape of the land.

The triangulation method proved to be an effective approach for calculating the area of an irregular plot. The process of measuring, applying geometric formulas, and summing the areas of triangles provided an accurate result for the total area. This exercise emphasized the importance of precise measurements and mathematical techniques in surveying practices.

Institute Of Engineering (IOE)
Western Regional Campus
Lamachaur-16, Pokhara
BCE Survey Camp 2081

Observer: Group I
Recorder: Group I

Date: 2081/01/26
Weather: Sunny

1.Distance Measurement Sheet

Line	Forward	Backward	Mean M	Discrepancy D	Precision (1:2000)	Remarks
					M/D	
CP1-CP2	77.734	77.738	77.736	0.004	19434.000	
CP2-M1	87.808	87.806	87.807	0.002	43903.500	
M1-M2	87.482	87.49	87.486	0.008	10935.750	
M2-M3	92.276	92.248	92.262	0.028	3295.071	
M3-M4	78.428	78.428	78.428	0	-	
M4-M5	69.858	69.857	69.858	0.001	69857.500	
M5-M6	87.362	87.408	87.385	0.046	1899.674	
M6-M7	82.982	82.978	82.980	0.004	20745.000	
M7-M8	85	84.962	84.981	0.038	2236.342	
M8-CP1	70.7	70.736	70.718	0.036	1964.389	

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2.Horizontal Angle Measurement Table for Major Traverse

Ins Stn	Sighted to	Face	HCR			Mean			Horizontal Angle	Corrected Angle	Distance By TS	Remarks
			d	m	s	d	m	s				
CP1	M8	L	0	0	0	171	4	31	171°04′30′′	171°04′41′′	71.092	
		R	180	0	1						71.094	
	CP2	L	171	4	31	171	4	29			77.917	
		R	351	4	30						77.916	
CP2	CP1	L	0	0	0	139	56	13	139°56′13′′	139°56′25′′	77.912	
		R	179	59	54						77.914	
	M1	L	139	56	13	139	56	12			88.157	
		R	319	56	6						88.157	
M1	CP2	L	0	0	0	134	34	43	134°34′43′′	134°34′55′′	88.142	
		R	179	59	58						88.144	
	M2	L	134	34	43	134	34	43			87.648	
		R	314	34	41						87.648	
M2	M1	L	0	0	0	127	2	21	127°02′20′′	127°02′32′′	87.642	
		R	180	0	2						87.649	
	M3	L	127	2	21	127	2	19			92.465	
		R	307	2	21						92.465	

M3	M2	L	0	0	0	161	24	16	161°24′09′′	161°24′20′′	92.47	
		R	180	0	8						92.469	
	M4	L	161	24	16	161	24	2			79.619	
		R	341	24	10						79.598	
M4	M3	L	0	0	0	151	52	54	151°52′50′′	151°53′1′′	79.601	
		R	180	0	8						79.601	
	M5	L	151	52	54	151	52	46			69.857	
		R	331	52	54						69.857	
M5	M4	L	0	0	0	135	56	35	135°56′35′′	135°56′47′′	69.852	
		R	180	0	0						69.851	
	M6	L	135	56	35	135	56	35			87.608	
		R	315	56	35						87.609	
M6	M5	L	0	0	0	140	22	7	140°22′10′′	140°22′22′′	87.599	
		R	180	0	2						87.588	
	M7	L	140	22	7	140	22	12			82.776	
		R	320	22	14						82.773	
M7	M6	L	0	0	0	144	10	4	144°10′04′′	144°10′15′′	82.769	
		R	180	0	1						82.767	
	M8	L	144	10	4	144	10	4			85.235	
		R	324	10	5						85.234	
M8	M7	L	0	0	0	134	34	30	133°34′30′′	133°34′42′′	85.225	
		R	180	0	1						85.225	
	CP1	L	133	34	30	134	34	30			71.097	
		R	313	34	31						71.097	
Sum									1439°58′4′′	1440°		
Error = - 0°1′56′′												
Correction = + 0°1′56′′												

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3.Horizontal Angle Measurement Table for Minor Traverse

Inst. Station	Sighted to	Face	HCR			Mean			Horizontal Angle	Distance By TS	Remarks
			D	M	S	D	M	S			
CP 2	CP1	F L	0	0	0	70	4	15	70° 4' 15"	77.916	
		F R	180	0	1					77.914	
	m 1	F L	70	4	15	70	4	14		67.323	
		F R	250	4	15					67.329	
m1	CP2	F L	0	0	0	78	25	54	78° 25' 54"	67.327	
		F R	180	0	1					67.325	
	m2	F L	78	25	54	78	25	54		44.175	
		F R	258	25	55					44.175	
m2	m1	F L	0	0	0	247	15	20	247° 15' 21"	44.174	
		F R	180	0	3					44.174	
	m3	F L	247	15	20	247	15	21		34.202	
		F R	67	15	24					34.201	
m3	m2	F L	0	0	0	219	40	40	219° 40' 40"	34.201	
		F R	180	0	3					34.201	
	m4	F L	219	40	40	219	40	40		52.843	
		F R	39	40	43					52.845	

3. Horizontal Angle Measurement Table for Minor Traverse

Inst. Station	Sighted to	Face	HCR			Mean			Horizontal Angle	Distance By TS	Remarks
			D	M	S	D	M	S			
m4	m3	F L	0	0	0	248	27	53	248° 27' 55"	52.846	
		F R	179	59	58					52.844	
	m5	F L	248	27	53	248	27	57		70.126	
		F R	68	27	55					70.126	
m5	m6	F L	0	0	0	90	29	33	90° 29' 34"	58.86	
		F R	180	0	2					58.86	
	m4	F L	90	29	33	90	29	34		70.129	
		F R	270	29	36					70.13	
m6	m5	F L	0	0	0	159	6	9	159° 6' 9"	58.861	
		F R	179	59	56					58.86	
	m7	F L	159	6	9	159	6	9		41.892	
		F R	339	6	5					41.893	
m7	m6	F L	0	0	0	77	21	4	77° 21' 5"	41.895	
		F R	180	0	1					41.897	
	m8	F L	77	21	4	77	21	6		70.985	
		F R	257	21	7					70.979	
m8	m7	F L	0	0	0	266	40	10	266° 40' 10"	70.989	
		F R	180	0	1					70.989	
	M2	F L	266	40	10	266	40	10		33.743	
		F R	86	40	11					33.745	
M2	m8	F L	0	0	0	28	1	6	28° 1' 7"	33.741	
		F R	179	59	58					33.749	
	M3	F L	28	1	6	28	1	8		92.468	
		F R	208	1	6					92.47	

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4.Major Traverse Computation Sheet

Coordinate of Reference Station No:				X			Y		Z		Bearing: =		Leg=	
Line/Leg		Distance	Station	Bearing (WCB)			Consecutive Coordinate		Correction		Corrected		COORDINATE	
From	To			d	m	s	Lat (+ -)	Dep (+ -)	Lat (+ -)	Dep (+ -)	Lat (+ -)	Dep (+ -)	N	E
CP1	CP2	77.914	CP1	133	30	0	-53.632	56.517	0.000	0.000	-53.632	56.517	3128682.00000	792016.92000
CP2	M1	88.150	CP2	93	26	25	-5.290	87.991	-0.025	-0.019	-5.314	87.972	3128628.36754	792073.43682
M1	M2	87.646	M1	48	1	20	58.621	65.156	-0.025	-0.019	58.597	65.137	3128623.05318	792161.40888
M2	M3	92.467	M2	355	3	52	92.124	-7.955	-0.026	-0.020	92.098	-7.975	3128681.65002	792226.54631
M3	M4	79.622	M3	336	28	12	73.002	-31.787	-0.022	-0.017	72.979	-31.805	3128773.74831	792218.57088
M4	M5	69.854	M4	308	31	13	43.504	-54.653	-0.020	-0.015	43.485	-54.668	3128846.72757	792186.76621
M5	M6	87.601	M5	264	18	0	-8.701	-87.168	-0.024	-0.019	-8.725	-87.187	3128890.21252	792132.09817
M6	M7	82.771	M6	224	40	22	-58.861	-58.193	-0.023	-0.018	-58.884	-58.211	3128881.48751	792044.91134
M7	M8	85.229	M7	188	50	37	-84.216	-13.103	-0.024	-0.018	-84.240	-13.121	3128822.60313	791986.70070
M8	CP1	71.094	M8	142	25	19	-56.344	43.356	-0.020	-0.015	-56.364	43.341	3128738.36353	791973.57931
													3128682.00000	792016.92000
	Sum =	822.348				Σ=	0.2082	0.1612	-0.2082	-0.1612	0.000	0.000		

Closing error $=\sqrt{(\sum lat.)^2 + (\sum dep.)^2} = 0.263269$

Precision = 3123.601

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5.Minor Traverse Computation Sheet

Line/Leg		Distance	Station	Observed Bearing (WCB)			Corrected Bearing (WCB)			Consecutive Coordinates		COORDINATE	
From	To			d	m	s	d	m	s	Lat (+ -)	Dep (+ -)	N	E
CP1	CP2	77.915	CP1	130	30	0	133	30	0	-53.6331	56.51754	3128682	792016.920
CP2	m1	67.326	CP2	20	34	15	20	34	20	63.03262	23.65753	3128628.367	792073.438
m1	m2	44.175	m1	279	0	9	279	0	19	6.914512	-43.6305	3128691.399	792097.095
m2	m3	34.201	m2	346	15	30	346	15	45	33.22264	-8.12185	3128698.314	792053.465
m3	m4	52.845	m3	25	56	10	25	56	30	47.52033	23.11735	3128731.537	792045.343
m4	m5	70.128	m4	94	24	5	94	24	30	-5.39032	69.92053	3128779.057	792068.460
m5	m6	58.86	m5	183	54	31	183	55	1	-58.7225	-4.02075	3128773.667	792138.381
m6	m7	41.894	m6	163	0	40	163	1	15	-40.0679	12.23405	3128714.944	792134.360
m7	m8	70.986	m7	60	21	45	60	22	25	35.09138	61.70581	3128674.876	792146.594
m8	M2	33.745	m8	147	1	55	147	2	40	-28.3152	18.35689	3128709.968	792208.300
M2	M3	92.469	M2	355	3	2	355	3	52			3128681.652	792226.657

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6.Two Peg Test

The staffs are held at the ends A and B of the distance 30 m.
Instrument Used = Level Machine

When instrument at mid of AB, Stadia reading at

	T	M	B
A	1.489	1.415	1.341
B	1.513	1.438	1.363

Level difference (H) = 0.023

When instrument is near B, Stadia reading at

	T	M	B
A	1.399	1.385	1.371
B	1.575	1.41	1.245

Level difference (H) = 0.025

Distance between AB, D = 30 m
Error, e = 0.002
Observed value range, e/D = 1/ 15000

Here, precision is 1 in 15000, which lies in permissible value of 1 in 10000

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7. RL Transfer TBM1 – TBM2

SN	BS			Mean	S1	FS			Mean	S2	Distance		Rise	Fall	Elevation	Correction (-)	Corrected Elevation	Remarks
	T	M	B			T	M	B			BS	FS						
1	1.337	1.305	1.27	1.305	0.064						6.4				800		800	TBM 1
2	1.733	1.686	1.639	1.686	0.094	1.418	1.382	1.346	1.592	0.072	9.4	7.2	0	0.077	799.923	0.0002	799.9228	
3	1.652	1.610	1.568	1.610	0.084	1.379	1.334	1.289	1.526	0.090	8.4	9.0	0.352	0	800.275	0.0005	800.2745	
4	1.522	1.482	1.442	1.482	0.080	1.295	1.249	1.203	1.249	0.092	8.0	9.2	0.361	0	800.636	0.0008	800.6352	
5	1.918	1.882	1.846	1.882	0.072	1.268	1.229	1.190	1.810	0.078	7.2	7.8	0.253	0	800.889	0.0010	800.8880	
6	1.945	1.907	1.869	1.907	0.076	0.899	0.864	0.829	1.831	0.070	7.6	7.0	1.018	0	801.907	0.0012	801.9058	
7	1.901	1.865	1.829	1.865	0.072	0.874	0.837	0.800	1.793	0.074	7.2	7.4	1.07	0	802.977	0.0014	802.9756	
8	1.856	1.813	1.770	1.813	0.086	1.048	1.012	0.976	1.727	0.072	8.6	7.2	0.853	0	803.83	0.0017	803.8283	
9	1.628	1.579	1.530	1.579	0.098	1.228	1.185	1.142	1.481	0.086	9.8	8.6	0.628	0	804.458	0.0019	804.4561	
10	1.385	1.333	1.281	1.333	0.104	1.488	1.439	1.390	1.229	0.098	10.4	9.8	0.140	0	804.598	0.0022	804.5958	
11	1.370	1.318	1.266	1.318	0.104	1.593	1.546	1.499	1.214	0.094	10.4	9.4	0	0.213	804.385	0.0025	804.3825	
12	1.421	1.362	1.303	1.362	0.118	1.529	1.476	1.423	1.244	0.106	11.8	10.6	0	0.158	804.227	0.0028	804.2242	
13	1.406	1.360	1.314	1.360	0.092	1.442	1.388	1.334	1.268	0.108	9.2	10.8	0	0.026	804.201	0.0032	804.1978	
14	1.596	1.538	1.480	1.538	0.116	1.450	1.403	1.356	1.422	0.094	11.6	9.4	0	0.043	804.158	0.0035	804.1545	
15	1.735	1.686	1.637	1.686	0.098	1.328	1.271	1.214	1.588	0.114	9.8	11.4	0.267	0	804.425	0.0038	804.4212	
16	1.669	1.614	1.559	1.614	0.110	1.332	1.284	1.236	1.504	0.096	11.0	9.6	0.402	0	804.827	0.0041	804.8229	
17	1.612	1.558	1.504	1.558	0.108	1.431	1.380	1.329	1.450	0.102	10.8	10.2	0.234	0	805.061	0.0044	805.0566	

18	1.673	1.617	1.561	1.617	0.112	1.365	1.310	1.255	1.505	0.110	11.2	11.0	0.248	0	805.309	0.0047	805.3043	
19	1.718	1.657	1.596	1.657	0.122	1.330	1.273	1.216	1.535	0.114	12.2	11.4	0.344	0	805.653	0.0051	805.6479	
20	1.729	1.684	1.639	1.684	0.090	1.315	1.255	1.195	1.594	0.120	9.0	12.0	0.402	0	806.055	0.0055	806.0495	
21	1.169	1.122	1.075	1.122	0.094	1.111	1.064	1.017	1.028	0.094	9.4	9.4	0.620	0	806.675	0.0057	806.6693	**TBM 2**
22	1.337	1.289	1.241	1.289	0.096	1.751	1.701	1.651	1.193	0.100	9.6	10.0	0	0.579	806.096	0.0060	806.0900	
23	1.972	1.921	1.870	1.921	0.102	1.284	1.231	1.178	1.819	0.106	10.2	10.6	0.058		806.154	0.0063	806.1477	
24	1.698	1.648	1.588	1.643	0.110	0.973	0.919	0.865	1.535	0.108	11.0	10.8	1.002	0	807.156	0.0067	807.1493	
25	1.739	1.685	1.631	1.685	0.108	1.320	1.265	1.210	1.577	0.110	10.8	11.0	0.383	0	807.539	0.0070	807.5320	
26	1.305	1.255	1.205	1.255	0.100	1.263	1.211	1.159	1.155	0.104	10.0	10.4	0.474	0	808.013	0.0073	808.0057	
27	1.151	1.093	1.035	1.093	0.116	1.530	1.483	1.436	0.977	0.094	11.6	9.4	0	0.228	807.785	0.0076	807.7774	
28	1.046	1.022	0.998	1.022	0.048	1.665	1.605	1.545	0.974	0.120	4.8	12.0	0	0.512	807.273	0.0080	807.2650	
29	0.889	0.862	0.835	0.862	0.054	1.799	1.777	1.755	0.808	0.044	5.4	4.4	0	0.755	806.518	0.0081	806.5099	
30	1.006	0.972	0.938	0.972	0.068	1.877	1.855	1.833	0.904	0.044	6.8	4.4	0	0.993	805.525	0.0083	805.5167	
31	1.508	1.454	1.400	1.454	0.108	1.610	1.578	1.546	1.346	0.064	10.8	6.4	0	0.606	804.919	0.0085	804.9105	
32	1.739	1.687	1.635	1.687	0.104	1.378	1.325	1.272	1.583	0.106	10.4	10.6	0.129	0	805.048	0.0088	805.0392	
33	0.975	0.943	0.911	0.943	0.064	1.349	1.300	1.251	0.879	0.098	6.4	9.8	0.387	0	805.435	0.0091	805.4259	
34	0.759	0.731	0.703	0.731	0.056	1.672	1.641	1.610	0.675	0.062	5.6	6.2	0	0.698	804.737	0.0093	804.7277	
35	0.916	0.866	0.816	0.866	0.100	1.954	1.930	1.906	0.766	0.048	10.0	4.8	0	1.199	803.538	0.0094	803.5286	
36	0.815	0.779	0.743	0.779	0.072	1.975	1.929	1.883	0.707	0.092	7.2	9.2	0	1.063	802.475	0.0097	802.4653	
37	0.961	0.917	0.873	0.917	0.088	1.779	1.741	1.703	0.829	0.076	8.8	7.6	0	0.962	801.513	0.0099	801.5031	
38	1.358	1.306	1.254	1.306	0.104	1.880	1.832	1.784	1.202	0.096	10.4	9.6	0	0.915	800.598	0.0102	800.5878	
39	1.295	1.274	1.199	1.247	0.096	1.649	1.601	1.553	1.160	0.096	9.6	9.6	0	0.295	800.303	0.0105	800.2925	
40	1.164	1.134	1.104	1.134	0.060	1.684	1.636	1.588	1.074	0.096	6.0	9.6	0	0.362	799.941	0.0108	799.9302	
41						1.233	1.204	1.175	1.204	0.058		5.8	0.07		800.011	0.0110	800.0000	**OK**

Check=∑rise-∑Fall =First RL-Last RL=11mm (OK)

Error = 11mm

Total Distance (K) =725.4m

Permissible error = 21.2mm

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8.RL Transfer TBM 2-TBM 3

SN	BS			FS			Distance		Rise	Fall	Elevation (RL)	Remarks
	T	M	B	T	M	B	BS	FS				
1	1.333	1.285	1.237								806.675	TBM 2
2	1.745	1.693	1.641	1.217	1.170	1.123	9.600	9.400	0.115		806.790	
3	1.711	1.661	1.611	1.248	1.195	1.142	10.400	10.600	0.498		807.288	
4	1.693	1.649	1.605	1.278	1.227	1.176	10.000	10.200	0.434		807.722	
5	1.689	1.639	1.589	1.290	1.249	1.208	8.800	8.200	0.400		808.122	
6	1.665	1.613	1.561	1.329	1.281	1.233	10.000	9.600	0.358		808.480	
7	1.601	1.555	1.509	1.309	1.259	1.209	10.400	10.000	0.354		808.834	
8	1.592	1.540	1.488	1.221	1.174	1.127	9.200	9.400	0.381		809.215	
9	1.572	1.518	1.464	1.226	1.215	1.204	10.400	2.200	0.325		809.540	
10	1.652	1.594	1.536	1.225	1.172	1.119	10.800	10.600	0.346		809.886	

11	1.603	1.553	1.503	1.493	1.437	1.381	11.600	11.200	0.157		810.043	
12	1.991	1.932	1.873	1.116	1.065	1.014	10.000	10.200	0.488		810.531	
13	1.404	1.364	1.324	1.319	1.261	1.203	11.800	11.600	0.671		811.202	
14	1.407	1.363	1.319	1.402	1.358	1.314	8.000	8.800	0.006		811.208	**TBM3**
15	1.115	1.050	0.985	1.529	1.487	1.445	8.800	8.400		0.124	811.084	
16	1.282	1.230	1.178	1.940	1.877	1.814	13.000	12.600		0.827	810.257	
17	1.320	1.253	1.186	1.455	1.405	1.355	10.400	10.000		0.175	810.082	
18	1.229	1.159	1.089	1.748	1.679	1.610	13.400	13.800		0.426	809.656	
19	1.288	1.219	1.150	1.693	1.625	1.557	14.000	13.600		0.466	809.190	
20	1.260	1.188	1.116	1.764	1.692	1.620	13.800	14.400		0.473	808.717	
21	1.285	1.215	1.145	1.812	1.741	1.670	14.400	14.200		0.553	808.164	
22	1.278	1.229	1.180	1.895	1.827	1.759	14.000	13.600		0.612	807.552	
23	1.269	1.231	1.193	1.738	1.687	1.636	9.800	10.200		0.458	807.094	
24	1.365	1.325	1.285	1.657	1.620	1.583	7.600	7.400		0.389	806.705	
25				1.395	1.355	1.315	8.000	8.000		0.030	806.675	**TBM 2**
						Total Distance = 504.6			$\sum$=4.533	$\sum$=4.533	**OK**	

Check: ∑Raise - ∑Fall = Last RL - First RL =0.000

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Weather: Sunny

9.Fly Levelling (RL Transfer to Major Traverse Pegs)

Station	BS			FS			Rise	Fall	RL	Distance		Remarks
	T	M	B	T	M	B				BS	FS	
TBM	1.416	1.367	1.318						806.65	9.8		TBM
	1.632	1.597	1.562	1.324	1.275	1.226	0.092		806.742	7	9.8	
M3	1.729	1.673	1.617	1.364	1.338	1.312	0.259		807.001	11.2	5.2	M3
	1.799	1.733	1.667	1.198	1.141	1.084	0.532		807.533	13.2	11.4	
	1.663	1.597	1.531	1.013	0.946	0.879	0.787		808.32	13.2	13.4	
	1.501	1.482	1.463	1.323	1.257	1.191	0.34		808.66	3.8	13.2	
M4	1.67	1.605	1.54	1.424	1.403	1.382	0.079		808.739	13	4.2	M4
	1.668	1.603	1.538	1.201	1.137	1.073	0.468		809.207	13	12.8	
	1.512	1.467	1.422	1.272	1.208	1.144	0.395		809.602	9	12.8	
M5	1.527	1.452	1.377	1.072	1.022	0.972	0.445		810.047	15	10	M5
	1.76	1.692	1.624	1.13	1.056	0.982	0.396		810.443	13.6	14.8	
	1.654	1.59	1.526	1.27	1.206	1.142	0.486		810.929	12.8	12.8	
	1.367	1.331	1.295	1.214	1.152	1.09	0.438		811.367	7.2	12.4	
M6	1.608	1.54	1.472	1.383	1.342	1.301		0.011	811.356	13.6	8.2	M6
	1.733	1.669	1.605	1.263	1.196	1.129	0.344		811.7	12.8	13.4	
	1.588	1.513	1.438	1.419	1.356	1.293	0.313		812.013	15	12.6	

Fly Levelling (RL Transfer to Major Traverse Pegs)

Station	BS			FS			Rise	Fall	RL	Distance		Remarks
	T	M	B	T	M	B				BS	FS	
M7	1.369	1.314	1.259	1.363	1.286	1.209	0.227		812.24	11	15.4	M7
	1.031	0.987	0.943	1.445	1.393	1.341		0.079	812.161	8.8	10.4	
	1.424	1.358	1.292	1.502	1.46	1.418		0.473	811.688	13.2	8.4	
	1.19	1.137	1.084	1.498	1.431	1.364		0.073	811.615	10.6	13.4	
M8	0.994	0.952	0.91	1.62	1.57	1.52		0.433	811.182	8.4	10	M8
	0.745	0.71	0.675	1.795	1.752	1.709		0.8	810.382	7	8.6	
	0.724	0.705	0.686	1.893	1.857	1.821		1.147	809.235	3.8	7.2	
	1.39	1.318	1.246	1.963	1.942	1.921		1.237	807.998	14.4	4.2	
	0.948	0.911	0.874	1.604	1.528	1.452		0.21	807.788	7.4	15.2	
CP1	0.844	0.781	0.718	1.434	1.398	1.362		0.487	807.301	12.6	7.2	CP1
	1.009	0.945	0.881	1.495	1.432	1.369		0.651	806.65	12.8	12.6	
	1.065	1.001	0.937	1.765	1.701	1.637		0.756	805.894	12.8	12.8	
CP2	1.115	1.05	0.985	1.604	1.535	1.466		0.534	805.36	13	13.8	CP2
	0.885	0.834	0.783	1.596	1.53	1.464		0.48	804.88	10.2	13.2	
	1.478	1.41	1.342	1.538	1.486	1.434		0.652	804.228	13.6	10.4	
	1.455	1.415	1.375	1.546	1.482	1.418		0.072	804.156	8	12.8	
M1	1.187	1.148	1.109	1.972	1.46	1.866		0.045	804.201	7.8	10.6	M1
	1.791	1.725	1.659	1.345	1.31	1.275		0.162	804.039	13.2	7	
	1.635	1.57	1.505	1.24	1.176	1.112	0.549		804.588	13	12.8	
	1.497	1.452	1.387	1.34	1.276	1.212	0.294		804.882	11	12.8	

Fly Levelling (RL Transfer to Major Traverse Pegs)

Station	BS			FS			Rise	Fall	RL	Distance		Remarks
	T	M	B	T	M	B				BS	FS	
M2	1.404	1.337	1.27	1.09	1.04	0.99	0.412		805.294	13.4	10	M2
	1.724	1.66	1.596	0.885	0.834	0.783	0.503		805.797	12.8	10.2	
	1.899	1.831	1.763	1.244	1.177	1.11	0.483		806.28	13.6	13.4	
TBM				1.518	1.451	1.384	0.38		806.66	0	13.4	TBM

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10.Fly Levelling (RL Transfer to Minor Traverse Pegs)

Station	BS			FS			Rise	Fall	RL	Distance		Remarks
	T	M	B	T	M	B				BS	FS	
CP2	1.49	1.432	1.374						805.353	11.6		CP2
	1.48	1.433	1.386	1.445	1.386	1.327	0.046	0	805.399	9.4	11.8	
	1.701	1.67	1.639	0.679	0.637	0.595	0.796	0	806.195	6.2	8.4	
	1.763	1.722	1.681	0.664	0.635	0.606	1.035	0	807.230	8.2	5.8	
	1.546	1.519	1.492	1.095	1.053	1.011	0.669	0	807.899	5.4	8.4	
	1.86	1.792	1.724	1.214	1.187	1.16	0.332	0	808.231	13.6	5.4	m1
	1.485	1.442	1.399	0.789	0.721	0.653	1.071	0	809.302	8.6	13.6	
	1.375	1.326	1.277	1.376	1.334	1.292	0.108	0	809.410	9.8	8.4	m2
	1.764	1.727	1.69	0.88	0.836	0.792	0.49	0	809.900	7.4	8.8	
	1.713	1.639	1.565	1.328	1.286	1.244	0.441	0	810.341	14.8	8.4	m3
	1.235	1.173	1.111	1.69	1.62	1.55	0.019	0	810.360	12.4	14	
	1.345	1.276	1.207	1.48	1.42	1.36	0	-0.247	810.113	13.8	12	m4
	1.347	1.278	1.209	1.628	1.557	1.486	0	-0.281	809.832	13.8	14.2	
	1.396	1.358	1.32	1.805	1.735	1.665	0	-0.457	809.375	7.6	14	
	1.3	1.227	1.154	1.668	1.629	1.59	0	-0.271	809.104	14.6	7.8	m5

Fly Levelling (RL Transfer to Minor Traverse Pegs)

Station	BS			FS			Rise	Fall	RL	Distance		Remarks
	T	M	B	T	M	B				BS	FS	
	1.189	1.115	1.041	1.313	1.235	1.157	0	-0.008	809.096	13.8	15.6	
	1.341	1.281	1.221	1.296	1.227	1.158	0	-0.112	808.984	12	14.8	m6
	0.649	0.602	0.555	1.799	1.74	1.681	0	-0.459	808.525	9.4	11.8	
	1.733	1.667	1.601	1.523	1.48	1.437	0	-0.878	807.647	13.2	8.6	m7
	1.342	1.277	1.212	1.884	1.815	1.746	0	-0.148	807.499	13	13.8	
	1.088	1.042	0.996	1.794	1.729	1.664	0	-0.452	807.047	9.2	13	
	0.902	0.834	0.766	1.898	1.851	1.804	0	-0.809	806.238	13.6	9.4	m8
	1.154	1.121	1.088	1.769	1.698	1.627	0	-0.864	805.374	6.6	14.2	
				1.245	1.214	1.183	0	-0.093	805.374	0	6.2	M2

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11.Reduced Level Correction Sheet for Major Traverse

SN	Station	Distance	Observed RL	Correction	Corrected RL	Remarks
1	TBM		806.65			
2	M3	31.8	807.001	0.000	807.001	
3	M4	79.604	808.739	-0.001	808.738	
4	M5	69.854	810.047	-0.002	810.045	
5	M6	87.601	811.356	-0.003	811.353	
6	M7	82.771	812.24	-0.004	812.236	
7	M8	85.229	811.182	-0.005	811.177	
8	CP1	71.095	807.301	-0.006	807.295	
9	CP2	77.914	805.36	-0.007	805.353	
10	M1	88.15	804.201	-0.008	804.193	
11	M2	87.646	805.294	-0.009	805.285	
12	TBM	80	806.66	-0.010	806.650	
	Total	841.664	error = + 0.01			

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12.Reduced Level Correction Sheet for Minor Traverse

SN	Station	Distance	Observed RL	Correction	Corrected RL	Remarks
1	CP2		805.353		805.353	
2	m1	80.6	808.231	0.001	808.232	
3	m2	44.175	809.410	0.001	809.411	
4	m3	34.201	810.341	0.001	810.342	
5	m4	52.845	810.113	0.002	810.115	
6	m5	70.128	809.104	0.002	809.106	
7	m6	58.86	808.984	0.003	808.987	
8	m7	41.894	807.647	0.003	807.650	
9	m8	70.986	806.238	0.004	806.242	
10	M2	33.745	805.281	0.004	805.285	
		487.434	error = -0.004			

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13.Detailing Sheet by Total Station

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
1	792016.912	3128682.008	807.293	CP 1
2	791973.603	3128738.332	811.184	M 8
3	792010.816	3128690.096	807.339	FT 1
4	792011.239	3128691.103	807.328	FT 1
5	792023.402	3128682.35	807.168	FT 1
6	792024.501	3128682.611	807.187	FT 1
7	792019.776	3128676.687	806.958	FT 1
8	792020.999	3128676.537	806.96	FT 1
9	792038.604	3128657.134	806.394	FT 1
10	792039.205	3128658.131	806.351	FT 1
11	792010.089	3128694.516	807.282	FT 2
12	792009.782	3128696.196	807.312	FT 2
13	792011.466	3128694.998	807.276	FT 2
14	792010.964	3128696.337	807.233	FT 2
15	792033.337	3128694.72	807.294	FT 2
16	792033.626	3128694.674	807.436	FT 2
17	792033.754	3128695.818	807.443	FT 2
18	792033.897	3128695.328	807.597	FT 2
19	792039.298	3128694.918	808.257	FT 2
20	792040.419	3128694.65	808.41	FT 2
21	792045.229	3128694.169	808.503	FT 2
22	792045.12	3128695.837	808.504	FT 2
23	792045.516	3128694.501	808.674	FT 2
24	792045.511	3128695.857	808.658	FT 2
25	792046.947	3128694.699	809.449	FT 2
26	792051.13	3128690.714	806.726	CIVILD
27	792051.097	3128689.174	806.755	CIVILD
28	792051.202	3128688.886	806.563	CIVILD
29	792047.354	3128688.683	806.584	CIVILD
30	792047.408	3128685.25	806.573	CIVILD

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
31	792038.466	3128684.881	806.543	CIVILD
32	792051.216	3128688.572	806.573	CIVILD
33	792047.667	3128688.417	806.527	CIVILD
34	792047.731	3128684.967	806.574	CIVILD
35	792038.727	3128684.594	806.534	CIVILD
36	792039.633	3128664.912	806.515	CIVILD
37	792021.579	3128688.626	807.255	TREE
38	792030.983	3128685.804	806.834	TREE
39	792029.962	3128679.614	806.729	TREE
40	792027.89	3128676.003	807.007	TREE
41	792036.143	3128697.23	808.392	TREE
42	792030.449	3128691.421	807.203	TREE
43	792042.842	3128709.623	809.428	GT
44	792043.224	3128702.278	809.38	GT
45	792012.604	3128684.915	807.39	GOP
46	792010.409	3128682.825	807.265	GOP
47	792014.218	3128679.007	807.443	GOP
48	792016.26	3128681.039	807.286	GOP
49	792023.595	3128675.393	807.088	CONT
50	792019.715	3128672.711	807.296	CONT
51	792031.523	3128682.651	806.63	CONT
52	792030.59	3128677.605	806.758	CONT
53	792034.805	3128672.999	806.592	CONT
54	792015.843	3128689.606	807.278	CONT
55	792018.452	3128692.7	807.135	CONT
56	792021.664	3128693.66	807.316	CONT
57	792029.493	3128693.59	807.018	CONT
58	792028.276	3128689.976	807.127	CONT
59	792029.1	3128689.429	806.963	CONT
60	792033.189	3128687.484	806.672	CONT
61	792040.244	3128689.487	806.602	CONT
62	792040.236	3128692.16	807.321	CONT
63	792040.519	3128694.313	808.049	CONT
64	792040.39	3128696.648	808.91	CONT
65	792042.049	3128697.987	809.581	CONT
66	792046.756	3128696.816	809.279	CONT
67	792041.696	3128700.749	809.759	CONT
68	792034.613	3128700.587	808.253	CONT
69	792031.905	3128698.666	807.717	CONT
70	792026.421	3128699.438	807.229	CONT
71	792028.343	3128702.611	807.934	CONT
72	792029.92	3128705.103	809.228	CONT

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
73	792025.06	3128711.963	809.234	. CONT
74	792025.419	3128714.778	809.912	CONT
75	792019.371	3128717.877	809.898	CONT
76	792019.916	3128708.842	808.885	CONT
77	792013.037	3128709.883	808.102	CONT
78	792073.392	3128628.359	805.341	CP2
79	792064.551	3128617.975	804.787	FT3
80	792065.53	3128617.353	804.794	FT3
81	792069.179	3128627.783	805.345	FT3
82	792070.04	3128627.306	805.338	FT3
83	792067.7	3128657.871	805.665	FT3
84	792068.84	3128657.996	805.603	FT3
85	792077.759	3128658.194	805.399	FT3
86	792076.453	3128659.339	805.347	FT3
87	792077.292	3128665	805.424	FT3
88	792077.245	3128666.225	805.425	FT3
89	792075.282	3128673.768	805.8	FT3
90	792076.582	3128673.789	805.74	FT3
91	792075.134	3128678.64	807.43	FT3
92	792076.327	3128678.836	807.482	FT3
93	792050.786	3128665.493	806.543	CIVILD
94	792050.732	3128667.435	806.515	CIVILD
96	792057.105	3128665.671	806.518	CIVILD
97	792090.455	3128671.937	807.091	BT
98	792090.188	3128668.178	806.355	BT
99	792096.225	3128667.361	806.193	BT
100	792126.377	3128647.836	804.892	AH
101	792128.036	3128647.576	804.779	AH
102	792129.483	3128646.183	804.848	AH
103	792131.222	3128646.179	804.534	AH
104	792131.344	3128635.333	804.264	AH
105	792100.152	3128633.969	804.851	TT
106	792098.835	3128633.756	804.879	TT
107	792099.328	3128631.23	804.775	TT
108	792100.708	3128631.543	804.826	TT
109	792063.687	3128616.496	804.591	DR
110	792064.647	3128615.897	804.644	DR
111	792058.553	3128621.289	804.511	DR
112	792060.258	3128622.786	804.557	DR
113	792051.593	3128629.701	804.044	DR
114	792054.668	3128629.587	804.117	DR
115	792068.889	3128613.443	804.755	DR

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
116	792069.761	3128616.133	805.096	DR
117	792080.373	3128612.85	804.899	DR
118	792079.749	3128614.981	805.093	DR
119	792098.451	3128621.59	804.619	DR
120	792097.674	3128623.712	804.722	DR
121	792117.068	3128629.61	804.356	DR
122	792115.499	3128631.387	804.556	DR
123	792122.113	3128630.531	804.442	DR
124	792121.841	3128631.642	804.318	DR
125	792131.781	3128631.111	804.436	DR
126	792131.79	3128632.39	804.519	DR
127	792140.646	3128630.843	804.425	DR
128	792140.217	3128632.119	804.307	DR
129	792063.071	3128615.526	804.625	RFT
130	792060.46	3128611.358	804.72	RFT
131	792059.968	3128610.568	804.604	RFT
132	792054.766	3128624.144	804.049	RD
133	792051.543	3128620.633	804.007	RD
134	792063.665	3128614.989	804.435	RD
135	792061.763	3128610.577	804.479	RD
136	792072.408	3128611.47	804.534	RD
137	792072.286	3128606.693	804.634	RD
138	792081.822	3128612.139	804.532	RD
139	792084.088	3128607.945	804.552	RD
140	792090.799	3128616.008	804.434	RD
141	792094.129	3128612.602	804.432	RD
142	792099.91	3128621.002	804.326	RD
143	792102.97	3128617.31	804.319	RD
144	792107.664	3128624.584	804.251	RD
145	792110.74	3128620.926	804.247	RD
146	792117.093	3128628.42	804.218	RD
147	792119.085	3128624.252	804.211	RD
148	792128.412	3128629.844	804.179	RD
149	792129.067	3128625.212	804.164	RD
150	792136.438	3128629.843	804.161	RD
151	792135.435	3128625.27	804.181	RD
152	792066.529	3128613.289	804.783	RFT
153	792064.359	3128608.796	804.785	RFT
154	792064.02	3128608.168	804.743	RFT
155	792077.321	3128611.285	804.905	RFT
156	792077.563	3128606.387	804.829	RFT
157	792077.478	3128605.237	804.849	RFT

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
158	792095.753	3128618.896	804.63	RFT
159	792098.985	3128615.262	804.628	RFT
160	792099.497	3128614.257	804.685	RFT
161	792112.973	3128626.969	804.49	RFT
162	792115.629	3128622.885	804.486	RFT
163	792123.563	3128629.648	804.482	RFT
164	792125.081	3128625.011	804.464	RFT
165	792125.219	3128623.965	804.438	RFT
166	792082.476	3128639.998	805.389	TREE
167	792077.7	3128644.411	805.537	TREE
168	792070.981	3128644.668	805.453	TREE
169	792064.546	3128652.305	806.056	TREE
170	792061.579	3128655.659	805.988	TREE
171	792091.772	3128661.694	805.349	TREE
172	792104.186	3128658.365	805.112	TREE
173	792117.058	3128653.682	805.502	TREE
174	792072.83	3128636.487	805.402	EP
175	792075.867	3128625.65	805.036	CONT
176	792084.459	3128625.437	805.162	CONT
177	792080.523	3128636.491	805.296	CONT
178	792063.822	3128650.892	805.99	CONT
179	792088.269	3128650.529	805.25	CONT
180	792068.054	3128660.619	806.346	CONT
181	792086.656	3128658.294	805.387	CONT
182	792073.116	3128678.839	807.521	CONT
183	792081.72	3128670.418	807.218	CONT
184	792091.317	3128662.568	805.598	CONT
185	792091.924	3128663.463	805.843	CONT
186	792105.341	3128662.686	805.95	CONT
187	792107.16	3128664.074	807.041	CONT
188	792097.06	3128691.418	808.23	MN1
189	792068.26	3128666.35	806.528	CIVILD
190	792058.612	3128685.832	806.538	CIVILD
191	792058.165	3128688.914	806.566	CIVILD
192	792054.647	3128688.748	806.545	CIVILD
193	792096.519	3128671.39	806.853	BT
194	792125.918	3128667.139	807.259	AH
195	792139.624	3128667.301	807.476	AH
196	792076.004	3128683.3	808.146	FT4
197	792074.811	3128683.269	808.053	FT4
198	792075.772	3128695.459	809.145	FT4
199	792074.021	3128695.685	809.217	FT4

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
200	792076.717	3128695.811	809.125	FT4
201	792090.585	3128671.979	807.093	FT4
202	792089.3	3128671.682	807.028	FT4
203	792077.343	3128701.786	809.213	FT4
204	792070.244	3128701.494	809.319	FT4
205	792070.128	3128696.894	809.284	FT4
206	792084.726	3128711.694	809.165	GEO
207	792085.139	3128702.484	809.243	GEO
208	792077.105	3128702.199	809.291	GEO
209	792118.122	3128699.841	809.116	MECHA
210	792122.264	3128700.034	809.121	MECHA
211	792122.634	3128692.923	809.105	MECHA
212	792125.92	3128693.117	809.075	MECHA
213	792125.847	3128694.163	809.114	MECHA
214	792134.324	3128694.614	809.096	MECHA
215	792117.71	3128687.549	808.11	EP
216	792105.37	3128699.776	809.52	TREE
217	792085.594	3128698.456	809.658	TREE
218	792080.702	3128692.584	808.692	TREE
219	792084.231	3128683.706	807.83	CONT
220	792083.684	3128688.872	808.179	CONT
221	792086.625	3128692.419	808.434	CONT
222	792081.2	3128694.96	808.972	CONT
223	792081.325	3128697.18	809.499	CONT
224	792085.409	3128697.639	809.676	CONT
225	792094.298	3128696.148	809.072	CONT
226	792098.292	3128699.835	809.477	CONT
227	792108.941	3128699.456	809.534	CONT
228	792053.489	3128698.323	809.432	MN2
229	792053.488	3128698.309	809.417	MN2
230	792070.3	3128702.003	809.328	GEO
231	792070.108	3128704.461	809.244	GEO
232	792061.179	3128704.07	809.232	GEO
233	792061.139	3128704.634	809.257	GEO
234	792052.817	3128704.229	809.274	GEO
235	792054.26	3128694.939	809.397	FT4
236	792054.269	3128693.49	809.408	FT4
237	792051.055	3128693.368	809.438	FT4
238	792050.962	3128694.929	809.399	FT4
239	792050.944	3128696.377	809.412	FT4
240	792052.195	3128696.36	809.385	FT4
241	792051.181	3128717.812	809.468	FT4

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
242	792050.073	3128717.679	809.41	FT4
243	792048.013	3128702.523	809.362	GT
244	792047.926	3128703.568	809.383	GT
245	792050.368	3128703.631	809.34	GT
246	792050.082	3128711.008	809.413	GT
247	792051.534	3128691.186	810.168	CIVILD
248	792053.967	3128691.313	810.166	CIVILD
249	792045.367	3128731.532	810.285	CIVILD
250	792046.539	3128710.898	809.377	GT
251	792046.461	3128711.488	809.405	GT
252	792045.571	3128711.419	809.403	GT
253	792045.6	3128709.835	809.405	GT
254	792051.707	3128710.807	809.292	GEO
255	792052.496	3128710.85	809.282	GEO
256	792051.519	3128713.884	809.35	GEO
257	792052.152	3128714.057	809.347	GEO
258	792060.794	3128714.348	809.25	GEO
259	792060.581	3128719.215	809.277	GEO
260	792071.328	3128719.427	809.259	GEO
261	792082.121	3128719.778	809.228	GEO
262	792081.419	3128733.328	809.156	GEO
263	792085.451	3128733.567	809.141	GEO
264	792078.588	3128732.908	809.417	FSU
265	792067.197	3128732.368	809.477	FSU
266	792066.701	3128741.757	809.495	FSU
267	792051.886	3128726.148	810.233	TLP
268	792051.812	3128727.286	810.218	TLP
269	792051.475	3128741.004	810.502	TLP
270	792063.414	3128741.654	810.528	TLP
271	792057.59	3128727.569	810.47	TLP
272	792057.528	3128728.634	810.438	TLP
273	792058.78	3128728.657	810.383	TLP
274	792058.823	3128727.613	810.414	TLP
275	792066.282	3128727.913	810.338	TLP
276	792066.05	3128730.689	810.153	TLP
277	792066.115	3128726.831	810.152	TLP
278	792068.937	3128724.85	810.108	TLP
279	792070.892	3128727.062	810.115	TLP
280	792068.638	3128728.802	810.099	TLP
281	792049.843	3128718.792	809.656	TLP
282	792049.901	3128718.818	809.651	TLP
283	792049.414	3128741.689	810.589	TLP

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
284	792050.552	3128741.659	810.593	TLP
285	792057.252	3128731.485	810.418	CONT
286	792059.455	3128727.339	809.847	CONT
287	792059.895	3128723.844	809.624	CONT
288	792058.875	3128720.535	809.662	CONT
289	792058.684	3128717.107	809.734	CONT
290	792065.778	3128720.202	809.186	CONT
291	792066.948	3128724.679	809.792	CONT
292	792068.493	3128779.092	810.033	MN4
293	792055.496	3128743.428	810.411	FT4
294	792057.379	3128743.55	810.471	FT4
295	792081.281	3128769.837	809.815	FT4
296	792079.596	3128770.56	809.839	FT4
297	792084.445	3128776.775	809.839	FT4
298	792084.381	3128778.566	809.893	FT4
299	792084.694	3128770.14	809.74	FT4
300	792086.204	3128770.196	809.701	FT4
301	792072.001	3128746.903	810.031	APPL
302	792071.546	3128756.535	810.055	APPL
303	792080.403	3128756.939	810.058	APPL
304	792080.214	3128764.98	809.733	APPL
305	792086.477	3128765.276	809.805	APPL
306	792086.429	3128769.329	809.795	APPL
307	792102.196	3128770.034	809.778	APPL
308	792109.981	3128769.36	809.67	APPL
309	792120.311	3128770.119	809.222	APPL
310	792060.659	3128787.443	810.104	CONT
311	792044.17	3128776.613	810.258	CONT
312	792038.707	3128766.859	810.426	CONT
313	792038.293	3128761.338	810.611	CONT
314	792032.73	3128762.142	811.302	CONT
315	792036.112	3128749.804	810.85	CONT
316	792032.546	3128778.082	810.64	CONT
317	792037.263	3128792.966	810.808	CONT
318	792040.542	3128805.142	810.82	CONT
319	792047.719	3128817.389	810.775	CONT
320	792057.218	3128758.51	810.253	SUPA
321	792052.425	3128753.69	810.427	SUPA
322	792056.271	3128749.609	810.317	SUPA
323	792061.113	3128752.382	810.249	SUPA
324	792138.422	3128773.669	809.115	MN4
325	792120.263	3128770.068	809.21	APPL

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
326	792120.512	3128767.15	809.187	APPL
327	792125.023	3128767.281	809.188	APPL
328	792125.381	3128761.248	809.114	APPL
329	792127.969	3128761.398	809.122	APPL
330	792128.174	3128757.882	809.111	APPL
331	792125.92	3128757.693	809.088	APPL
332	792128.287	3128760.129	809.071	FT5
333	792128.418	3128758.963	809.104	FT5
334	792149.194	3128761.148	808.505	FT5
335	792149.193	3128759.958	808.551	FT5
336	792149.135	3128759.237	808.531	FT5
337	792149.538	3128757.604	808.358	MET
338	792138.377	3128757.207	808.435	MET
339	792138.287	3128749.852	808.38	MET
340	792131.174	3128754.288	809.153	GP
341	792126.059	3128754.017	809.056	GP
342	792131.491	3128749.219	809.173	GP
343	792148.264	3128781.156	808.716	FT5
344	792151.906	3128781.886	807.953	PW
345	792152.835	3128761.876	807.735	PW
346	792155.04	3128759.645	808.551	PW
347	792128.12	3128738.434	808.957	MECHA
348	792127.973	3128739.438	808.961	MECHA
349	792129.328	3128732.111	808.911	MECHA
350	792132.582	3128732.347	808.961	MECHA
351	792134.795	3128774.471	809.313	TCC
352	792138.347	3128770.867	809.242	TCC
353	792134.686	3128765.872	809.265	TCC
354	792129.741	3128770.505	809.351	TCC
355	792134.872	3128775.661	809.164	EP
356	792134.66	3128777.575	809.109	EP
357	792144.393	3128776.578	809.097	EP
358	792144.373	3128778.336	809.141	EP
359	792117.223	3128774.759	809.243	EP
360	792174.527	3128741.898	807.702	FW
361	792176.787	3128741.936	808.08	FW
362	792134.272	3128758.686	809.012	FT5
363	792133.1	3128758.561	809.007	FT5
364	792147.443	3128775.152	808.772	CONT
365	792145.297	3128775.805	809.174	CONT
366	792147.34	3128784.759	808.591	CONT
367	792142.685	3128778.705	809.226	CONT

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
368	792131.26	3128780.147	808.941	CONT
369	792123.502	3128774.607	809.426	CONT
370	792119.392	3128780.683	808.744	CONT
371	792121.051	3128780.212	809.176	CONT
372	792129.594	3128778.083	809.275	CONT
373	792134.384	3128714.945	808.983	MN6
374	792133.244	3128718.538	808.946	MECHA
375	792129.355	3128718.394	808.941	MECHA
376	792129.598	3128714.147	808.939	MECHA
377	792133.4	3128714.309	808.92	MECHA
378	792134.336	3128694.592	808.928	MECHA
379	792133.929	3128715.476	808.919	FT5
380	792133.838	3128717.52	808.896	FT5
381	792139.199	3128698.891	808.292	FT5
382	792140.46	3128699.03	808.098	FT5
383	792137.603	3128715.87	808.429	FT5
384	792137.3	3128717.641	808.45	FT5
385	792152.619	3128740.993	807.258	FW
386	792152.713	3128732.005	807.227	FW
387	792148.412	3128728.874	807.653	FW
388	792148.779	3128721.543	807.664	FW
389	792153.892	3128721.386	807.25	FW
390	792153.822	3128721.838	807.374	FW
391	792175.321	3128722.506	807.263	FW
392	792176.289	3128722.653	807.601	FW
393	792179.823	3128722.884	807.588	FW
394	792175.619	3128716.306	807.241	FW
395	792150.539	3128714.984	807.437	FW
396	792151.522	3128695.225	807.247	FW
397	792136.155	3128709.384	808.877	CONT
398	792140.983	3128710.332	808.542	CONT
399	792146.519	3128718.646	807.904	CONT
400	792150.238	3128717.024	807.539	CONT
401	792112.399	3128718.239	809.244	RE1
402	792117.387	3128713.533	808.932	MECHA
403	792120.806	3128713.762	808.947	MECHA
404	792120.669	3128717.926	808.94	MECHA
405	792117.236	3128717.795	808.943	MECHA
406	792116.32	3128737.567	808.935	MECHA
407	792111.398	3128706.949	809.05	GEO
408	792110.977	3128716.589	809.045	GEO
409	792096.001	3128716.016	809.061	GEO

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
410	792095.671	3128723.191	809.04	GEO
411	792096.227	3128723.299	809.04	GEO
412	792095.799	3128734.059	808.958	GEO
413	792095.213	3128734.075	808.97	GEO
414	792094.822	3128742.992	809.029	GEO
415	792115.386	3128748.118	809.164	APPL
416	792115.151	3128751.053	809.135	APPL
417	792112.474	3128750.983	809.078	APPL
418	792112.579	3128748	809.14	APPL
419	792101.85	3128747.57	809.125	APPL
420	792098.168	3128744.591	809.084	FT5
421	792098.047	3128745.901	809.106	FT5
422	792113.096	3128734.621	809.422	CONT
423	792112.204	3128730.077	809.442	CONT
424	792104.896	3128733.026	809.28	CONT
425	792113.181	3128711.601	809.136	CONT
426	792115.215	3128697.784	808.718	CONT
427	792100.691	3128743.62	809.184	RE2
428	792090.569	3128742.853	809.021	GEO
429	792089.326	3128742.752	809.692	GEO
430	792085.165	3128741.926	809.679	GEO
431	792084.526	3128741.832	809.664	GEO
432	792078.532	3128742.293	809.281	FSU
433	792071.015	3128744.479	809.153	FT5
434	792082.279	3128745.148	809.011	FT5
435	792082.414	3128743.724	809.046	FT5
436	792091.055	3128745.552	809.017	FT5
437	792091.09	3128744.305	808.964	FT5
438	792133.368	3128746.3	809.076	FT5
439	792133.279	3128747.496	808.959	FT5
440	792126.388	3128749.221	808.941	GP
441	792126.121	3128748.632	808.906	APPL
442	792101.399	3128756.307	809.123	APPL
443	792092.516	3128755.783	809.049	APPL
444	792092.945	3128747.867	809.09	APPL
445	792089.171	3128747.568	809.018	APPL
446	792071.315	3128746.553	809.138	APPL
447	792068.936	3128745.911	809.318	APPL
448	792098.18	3128747.596	809.315	CONT
449	792067.145	3128745.531	810.113	CONT
450	792070.274	3128745.03	809.264	CONT
451	792106.152	3128741.28	809.308	TREE

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
452	792117.338	3128742.474	809.507	TREE
453	792146.616	3128674.877	807.646	MN7
454	792140.308	3128644.569	807.18	AH
455	792152.035	3128644.851	807.162	AH
456	792151.666	3128665.562	807.195	AH
457	792172.843	3128665.968	806.979	AH
458	792176.595	3128696.595	807.369	FW
459	792177.199	3128691.981	807.564	FW
460	792181.326	3128694.182	807.276	FW
461	792191.01	3128692.194	807.486	FW
462	792190.941	3128690.645	807.192	FW
463	792193.256	3128690.52	807.129	FW
464	792193.879	3128681.349	806.804	FW
465	792177.185	3128696.934	807.402	FT2
466	792177.283	3128693.925	807.315	FT2
467	792155.809	3128692.84	807.525	FT2
468	792155.955	3128691.824	807.528	FT2
469	792172.915	3128665.926	806.994	FT2
470	792208.332	3128709.951	806.242	MN8
471	792181.069	3128710.313	807.321	MW
472	792208.088	3128711.551	807.117	MW
473	792207.152	3128731.263	807.437	MW
474	792211.544	3128713.869	807.173	TREE
475	792207.224	3128700.109	807.173	TREE
476	792200.739	3128699.771	807.173	TREE
477	792198.003	3128704.57	807.001	EP
478	792225.587	3128709.944	805.787	EP
479	792214.813	3128714.058	806.823	CONT
480	792216.573	3128713.75	806.249	CONT
481	792211.853	3128703.912	807.058	CONT
482	792216.757	3128705.82	806.327	CONT
483	792183.231	3128705.164	807.276	CONT
484	792181.781	3128697.039	807.231	RD
485	792187.558	3128698.352	807.167	RD
486	792186.227	3128709.786	807.167	RD
487	792197.302	3128695.31	807.057	RD
488	792196.19	3128704.905	806.845	RD
489	792218.869	3128707.769	805.692	RD
490	792218.467	3128713.212	805.782	RD
491	792219.427	3128713.988	805.702	RD
492	792219.813	3128707.465	805.565	RD
493	792220.306	3128706.241	805.496	RD

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
494	792219.598	3128715.464	805.673	RD
495	792217.574	3128707.5	805.891	RFT
496	792217.713	3128706.354	805.893	RFT
497	792219.02	3128706.385	805.761	RFT
498	792213.098	3128739.027	806.371	RE3
499	792226.692	3128681.638	805.295	M2
500	792211.894	3128695.505	806.946	FW
501	792213.027	3128682.447	806.742	FW
502	792221.134	3128681.381	805.072	RD
503	792219.847	3128681.804	805.359	RFT
504	792206.406	3128666.68	805.221	RFT
505	792207.054	3128665.769	804.838	RFT
506	792197.802	3128657.004	804.867	RD
507	792196.553	3128656.701	804.924	RFT
508	792173.558	3128653.664	806.805	AH
509	792170.253	3128652.385	806.921	AH
510	792161.843	3128622.673	804.192	M1
511	792131.621	3128634.707	804.07	AH
512	792157.191	3128635.823	804.644	AH
513	792161.012	3128640.412	806.03	AH
514	792161.224	3128643.233	806.49	AH
515	792163.94	3128643.319	806.633	AH
516	792153.116	3128629.338	803.863	RD
517	792175.724	3128634.273	804.106	RD
518	792178.86	3128630.473	804.1	RD
519	792151.97	3128624.676	803.839	RD
520	792180.146	3128729.645	807.406	MW
521	792179.533	3128736.453	807.61	MW
522	792179.358	3128739.744	807.596	MW
523	792179.049	3128745.168	807.336	ST
524	792208	3128747.372	807.126	ST
525	792207.527	3128755.355	807.154	ST
526	792208.243	3128759.389	807.361	ST
527	792207.752	3128766.727	807.388	ST
528	792219.096	3128770.775	806.748	RE4
529	792204.476	3128755.11	807.141	ST
530	792178.149	3128765.223	807.339	ST
531	792178.195	3128771.534	807.274	WW
532	792203.51	3128773.494	807.072	WW
533	792203.07	3128781.268	807.159	WW
534	792201.139	3128782.48	807.513	WW
535	792203.355	3128789.236	807.312	WW

SN	EASTING	NORTHING	REDUCED LEVEL	CODE IN TS
536	792191.357	3128803.378	808.157	RE5
537	792198.905	3128792.574	807.128	WW
538	792176.988	3128791.275	807.218	WW
539	792175.883	3128790.616	807.879	WW
540	792174.049	3128790.654	807.863	WW
541	792172.828	3128794.272	807.994	WW
542	792172.507	3128797.789	808.072	WW
543	792198.747	3128798.566	807.659	WW
544	792198.026	3128802.749	807.64	WW
545	792208.453	3128795.524	807.42	WW

Institute Of Engineering (IOE)
Western Regional Campus
Lamachaur-16, Pokhara
BCE Survey Camp 2081

Observer: Group I

Recorder: Group I

Date: 2081/01/22

Weather: Sunny

14.Road Alignment Sheet

IP	Distance Between IPS	Deflection angle (Δ)			Orien--tation	Radius	Tangent Length	Curve length	Apex distance	Chainage of IP	Chainage of BC	Chainage of MO	Chainage of EC	Remarks
		d	m	s			TL= R tan(Δ/2)	L = ΠRΔ/180°	R (sec(Δ/2)-1)		Ch. Of IP-TL	Ch of BC+L/2	Ch of M+L/2	
TBM														
IP0	4.092									0				
IP1	47.226	8	15	20	Left	300	21.650	43.226	0.780	47.226	25.576	47.189	68.802	
IP2	57.636	50	48	20	Left	20	9.498	17.734	2.141	104.787	95.289	104.156	113.024	
IP3	59.764	23	44	20	Right	65	13.661	26.931	1.420	163.290	149.628	163.094	176.559	
IP4	44.028	31	30	40	Left	28	7.900	15.399	1.093	206.926	199.026	206.726	214.425	
IP5	42.374	40	11	40	Right	15	5.488	10.523	0.973	248.900	243.411	248.673	253.934	
IP6	27.64	49	30	0	Left	15	6.915	12.959	1.517	276.086	269.171	275.650	282.130	
IP7	21.11	86	10	40	Right	15	14.031	22.561	5.540	296.324	282.293	293.574	304.854	
IP8	29.3	8	26	40	Left	150	11.074	22.108	0.408	320.123	309.049	320.103	331.157	
IP9	40.898	27	17	20	Left	45	10.924	21.433	1.307	360.981	350.057	360.774	371.490	
IP10	26.55	13	48	40	Left	80	9.689	19.284	0.585	387.117	377.428	387.070	396.712	
IP11	41.59	76	40	0	Right	15	11.860	20.071	4.123	428.613	416.752	426.788	436.823	

IP12	37.63	17	16	40	Left	60	9.116	18.093	0.689	462.593	453.477	462.524	471.570	
IP13	57.26	38	28	40	Left	30	10.470	20.147	1.775	519.715	509.245	519.318	529.392	
IP14	31.91	86	6	20	Right	15	14.014	22.542	5.528	550.832	536.818	548.089	559.360	
IP15	46.642	61	48	40	Right	18	10.775	19.419	2.979	591.989	581.214	590.923	600.632	
IP16	22.63	69	57	20	Left	15	10.494	18.314	3.307	612.487	601.993	611.150	620.307	
IP17	30.874	20	36	40	Right	60	10.910	21.584	0.984	640.687	629.777	640.569	651.361	
IP18	31.01	11	1	20	Right	120	11.578	23.085	0.557	671.461	659.883	671.425	682.967	
IP19	38.978	45	13	31	Left	20	8.330	15.787	1.666	710.367	702.037	709.930	717.823	
IP20	25	80	50	6	Right	15	12.774	21.163	4.702	734.493	721.719	732.300	742.882	
IP21	26.94	45	26	22	Left	25	10.468	19.827	2.103	757.048	746.580	756.493	766.407	
IP22	26.634	44	6	47	Left	30	12.155	23.098	2.369	782.573	770.418	781.966	793.515	
IP23	32.1	34	59	53	Left	50	15.764	30.542	2.426	813.460	797.696	812.967	828.238	
IP24	46.195									858.669				

Institute Of Engineering (IOE)
Western Regional Campus
Lamachaur-16, Pokhara
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Observer: Group I　　　　Date: 2081/01/22

Recorder: Group I　　　　Weather: Cloudy

15.Profile Level and Cross Sectioning of Road

Stn	Distance			BS	IS	FS	Rise	Fall	RL	Remarks
	Left	Center	Right							
TBM				0.13					720.000	
		0+000			0.175			-0.045	719.955	Chainage
			4.5		0.205		0		719.715	
	4.7				0.045			0	719.755	
		0+020.000			1.337		0	-1.292	718.663	Chainage
	2.2				1.48		0	-0.143	718.520	
			2.5		1.229		0.251	0	718.771	
			4.4		0.712		0.517	0	719.288	
BC1		0+025.576			1.708		0	-0.996	718.292	
			2.5		1.532		0.176	0	718.468	
			3.5		1.12		0.412	0	718.880	
	2.5				1.634		0	-0.514	718.366	
	3.4				2.228		0	-0.594	717.772	
		0+040			2.075		0.153	0	717.925	Chainage
	2.5			1.43		2.838	0	-0.763	717.162	Changing point
	5				1.548		0	-0.118	717.044	
	6.44				1.933		0	-0.385	716.659	
			1.45		1.246		0.687	0	717.346	
CP				1.3		1.512	0	-0.266	717.080	Changing point
MC1		0+047.189			1.364		0	-0.064	717.016	
			2.3		0.96		0.404	0	717.420	
	2.5				1.26		0	-0.3	717.120	
	4				1.585		0	-0.325	716.795	
		0+060.000			1.313		0.272	0	717.067	Chainage
	2.5				1.304		0.009	0	717.076	
	5				1.31		0	-0.006	717.070	
	8.4				1.415		0	-0.105	716.965	
			1.422		1.056		0.359	0	717.324	
EC1		0+068.802			0.925		0.131	0	717.455	
	2.4				0.953		0	-0.028	717.427	
			2.5	2.315		0.725	0.228	0	717.655	Changing point

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15.Profile Level and Cross Sectioning of Road

Stn	Distance			BS	IS	FS	Rise	Fall	RL	Remarks
	Left	Center	Right							
TBM				0.13					720.000	
		0+000			0.175			-0.045	719.955	Chainage
			4.5		0.205		0		719.715	
	4.7				0.045			0	719.755	
		0+020.000			1.337		0	-1.292	718.663	Chainage
	2.2				1.48		0	-0.143	718.520	
			2.5		1.229		0.251	0	718.771	
			4.4		0.712		0.517	0	719.288	
BC1		0+025.576			1.708		0	-0.996	718.292	
			2.5		1.532		0.176	0	718.468	
			3.5		1.12		0.412	0	718.880	
	2.5				1.634		0	-0.514	718.366	
	3.4				2.228		0	-0.594	717.772	
		0+040			2.075		0.153	0	717.925	Chainage
	2.5			1.43		2.838	0	-0.763	717.162	Changing point
	5				1.548		0	-0.118	717.044	
	6.44				1.933		0	-0.385	716.659	
			1.45		1.246		0.687	0	717.346	
CP				1.3		1.512	0	-0.266	717.080	Changing point
MC1		0+047.189			1.364		0	-0.064	717.016	
			2.3		0.96		0.404	0	717.420	
	2.5				1.26		0	-0.3	717.120	
	4				1.585		0	-0.325	716.795	
		0+060.000			1.313		0.272	0	717.067	Chainage
	2.5				1.304		0.009	0	717.076	
	5				1.31		0	-0.006	717.070	
	8.4				1.415		0	-0.105	716.965	
			1.422		1.056		0.359	0	717.324	
EC1		0+068.802			0.925		0.131	0	717.455	
	2.4				0.953		0	-0.028	717.427	
			2.5	2.315		0.725	0.228	0	717.655	Changing point

		0+080.000			1.735		0.58	0	718.235	Chainage
			2.5		1.497		0.238	0	718.473	
			2.9		1.313		0.184	0	718.657	
	2.2				2.197		0	-0.884	717.773	
BC2		0+095.289			1.543		0.654	0	718.427	
	2.5				1.273		0.27	0	718.697	
	3.4				1.287		0	-0.014	718.683	
			1.98		1.28		0.007	0	718.690	
		0+100.000			1.08		0.2	0	718.890	Chainage
	2.34				0.98		0.1	0	718.990	
			2.05		0.93		0.05	0	719.040	
			2.95		0.823		0.107	0	719.147	
MC2		0+104.156			0.785		0.038	0	719.185	
			2.5		0.927		0	-0.142	719.043	
			4.378		0.88		0.047	0	719.090	
	1.8			3.44		1.023	0	-0.143	718.947	Changing point
EC2		0+113.024			2.415		1.025	0	719.972	
			2.5		2.485		0	-0.07	719.902	
			3.5		2.127		0.358	0	720.260	
	1.5				2.643		0	-0.516	719.744	
		0+120.000			1.487		1.156	0	720.900	Chainage
	2.5				1.653		0	-0.166	720.734	
	3.43				1.68		0	-0.027	720.707	
			2.5		1.495		0.185	0	720.892	
			2.84		1.283		0.212	0	721.104	
CP				2.58		1.44	0	-0.157	720.947	Changing point
		0+140.000			3.667		0	-1.087	719.860	Chainage
	1.75				4.05		0	-0.383	719.477	
			2.5		3.823		0.227	0	719.704	
			3.65		3.55		0.273	0	719.977	
BC3		0+149.628			3.135		0.415	0	720.392	
			2.5		3.145		0	-0.01	720.382	
			3.43		2.615		0.53	0	720.912	
	1.4				2.878		0	-0.263	720.649	
		0+160.000			1.676		1.202	0	721.851	Chainage
	2.5				2.037		0	-0.361	721.490	
	3.3				2.187		0	-0.15	721.340	
			2.5		1.655		0.532	0	721.872	
			4.4		1.156		0.499	0	722.371	
MC3		0+163.094			1.017		0.139	0	722.510	
	2.5				0.877		0.14	0	722.650	
	4.4				1.147		0	-0.27	722.380	
			2.5		0.947		0.2	0	722.580	
			3.35		0.755		0.192	0	722.772	
				3.167		0.393	0.362	0	723.134	Changing

										point
EC3		0+176.559			2.265		0.902	0	724.036	
	1.7				2.375		0	-0.11	723.926	
			2.5		2.417		0	-0.042	723.884	
			5		2.145		0.272	0	724.156	
			5.9		1.747		0.398	0	724.554	
		0+180.000			2.105		0	-0.358	724.196	Chainage
	1.55				2.395		0	-0.29	723.906	
			2.5		2.263		0.132	0	724.038	
			5		2.18		0.083	0	724.121	
			6.242		1.49		0.69	0	724.811	
BC4		0+199.026			0.793		0.697	0	725.508	
	2.5				0.607		0.186	0	725.694	
			2.5		0.65		0	-0.043	725.651	
			3.435		0.09		0.56	0	726.211	
				3.465		0.345	0	-0.255	725.956	Changing point
MC4		0+206.726			3.065		0.4	0	726.356	
	2.5				3.34		0	-0.275	726.081	
	4.6				3.88		0	-0.54	725.541	
			2		2.85		1.03	0	726.571	
EC4		0+214.425			2.265		0.585	0	727.156	
	2.5				2.85		0	-0.585	726.571	
	3.4				2.94		0	-0.09	726.481	
			2.5		2.305		0.635	0	727.116	
			4.5		1.755		0.55	0	727.666	
		0+220.000			1.77		0	-0.015	727.651	Chainage
	0.6				1.8		0	-0.03	727.621	
			2.5		1.81		0	-0.01	727.611	
			5		1.54		0.27	0	727.881	
			5.2		1.463		0.077	0	727.958	
CP				4.485		0.573	0.89	0	728.848	Changing point
		0+240.000			2.257		2.228	0	731.076	Chainage
	2.2				2.154		0.103	0	731.179	
			2.5		2.04		0.114	0	731.293	
			2.87		1.85		0.19	0	731.483	
BC5		0+243.411			1.562		0.288	0	731.771	
	2.5				1.456		0.106	0	731.877	
			2.5		1.54		0	-0.084	731.793	
			3.3		1.338		0.202	0	731.995	
MC5		0+248.673			0.646		0.692	0	732.687	
	2.5				0.473		0.173	0	732.860	
	4.6				0.472		0.001	0	732.861	
			2.5		0.678		0	-0.206	732.655	
			3.6		0.406		0.272	0	732.927	
CP				2.681		0.406	0	0	732.927	Changing

										point
EC5		0+253.934			2.161		0.52	0	733.447	
	2.5				2.007		0.154	0	733.601	
	4				2.105		0	-0.098	733.503	
			2.5		2.173		0	-0.068	733.435	
		0+260			1.713		0.46	0	733.895	Chainage
	2.5				1.571		0.142	0	734.037	
	4.5				1.85		0	-0.279	733.758	
			2.5		1.595		0.255	0	734.013	
CP				1.577		0.422	1.173	0	735.186	Changing point
BC6		0+269.171			2.49		0	-0.913	734.273	
	2.5				2.407		0.083	0	734.356	
	4.5				2.9		0	-0.493	733.863	
			2.5		2.407		0.493	0	734.356	
			3.15		2.375		0.032	0	734.388	
MC6		0+275.650			1.713		0.662	0	735.050	
	2.5				1.887		0	-0.174	734.876	
	4.05				1.587		0.3	0	735.176	
			2.5		1.677		0	-0.09	735.086	
			3.4		1.497		0.18	0	735.266	
		0+280.000			1.1		0.397	0	735.663	Chainage
	2.5				1.491		0	-0.391	735.272	
	4.9				1.133		0.358	0	735.630	
			2.5		0.999		0.134	0	735.764	
EC6		0+282.130			0.673		0.326	0	736.090	
	2.5				0.89		0	-0.217	735.873	
	5				0.727		0.163	0	736.036	
	5.921				0.569		0.158	0	736.194	
			1.17		0.287		0.282	0	736.476	
BC7		0+282.293			0.662		0	-0.375	736.101	
	2.5				0.844		0	-0.182	735.919	
	5				0.727		0.117	0	736.036	
	5.24				0.578		0.149	0	736.185	
			1.2		0.287		0.291	0	736.476	
CP				2.53		0.583	0	-0.296	736.180	Changing point
CP				2.073		0.693	1.837	0	738.017	Changing point
MC7		0+293.574			1.077		0.996	0	739.013	
	2.5				1.853		0	-0.776	738.237	
	5				1.917		0	-0.064	738.173	
	7.5				1.852		0.065	0	738.238	
	10				1.677		0.175	0	738.413	
	12.5				1.565		0.112	0	738.525	
	13.7				1.73		0	-0.165	738.360	
		0+300.000			0.229		1.501	0	739.861	Chainage

	2.5				0.347		0	-0.118	739.743	
	5				0.21		0.137	0	739.880	
	7.5				0.17		0.04	0	739.920	
			1	3.335		0.299	0	-0.129	739.791	Changing point
EC7		0+304.854			2.433		0.902	0	740.693	
			2.5		2.315		0.118	0	740.811	
			5		2.16		0.155	0	740.966	
			7.5		2.025		0.135	0	741.101	
	2.5				2.043		0	-0.018	741.083	
CP				2.041		0.249	1.794	0	742.877	Changing point
BC8		0+309.049			3.485		0	-1.444	741.433	
	1				2.207		1.278	0	742.711	
			2.5		3.625		0	-1.418	741.293	
			5		3.36		0.265	0	741.558	
			7.5		3.43		0	-0.07	741.488	
MC8		0+320.103			1.213		2.217	0	743.705	
	2				0.645		0.568	0	744.273	
			2.5		1.55		0	-0.905	743.368	
			5		1.35		0.2	0	743.568	
			6		1.121		0.229	0	743.797	
CP				3		0.22	0.901	0	744.698	Changing point
EC8		0+331.157			2.161		0.839	0	745.537	
	2				1.987		0.174	0	745.711	
			2.5		2.471		0	-0.484	745.227	
			3.9		1.831		0.64	0	745.867	
		0+340.000			1.043		0.788	0	746.655	Chainage
	2.5				0.857		0.186	0	746.841	
			2.5		0.927		0	-0.07	746.771	
			3.4		0.651		0.276	0	747.047	
CP				3.51		0.539	0.112	0	747.159	Changing point
BC9		0+350.057			2.635		0.875	0	748.034	
	2.5				2.451		0.184	0	748.218	
	3				2.363		0.088	0	748.306	
			2.2		2.285		0.078	0	748.384	
		0+360.000			1.269		1.016	0	749.400	Chainage
	2.5				1.285		0	-0.016	749.384	
	3.3				1.14		0.145	0	749.529	
			2.5		1.133		0.007	0	749.536	
MC9		0+360.774			0.99		0.143	0	749.679	
	2.5				0.96		0.03	0	749.709	
			2.5		0.781		0.179	0	749.888	
			3.7		0.595		0.186	0	750.074	
CP				3.843		0.119	0.476	0	750.550	Changing

										point
EC9		0+371.490			2.788		1.055	0	751.605	
	2.5				2.545		0.243	0	751.848	
	3.1				2.75		0	-0.205	751.643	
			0.55		2.508		0.242	0	751.885	
BC10		0+377.428			1.48		1.028	0	752.913	
	2.5				1.2		0.28	0	753.193	
	3.15				1.191		0.009	0	753.202	
			0.7		1.477		0	-0.286	752.916	
		0+380.000			1.265		0.212	0	753.128	Chainage
	2.5				0.877		0.388	0	753.516	
	3.1				0.795		0.082	0	753.598	
			1		0.861		0	-0.066	753.532	
CP				1.753		0.16	0.701	0	754.233	Changing point
MC10		0+387.070			1.585		0.168	0	754.401	
	2.5				1.4		0.185	0	754.586	
			1.3		1.337		0.063	0	754.649	
EC10		0+396.712			1.554		0	-0.217	754.432	
	1.5				1.527		0.027	0	754.459	
			2.5		1.451		0.076	0	754.535	
		0+400.000			1.515		0	-0.064	754.471	Chainage
	1.3				1.395		0.12	0	754.591	
			2.5		1.47		0	-0.075	754.516	
CP				1.03		1.47	0	0	754.516	Changing point
BC11		0+416.752			1.234		0	-0.204	754.312	
	2.5				1.14		0.094	0	754.406	
	3.6				0.98		0.16	0	754.566	
			1.6		1.206		0	-0.226	754.340	
		0+420.000			1.342		0	-0.136	754.204	
	2.5				1.215		0.127	0	754.331	
	5				0.938		0.277	0	754.608	
			1		1.27		0	-0.332	754.276	
MC11		0+426.788			1.572		0	-0.302	753.974	
	2.5				1.595		0	-0.023	753.951	
	5				1.535		0.06	0	754.011	
	7.5				1.469		0.066	0	754.077	
	10				0.718		0.751	0	754.828	
			1.5		1.096		0	-0.378	754.450	
EC11		0+436.823			2.419		0	-1.323	753.127	
	2.5				2.416		0.003	0	753.130	
			2.5		2.255		0.161	0	753.291	
			4.5		2.253		0.002	0	753.293	
		0+ 440.000			2.745		0	-0.492	752.801	Chainage
			2.5		2.563		0.182	0	752.983	

			3.7		2.42		0.143	0	753.126	
	2.5				2.647		0	-0.227	752.899	
CP				0.628		3.775	0	-1.128	751.771	Changing point
BC12		0+ 453.477			1.581		0	-0.953	750.818	
			1.15		1.333		0.248	0	751.066	
	2.5				1.45		0	-0.117	750.949	
	3.5				1.583		0	-0.133	750.816	
		0+ 460.000			2.111		0	-0.528	750.288	Chainage
			2		1.821		0.29	0	750.578	
	2.5				1.172		0.649	0	751.227	
	3.5				1.154		0.018	0	751.245	
MC12		0+462.524			2.635		0	-1.481	749.764	
			2.5		2.197		0.438	0	750.202	
	2.5				2.716		0	-0.519	749.683	
EC12		0+471.490			2.834		0	-0.118	749.565	
			2.5		2.762		0.072	0	749.637	
			4.1		2.49		0.272	0	749.909	
	1.5				2.786		0	-0.296	749.613	
CP				0.947		2.49	0.296	0	749.909	Changing point
		0+480			1.477		0	-0.53	749.379	Chainage
			2.5		1.407		0.07	0	749.449	
			3.4		1.12		0.287	0	749.736	
	1				1.46		0	-0.34	749.396	
		0+500			1.131		0.329	0	749.725	Chainage
			2.5		0.932		0.199	0	749.924	
	1.8				1.197		0	-0.265	749.659	
BC13		0+ 509.245			0.852		0.345	0	750.004	
			2.5		0.769		0.083	0	750.087	
			3.2		0.617		0.152	0	750.239	
	2.4				0.937		0	-0.32	749.919	
MC13		0+519.318		3.673		0.253	0.684	0	750.603	Changing point
			2.5		3.443		0.23	0	750.833	
	2.5				3.515		0	-0.072	750.761	
EC13		0+529.392			2.672		0.843	0	751.604	
	2.5				2.547		0.125	0	751.729	
					2.545		0.002	0	751.731	
BC14		0+536.818			2.005		0.54	0	752.271	
	2.5				2.015		0	-0.01	752.261	
	4.5				2.153		0	-0.138	752.123	
			1.64		1.853		0.3	0	752.423	
		0+540.000			1.879		0	-0.026	752.397	Chainage

			2.2		1.667		0.212	0	752.609	
	2.5				1.863		0	-0.196	752.413	
MC14		0+548.089			1.28		0.583	0	752.996	
			2.5		1.59		0	-0.31	752.686	
			5		1.553		0.037	0	752.723	
			7.5		1.447		0.106	0	752.829	
			10		1.44		0.007	0	752.836	
			12.5		1.385		0.055	0	752.891	
			13.2		1.36		0.025	0	752.916	
CP				0.213		1.715	0	-0.355	752.561	Changing point
EC14		0+559.360			0.515		0	-0.302	752.259	
	2.5				0.617		0	-0.102	752.157	
	4.5				0.453		0.164	0	752.321	
			0.5		0.47		0	-0.017	752.304	
TBM2		BM			1.62		0	-1.15	751.154	TBM2
		0+580.000			2.175		0	-0.555	750.599	Chainage
	2.5				2.381		0	-0.206	750.393	
			2.5		1.875		0.506	0	750.899	
BC15		0+581.214			2.303		0	-0.428	750.471	
	2.4				2.3		0.003	0	750.474	
			2.5		2.053		0.247	0	750.721	
MC15		0+590.923		0.803		2.873	0	-0.82	749.901	Changing point
	2.5				0.715		0.088	0	749.989	
	4.5				1.023		0	-0.308	749.681	
			1.1		0.775		0.248	0	749.929	
EC15		0+600.632			1.276		0	-0.501	749.428	
	2.5				1.24		0.036	0	749.464	
	4				1.281		0	-0.041	749.423	
			1.6		1.613		0	-0.332	749.091	
BC16		0+601.993			1.284		0.329	0	749.420	
	2.5				1.31		0	-0.026	749.394	
	4				1.317		0	-0.007	749.387	
			1.6		1.39		0	-0.073	749.314	
MC16		0+611.150			1.569		0	-0.179	749.135	
	1				1.505		0.064	0	749.199	
			2.5		1.593		0	-0.088	749.111	
			5		1.283		0.31	0	749.421	
CP				2.363		1.585	0	-0.302	749.119	Changing point
EC16		0+620.307			2.295		0.068	0	749.187	
	2.5				2.35		0	-0.055	749.132	
			2.5		2.165		0.185	0	749.317	
BC17		0+629.777			1.795		0.37	0	749.687	
	2.5				1.535		0.26	0	749.947	
	4.5				1.58		0	-0.045	749.902	

			1		1.503		0.077	0	749.979	
MC17		0+640.569			1.323		0.18	0	750.159	
	2.5				1.34		0	-0.017	750.142	
	3,5				1.347		0	-0.007	750.135	
			2		1.174		0.173	0	750.308	
EC17		0+651.361			1.005		0.169	0	750.477	
	1.2				0.68		0.325	0	750.802	
			2.5		1.09		0	-0.41	750.392	
			3.7		0.873		0.217	0	750.609	
BC18		0+659.883			0.457		0.416	0	751.025	
			2.5		0.49		0	-0.033	750.992	
			3.7	2.345		1.464	0	-0.974	750.018	Changing point
	2.53				2.36		0	-0.015	750.003	
MC18		0+671.425			1.603		0.757	0	750.760	
	2				1.43		0.173	0	750.933	
			2.5		1.459		0	-0.029	750.904	
			3		1.125		0.334	0	751.238	
		0+680.000			1.377		0	-0.252	750.986	Chainage
	1.5				1.313		0.064	0	751.050	
			2.5		1.463		0	-0.15	750.900	
			3		1.173		0.29	0	751.190	
EC18		0+682.967			1.265		0	-0.092	751.098	
	0.8				1.271		0	-0.006	751.092	
			2.5		1.447		0	-0.176	750.916	
			4		1.326		0.121	0	751.037	
BC19		0+702.037			1.72		0	-0.394	750.643	
			2.5		2.012		0	-0.292	750.351	
	2.3				1.384		0.628	0	750.979	
MC19		0+709.930			1.759		0	-0.375	750.604	
			2.5		2.046		0	-0.287	750.317	
	2.5				1.162		0.884	0	751.201	
EC19		0+717.832			0.945		0.217	0	751.418	
			2.5		0.883		0.062	0	751.480	
	2.5			1.942		0.985	0	-0.102	751.378	Changing point
BC20		0+721.719			1.515		0.427	0	751.805	
			2.5		1.339		0.176	0	751.981	
	2.5				1.45		0	-0.111	751.870	
MC20		0+732.300			1.305		0.145	0	752.015	
			2.5		1.299		0.006	0	752.021	
	2.5				1.224		0.075	0	752.096	
	5				1.25		0	-0.026	752.070	
	7				1.198		0.052	0	752.122	
		0+740			1.249		0	-0.051	752.071	Chainage
	2.5				1.174		0.075	0	752.146	
	5				1.27		0	-0.096	752.050	

			2.5		1.269		0.001	0	752.051	
EC20		0+742.882			1.445		0	-0.176	751.875	
	2.5				1.381		0.064	0	751.939	
	5				1.49		0	-0.109	751.830	
			2.5		1.383		0.107	0	751.937	
BC21		0+746.580			1.718		0	-0.335	751.602	
	2.5				1.78		0	-0.062	751.540	
	5				1.71		0.07	0	751.610	
			2.5		1.611		0.099	0	751.709	
MC21		0+756.493		0.546		2.405	0	-0.794	750.915	Changing point
	2.5				0.547		0	-0.001	750.914	
	4				0.525		0.022	0	750.936	
			2.5		0.465		0.06	0	750.996	
		0+760.000			0.695		0	-0.23	750.766	Chainage
	2.5				0.684		0.011	0	750.777	
	4				0.594		0.09	0	750.867	
			2.5		0.679		0	-0.085	750.782	
			3		0.55		0.129	0	750.911	
EC21		0+766.407			1.282		0	-0.732	750.179	
			2.5		1.258		0.024	0	750.203	
	2.5				1.155		0.103	0	750.306	
	3				1.091		0.064	0	750.370	
BC22		0+770.418			1.943		0	-0.852	749.518	
	2.5				1.798		0.145	0	749.663	
			2.5		1.886		0	-0.088	749.575	
			4		1.772		0.114	0	749.689	
		0+780.000			2.175		0	-0.403	749.286	Chainage
	2.5				2.094		0.081	0	749.367	
	3				1.996		0.098	0	749.465	
			2.5		2.095		0	-0.099	749.366	
			3.5		2.108		0	-0.013	749.353	
MC22		0+781.966			2.33		0	-0.222	749.131	
	2.5				2.301		0.029	0	749.160	
	3.5				1.921		0.38	0	749.540	
			2.5		2.285		0	-0.364	749.176	
EC22		0+793.515		0.685		2.015	0.27	0	749.446	Changing point
	2.5				2.651		0	-1.216	748.98	
	3.5				2.639		0.012	0	748.992	
			2.5		2.55		0.089	0	749.081	
			3.5		2.456		0.094	0	748.175	
BC23		0+797.696			1.011		0.695	0	749.120	
	2.5				1.204		0	-0.193	748.927	
	3.5				1.23		0	-0.026	748.901	
			2.5		1.091		0.139	0	749.040	
			3.5		1.22		0	-0.129	748.911	

		0+800			1.2		0.02	0	748.931	Chainage
	2.5				1.093		0.107	0	749.038	
	5				1.281		0	-0.188	748.850	
			2.5		1.245		0.036	0	748.886	
			3.5		1.056		0.189	0	749.075	
MC23		0+812.967			1.894		0	-0.838	748.237	
	2.5				1.992		0	-0.098	748.139	
			2.5		1.744		0.248	0	748.387	
			3		1.481		0.263	0	748.650	
		0+820.000			1.326		0	-1.349	747.301	
	2.5				1.298			-0.059	747.242	
	5				1.328		0	-0.032	747.210	
			2.5		1.401		0.112	0	747.322	
			3.4		1.406		0.176	0	747.498	
				0.644		2.289	0	-1.043		Changing point
EC23		0+828.238			1.789		0	-1.145	746.455	
	2.5				1.704		0	-0.113	746.342	
	5				1.64		0	-0.021	746.321	
			2.5		1.794		0.361	0	746.682	
		0+840.000			1.943			-0.762	745.92	
	2.5				1.798			-0.8	745.12	
	4.9				1.886	2.91	0.44		745.56	
			2.5		1.772			-0.24	745.32	
			3.1		2.175		0.04		745.36	
IP24		858.669			2.094			-0.258	745.102	
	2.5				1.996			-0.004	745.098	
	5				2.095		0.138		745.236	
			2.5		2.108			-0.002	745.234	
			3.5		2.33			-0.122	745.112	

Institute Of Engineering (IOE)
Western Regional Campus
Lamachaur-16, Pokhara
BCE Survey Camp 2081

Observer: Group I   Date: 2081/01/23

Recorder: Group I   Weather: Cloudy

16.Fly Levelling from IP 24 to TBM 2

Station	BS	FS	Rise	Fall	RL	Remarks
IP24	1.805				745.102	
	1.768	0.943	0.862	0	745.964	
	3.805	0.905	0.863	0	746.827	
	1.568	0.343	3.462	0	750.289	
	3.178	0.876	0.692	0	750.981	
	2.425	0.579	2.599	0	753.58	
	0.69	2.715	0	0.29	753.29	
	1.217	3.037	0	2.347	750.943	
	0.483	3.277	0	2.06	748.883	
	2.455	0.577	0	0.094	748.789	
	2.237	0.39	2.065	0	750.854	
TBM 2 (Chautari)		1.8	0.437	0	751.291	
						OK!!
Sum	21.631	15.442	10.98	4.791		
Check:						
ΣBS-ΣFS=	6.189					
Σrise-Σfall=	6.189					
Last Rl -First Rl=	6.189	**OK!!**				

Institute Of Engineering (IOE)
Western Regional Campus
Lamachaur-16, Pokhara
BCE Survey Camp 2081

Observer: Group I — Date: 2081/01/30

Recorder: Group I — Weather: Sunny

17. Earth work Calculations

SN	Chainage	Area		Mean Area		Length	Quantity	
		Cutting	Filling	Cutting	Filling		Cutting	Filling
1	0+000	1.25	0.53	1.25	0.53	0	0	0
2	0+020.000	3.16	1.5	2.205	1.015	20	44.1	20.3
3	0+025.576	3.9	1.15	3.53	1.325	5.576	19.68328	7.3882
4	0+040	3.83	1.27	3.865	1.21	14.424	55.74876	17.45304
5	0+047.189	4.07	3.54	3.95	2.405	7.189	28.39655	17.28955
6	0+060.000	4.66	5.04	4.365	4.29	12.811	55.920015	54.95919
7	0+068.802	3.45	3.12	4.055	4.08	8.802	35.69211	35.91216
8	0+080.000	4.86	6.09	4.155	4.605	11.198	46.52769	51.56679
9	0+095.289	3.78	5.19	4.32	5.64	15.289	66.04848	86.22996
10	0+100.000	4.65	6.36	4.215	5.775	4.711	19.856865	27.20603
11	0+104.156	3.39	6.66	4.02	6.51	4.156	16.70712	27.05556
12	0+113.024	2.63	11.58	3.01	9.12	8.868	26.69268	80.87616
13	0+120.000	4.96	1.08	3.795	6.33	6.976	26.47392	44.15808
14	0+140.000	1.43	18.1	3.195	9.59	20	63.9	191.8
15	0+149.628	4.43	20.3	2.93	19.2	9.628	28.21004	184.8576
16	0+160.000	2.15	19.5	3.29	19.9	10.372	34.12388	206.4028
17	0+163.094	1.55	15.2	1.85	17.35	3.094	5.7239	53.6809
18	0+176.559	6.85	17.25	4.2	16.225	13.465	56.553	218.4696
19	0+180.000	3.18	24.56	5.015	20.905	3.441	17.256615	71.93411
20	0+199.026	2.1	20.6	2.64	22.58	19.026	50.22864	429.6071
21	0+206.726	2.34	17.7	2.22	19.15	7.7	17.094	147.455
22	0+214.425	2.65	25.18	2.495	21.44	7.699	19.209005	165.0666
23	0+220.000	2.84	23.67	2.745	24.425	5.575	15.303375	136.1694
24	0+240.000	2.65	11.7	2.745	17.685	20	54.9	353.7
25	0+243.411	8.05	10.36	5.35	11.03	3.411	18.24885	37.62333
26	0+248.673	3.17	8.26	5.61	9.31	5.262	29.51982	48.98922
27	0+253.934	7.07	4.03	5.12	6.145	5.261	26.93632	32.32885
28	0+260	5.24	6.18	6.155	5.105	6.066	37.33623	30.96693
29	0+269.171	5.06	17.95	5.15	12.065	9.171	47.23065	110.6481
30	0+275.650	3.01	8.27	4.035	13.11	6.479	26.142765	84.93969
31	0+280.000	2.03	11.67	2.52	9.97	4.35	10.962	43.3695

32	0+282.130	7.23	4.51	4.63	8.09	2.13	9.8619	17.2317
33	0+282.293	7.95	4.92	7.59	4.715	0.163	1.23717	0.768545
34	0+293.574	9.58	1.43	8.765	3.175	11.281	98.877965	35.81718
35	0+300.000	3.07	0	6.325	0.715	6.426	40.64445	4.59459
36	0+304.854	9.75	0	6.41	0	4.854	31.11414	0
37	0+309.049	13.45	0	11.6	0	4.195	48.662	0
38	0+320.103	7.45	0	10.45	0	11.054	115.5143	0
39	0+331.157	22.51	0	14.98	0	11.054	165.58892	0
40	0+340.000	28.13	0	25.32	0	8.843	223.90476	0
41	0+350.057	35.39	0	31.76	0	10.057	319.41032	0
42	0+360.000	33.68	0	34.535	0	9.943	343.3815	0
43	0+360.774	30.65	0	32.165	0	0.774	24.89571	0
44	0+371.490	55.15	0	42.9	0	10.716	459.7164	0
45	0+377.428	63.6	0	59.375	0	5.938	352.56875	0
46	0+380.000	46.63	0	55.115	0	2.572	141.75578	0
47	0+387.070	50.87	0	48.75	0	7.07	344.6625	0
48	0+396.712	49.65	0	50.26	0	9.642	484.60692	0
49	0+400.000	38.75	0	44.2	0	3.288	145.3296	0
50	0+416.752	41.25	0	40	0	16.752	670.08	0
51	0+420.000	33.8	0	37.525	0	3.248	121.8812	0
52	0+426.788	22.53	0	28.165	0	6.788	191.18402	0
53	0+436.823	6.85	0	14.69	0	10.035	147.41415	0
54	0+ 440.000	5.86	0	6.355	0	3.177	20.189835	0
55	0+ 453.477	15.5	4.74	10.68	2.37	13.477	143.93436	31.94049
56	0+ 460.000	5.55	4.18	10.525	4.46	6.523	68.654575	29.09258
57	0+462.524	10.73	4.27	8.14	4.225	2.524	20.54536	10.6639
58	0+471.490	1.67	9.21	6.2	6.74	8.885	55.087	59.8849
59	0+480	5.93	4.57	3.8	6.89	8.591	32.6458	59.19199
60	0+500	7.85	0.53	6.89	2.55	20	137.8	51
61	0+ 509.245	5.37	1.16	6.61	0.845	9.245	61.10945	7.812025
62	0+519.318	8.76	0.11	7.065	0.635	10.073	71.165745	6.396355
63	0+529.392	18.75	0	13.755	0.055	10	137.55	0.55
64	0+536.818	22.2	0	20.475	0	0.042	0.85995	0
65	0+540.000	17.65	0	19.925	0	10.64	212.002	0
66	0+548.089	30.25	0	23.95	0	8.089	193.73155	0
67	0+559.360	26.24	0	28.245	0	11.271	318.34939	0
68	0+580.000	9.78	1.55	18.01	0.775	20.64	371.7264	15.996
69	0+581.214	7.37	3.1	8.575	2.325	1.214	10.41005	2.82255
70	0+590.923	16.31	2.59	11.84	2.845	9.709	114.95456	27.6221
71	0+600.632	4.65	5.13	10.48	3.86	9.709	101.75032	37.47674
72	0+601.993	13.02	3.14	8.835	4.135	1.361	12.024435	5.627735
73	0+611.150	7.19	1.7	10.105	2.42	9.157	92.531485	22.15994
74	0+620.307	4.2	3.43	5.695	2.565	9.157	52.149115	23.48771

75	0+629.777	17.17	0	10.685	1.715	9.47	101.18695	16.24105
76	0+640.569	18.65	0	17.91	0	10.792	193.28472	0
77	0+651.361	14.1	1.47	16.375	0.735	10.792	176.719	7.93212
78	0+659.883	14.47	0.66	14.285	1.065	8.522	121.73677	9.07593
79	0+671.425	11.14	0.04	12.805	0.35	11.542	147.79531	4.0397
80	0+682.967	7.91	2.59	9.525	1.315	11.542	109.93755	15.17773
81	0+702.037	4.85	1.11	6.38	1.85	19.07	121.6666	35.2795
82	0+709.930	5.47	2.24	5.16	1.675	7.893	40.72788	13.22077
83	0+717.832	14.36	0.65	9.915	1.445	7.902	78.34833	11.41839
84	0+721.719	13	0.3	13.68	0.475	3.347	45.78696	1.589825
85	0+732.300	24.76	0	18.88	0.15	11.121	209.96448	1.66815
86	0+742.882	23.45	0	24.105	0	10.582	255.07911	0
87	0+746.580	9.12	0	16.285	0	3.698	60.22193	0
88	0+756.493	10.67	0	9.895	0	9.913	98.089135	0
89	0+760.000	11.8	0	11.235	0	3.507	39.401145	0
90	0+766.407	9.67	0.12	10.735	0.06	6.407	68.779145	0.38442
91	0+770.418	1.76	3.12	5.715	1.62	4.011	22.922865	6.49782
92	0+780.000	2.76	4.11	2.26	3.615	9.582	21.65532	34.63893
93	0+781.966	2.53	2.76	2.645	3.435	1.966	5.20007	6.75321
94	0+793.515	3.26	1.11	2.895	1.935	11.549	33.434355	22.34732
95	0+797.696	1.79	0.45	2.525	0.78	4.181	10.557025	3.26118
96	0+800	2.17	0.36	1.98	0.405	2.304	4.56192	0.93312
97	0+812.967	3.12	0.32	2.645	0.34	12.967	34.297715	4.40878
98	0+820.000	2.27	7.32	2.695	3.82	7.033	18.953935	26.86606
99	0+828.238	7.34	4.24	4.805	5.78	8.238	39.58359	47.61564
100	0+828.238	2.32	5.11	4.83	4.675	11.762	56.81046	54.98735
101	0+840.000	5.45	0.26	3.885	2.685	18.669	72.529065	50.12627

Hence from the mass haul calculation

Area of cut = 9901.4217 cubic meters.

Area of fill = 3843.004 cubic meters.

Cut left = 6058.4181 cubic meters.

As the area of cut is greater than area of fill, this imbalance can increase hauling distance fuel consumption, which affect project overall cost and environment there .

The excess material will require either relocation, storage, or use in nearby construction projects. It is recommended that efforts be made to reuse the surplus material, potentially for future roadworks, embankment construction, or landscaping. Careful planning is necessary to minimize transportation costs and environmental impacts associated with material disposal.

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Lamachaur-16, Pokhara
BCE Survey Camp 2081

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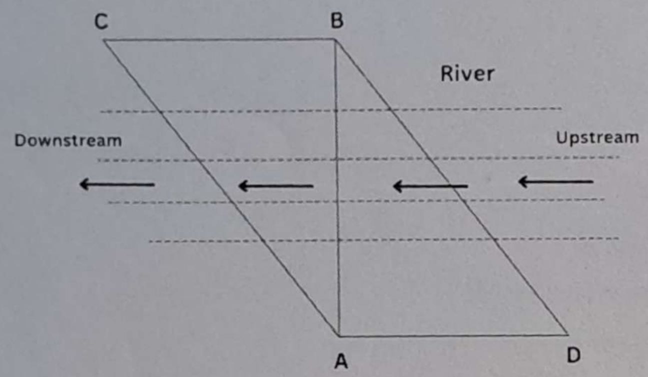
Weather: Sunny

18.Triangulation of Bridge Axis

Inst station	Sighted to	Face	HCR	Angle	Mean	Corrected Angle	Remarks
A	C	L	0°0'0"	39°59'20"	< BAC = 39°59'26"	39°59'19"	
		R	179°59'59"				
	B	L	39°59'20"	39°59'32"			
		R	219°59'31"				
A	C	L	0°0'0"	132°13'40"	< CAD = 132°13'32.5"	132°13'47.5"	
		R	179°59'59"				
	D	L	132°13'40"	132°13'25"			
		R	312°13'24"				
D	A	L	0°0'0"	53°53'38"	< ADB = 53°53'26"	53°53'48"	
		R	180°0'1"				
	B	L	53°53'38"	53°53'14"			
		R	233°53'15"				
B	A	L	0°0'0"	83°59'55"	< ABC = 83°59'48.5"	83°59'48.5"	
		R	180°0'3"				
	C	L	83°59'55"	83°59'42"			
		R	263°59'45"				
B	D	L	0°0'0"	117°51'17"		117°51'24"	

		R	180°0'13"		< CBD = 117°51'9.5"		
	C	L	117°51'17"	117°51'2"			
		R	297°51'15"				
C	B	L	0°0'0"	56°01'5"	< ACB = 56°01'7.5"	56°01'0.5"	
		R	180°0'8"				
	A	L	56°1'5"	56°01'10"			
		R	236°1'18"				

Calculation for triangulation



In ΔABC,	In ΔABD,
$\angle ACB=56°01'0.5''$	$\angle BAD=92°14'28.5''$
$\angle CAB=39°59'19''$	$\angle ABD=33°51'43.5''$
$\angle ABC=83°59'40.5''$	$\angle ADB=53°53'48''$

Base Line AD = 24.634 m		Base line BC = 27.674 m

Using sine law for the length of AB,

From ΔABD, and from ΔABC

$AB / \sin D = AD / \sin B$		$AB / \sin C = BC / \sin A$

Bridge Span, AB =35.7203 m		Bridge Span, AB = 35.7082 m

Average Bridge Span AB= 35.7143 m

Discrepancy = 0.0121

Precision=1/2951 (<1/2000). **Hence OK**

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19.Reciprocal Levelling

When instrument at left bank near A, Stadia reading at

	T	M	B
A	1.83	1.818	1.806
B	3.633	3.442	3.251

Level difference (H) = 1.624

When instrument is at right bank near B, Stadia reading at

	T	M	B
A	0.487	0.305	0.123
B	1.913	1.917	1.921

Level difference (H) = 1.612

Mean level difference = 1.618

A is at greater elevation than B.

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20.Computation of RL in triangulation points (Level Transfer)

Ins stn	Sighted to	BS			IS			Rise	Fall	RL	Remarks
		T	M	B	T	M	B				
1	TBM	1.693	1.635	1.577						700.000	
	A				1.601	1.565	1.529	0.07		700.070	
	D				0.72	0.629	0.538	0.936		701.006	

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21.Tacheometric Sheet for Detailing (Bridge Site)

Inst.Stn & Ht. of Instru- -ment (m)	Sighted to	HCR			Stadia Reading			VCR			Distance D= $KScos^2\theta$ (m)	Vertical Ht. H = $Dtan\theta$ (m)	RL = RL of Stn + HI ± V-M (m)	Remarks
		D	M	S	T	M	B	D	M	S				
														A
A	NORTH	0	0	0										
	D	291	2	24							24.634	AD		D
	B	198	47	56							35.714	AB		B
B HI = 1.41	Along the bridge axis													
	D	0	0	0	1.19	0.97	0.75	87	10	25	43.893	2.167	701.059	
	B1	32	58	35	1.29	1.07	0.85	83	11	37	42.790	5.107	703.899	
	B2	32	58	35	2.46	2.27	2.07	83	3	56	39.023	4.746	702.343	
	B3	32	47	21	2.64	2.46	2.29	85	42	9	35.002	2.630	700.031	
	B4	33	12	0	1.50	1.35	1.21	88	9	28	29.270	0.941	699.450	
	B5	32	1.0	6	1.57	1.44	1.31	91	34	22	25.980	-0.713	697.709	HFL

B6	30	56	38	2.51	2.43	2.35	92	57	59	16.256	-0.842	696.592	BL
B7	40	37	31	1.93	1.88	1.83	97	21	34	9.836	-1.270	696.717	
B8	38	19	49	2.79	2.78	2.77	98	45	41	1.954	-0.301	696.786	WL
B9	35	29	31	1.62	1.60	1.59	97	59	0	2.256	-0.316	697.943	
B10	159	8	20	1.42	1.40	1.39	89	31	47	3.000	0.025	698.484	
B11	218	13	38	0.36	0.34	0.33	66	25	55	2.352	1.026	700.546	
0+025 m Downstream													
C1	58	25	28	0.867	0.636	0.405	83	57	3	45.687	4.842	704.068	
C2	59	46	46	2.903	2.688	2.473	83	57	50	42.525	4.497	701.671	
C3	58	31	13	0.867	0.665	0.463	89	10	8	40.391	0.586	699.783	
C4	61	33	10	1.117	0.945	0.773	89	10	19	34.393	0.497	699.414	
C5	61	28	27	2.005	1.850	1.695	89	10	19	30.994	0.448	698.460	
C6	63	30	54	1.813	1.679	1.545	93	14	25	26.714	-1.512	696.671	WL
C7	106	41	0	2.008	1.880	1.768	94	10	22	23.873	-1.742	696.240	BL
C8	121	12	58	0.670	0.544	0.418	94	55	56	25.014	-2.159	697.159	
C9	124	39	25	1.974	1.849	1.725	91	30	12	24.883	-0.653	697.360	HFL
C10	128	46	35	1.452	1.323	1.195	89	9	13	25.694	0.380	698.919	
C11	137	7	32	2.586	2.448	2.310	80	28	41	26.845	4.503	701.917	
0 + 050m Downstream													
D1	86	49	4	1.520	1.250	0.900	90	15	13	61.999	-0.274	698.338	
D2	89	29	15	2.880	2.590	2.300	89	37	2	57.997	0.387	697.659	
D3	98	30	19	2.240	2.010	1.780	91	55	51	45.948	-1.549	696.303	HFL
D4	104	46	29	3.420	3.165	2.940	91	56	0	47.945	-1.618	695.079	BL
D5	115	12	13	2.743	2.485	2.227	92	17	23	51.518	-2.060	695.317	
D6	117	13	53	1.627	1.370	1.113	92	35	13	51.295	-2.318	695.812	HFL
D7	121	17	50	1.525	1.279	1.033	90	12	53	49.199	-0.184	698.399	
D8	124	43	51	3.573	3.330	3.087	87	36	37	48.516	2.025	698.557	

	B6	30	56	38	2.51	2.43	2.35	92	57	59	16.256	-0.842	696.592	BL
	B7	40	37	31	1.93	1.88	1.83	97	21	34	9.836	-1.270	696.717	
	B8	38	19	49	2.79	2.78	2.77	98	45	41	1.954	-0.301	696.786	WL
	B9	35	29	31	1.62	1.60	1.59	97	59	0	2.256	-0.316	697.943	
	B10	159	8	20	1.42	1.40	1.39	89	31	47	3.000	0.025	698.484	
	B11	218	13	38	0.36	0.34	0.33	66	25	55	2.352	1.026	700.546	
	0+025 m Downstream													
	C1	58	25	28	0.867	0.636	0.405	83	57	3	45.687	4.842	704.068	
	C2	59	46	46	2.903	2.688	2.473	83	57	50	42.525	4.497	701.671	
	C3	58	31	13	0.867	0.665	0.463	89	10	8	40.391	0.586	699.783	
	C4	61	33	10	1.117	0.945	0.773	89	10	19	34.393	0.497	699.414	
	C5	61	28	27	2.005	1.850	1.695	89	10	19	30.994	0.448	698.460	
	C6	63	30	54	1.813	1.679	1.545	93	14	25	26.714	-1.512	696.671	WL
	C7	106	41	0	2.008	1.880	1.768	94	10	22	23.873	-1.742	696.240	BL
	C8	121	12	58	0.670	0.544	0.418	94	55	56	25.014	-2.159	697.159	
	C9	124	39	25	1.974	1.849	1.725	91	30	12	24.883	-0.653	697.360	HFL
	C10	128	46	35	1.452	1.323	1.195	89	9	13	25.694	0.380	698.919	
	C11	137	7	32	2.586	2.448	2.310	80	28	41	26.845	4.503	701.917	
	0 + 050m Downstream													
	D1	86	49	4	1.520	1.250	0.900	90	15	13	61.999	-0.274	698.338	
	D2	89	29	15	2.880	2.590	2.300	89	37	2	57.997	0.387	697.659	
	D3	98	30	19	2.240	2.010	1.780	91	55	51	45.948	-1.549	696.303	HFL
	D4	104	46	29	3.420	3.165	2.940	91	56	0	47.945	-1.618	695.079	BL
	D5	115	12	13	2.743	2.485	2.227	92	17	23	51.518	-2.060	695.317	
	D6	117	13	53	1.627	1.370	1.113	92	35	13	51.295	-2.318	695.812	HFL
	D7	121	17	50	1.525	1.279	1.033	90	12	53	49.199	-0.184	698.399	
	D8	124	43	51	3.573	3.330	3.087	87	36	37	48.516	2.025	698.557	

	CP1	85	33	43	1.675	1.486	1.297	89	5	22	37.790	0.601	698.977	CP
CP 1	B	0	0	0										
	IS 1	129	29	13							53.746		694.975	
IS 1 HI = 1.446	**0 + 075m Downstream**													
	CP1	0	0	0	1	1.140	0.870	86	3	58	53.746	3.696	694.975	RL (IS 1)
	E1	303	57	42	2	1.800	1.630	80	23	32	33.053	5.595	700.216	
	E2	308	38	41	2	1.380	1.243	81	5	52	26.744	4.189	699.230	
	E3	311	56	50	2	1.550	1.430	83	4	51	24.342	2.954	697.825	
	E4	316	36	52	1	1.220	1.107	89	39	14	22.299	0.135	695.335	HFL
	E5	324	20	38	1	0.583	0.480	93	20	5	20.456	-0.952	694.885	
	E6	330	5	46	1	1.325	1.250	92	9	32	14.985	-0.482	694.614	BL
	E7	343	4	26	2	1.460	1.373	90	28	49	17.699	0.148	695.109	WL
	E8	355	43	11	2	1.490	1.405	87	49	44	16.976	0.644	695.574	
	E9	7	11	32	1	1.160	1.050	86	42	17	21.927	1.263	696.523	
	E10	16	8	24	1	0.455	0.365	84	47	26	17.852	1.628	697.593	
	E11	20	15	52	1	0.636	0.547	81	28	13	17.408	2.611	698.396	
	E12	26	14	2	1	0.694	0.595	76	39	4	18.745	4.448	700.175	
	0 + 100m Downstream													
	F1	252	30	54	1.785	1.696	1.607	80	39	15	17.331	2.852	697.577	
	F2	248	50	7	1.723	1.614	1.505	78	10	13	20.884	4.374	699.181	
	F3	249	2	27	1.463	1.363	1.263	83	32	7	19.746	2.238	697.295	
	F4	243	33	19	1.280	1.193	1.106	88	31	27	17.388	0.448	695.676	
	F5	226	42	20	1.483	1.420	1.357	94	0	6	12.539	-0.876	694.124	BL
	F6	214	9	58	0.795	0.739	0.683	98	59	13	11.033	-1.357	694.324	
	F7	207	59	41	0.865	0.817	0.769	98	22	58	9.431	-1.261	694.542	WL
	F8	184	47	33	1.285	1.240	1.195	92	40	11	8.995	-0.209	694.972	
	F9	162	36	2	1.290	1.244	1.198	87	31	21	9.183	0.397	695.574	HFL

	F10	156	16	33	0.523	0.471	0.419	76	11	38	9.808	2.410	698.360	
	F11	139	55	6	0.895	0.824	0.753	67	58	1	12.202	4.938	700.535	
	F12	133	35	37	1.245	1.146	1.047	62	28	39	15.572	8.114	703.389	
D													701.006	D
	A	0	0	0										
	IS2	125	33	0							14.4			IS 2
IS 2 HI= 1.464	**0 + 025 m Upstream**													
	D	0	0	0	0.969	0.867	0.825	78	44	21	14.400	2.867	697.542	RL (IS 2)
	G 1	146	5	50	1.581	1.441	1.301	76	16	50	26.425	6.451	704.016	
	G 2	146	28	49	1.527	1.401	1.275	78	55	20	24.270	4.752	702.357	
	G 3	143	13	15	1.53	1.421	1.312	86	11	13	21.704	1.447	699.031	
	G 4	143	23	46	1.44	1.348	1.256	90	35	25	18.398	0.190	697.847	HFL
	G 5	142	26	50	1.32	1.24	1.16	91	33	25	15.999	-0.124	697.642	
	G 6	142	7	50	1.582	1.514	1.446	92	19	3	13.588	-0.399	697.093	BL
	G 7	130	42	53	1.585	1.557	1.529	92	18	42	5.595	-0.165	697.284	
	G 8	121	33	24	1.498	1.477	1.456	92	12	48	4.196	-0.131	697.398	WL
	G 9	356	55	52	0.65	0.625	0.6	84	40	11	4.957	0.462	698.843	
	G 10	0	27	11	1.425	1.355	1.285	75	7	36	13.078	3.473	701.124	
	G 11	353	34	31	0.753	0.668	0.583	78	34	48	16.334	3.299	701.637	
	G 12	350	6	53	1.425	1.312	1.199	72	31	28	20.562	6.474	704.167	
	G 13	348	23	21	0.673	0.539	0.405	70	21	39	23.773	8.483	706.950	
	G 14	347	45	10	1.675	1.525	1.375	66	28	19	25.219	10.980	708.461	
	0 + 050 m Upstream													
	I 1	293	53	17	0.824	0.702	0.58	75	38	57	22.901	5.859	704.163	
	I 2	281	53	4	1.703	1.579	1.455	77	48	5	23.693	5.122	702.549	
	I 3	272	11	49	0.865	0.76	0.655	79	4	4	20.245	3.910	702.156	

	I 4	265	57	55	1.355	1.259	1.163	82	51	0	18.903	2.371	700.118	
	I 5	254	55	12	1.355	1.256	1.157	86	45	30	19.737	1.118	698.868	WL
	I 6	229	1	7	0.885	0.79	0.695	92	8	17	18.980	-0.617	697.599	BL
	I 7	216	14	36	0.68	0.58	0.48	92	48	19	19.991	-0.417	698.009	HFL
	I 8	201	25	42	1.425	1.331	1.237	90	9	36	18.800	0.052	697.727	
	I 9	194	34	14	0.81	0.68	0.55	90	44	30	25.996	0.337	698.662	
	I 10	193	23	22	0.47	0.335	0.2	88	51	8	26.989	0.541	699.212	
	0 + 075m Upstream													
	J 1	259	19	59	1.84	1.615	1.39	81	56	46	44.117	6.243	703.633	
	J 2	254	35	49	0.95	0.73	0.51	82	52	42	43.324	5.413	703.689	
	J 3	249	9	22	1.9	1.68	1.46	87	15	15	43.899	2.105	699.431	
	J 4	244	14	48	1.885	1.675	1.465	89	7	7	41.990	0.646	697.977	
	J 5	240	32	55	0.775	0.56	0.345	90	58	15	42.988	0.728	699.174	WL
	J 6	235	32	45	0.78	0.56	0.34	91	10	20	43.991	-0.636	697.810	BL
	J 7	232	39	42	0.84	0.615	0.39	90	52	22	44.990	0.685	699.076	HFL
	J 8	226	36	42	0.76	0.535	0.31	90	42	10	44.993	0.552	699.023	
	J 9	219	57	37	0.77	0.525	0.28	89	37	55	48.998	0.315	698.796	
													699.006	
	CP 2	213	48	2	0.895	0.656	0.417	90	42	15	47.793	0.587	698.937	CP2
CP 2	IS 2	0	0	0										
	IS 3	210	0	36							41.000			
	0 + 100m Upstream													
IS 3 HI = 1.442	CP 2	0	0	0	3.19	2.98	2.77	89	2	26	41.988	0.703	699.772	RL (IS 3)
	K 1	35	49	31	0.7	0.6	0.5	75	44	39	18.787199	4.773	705.387	
	K 2	7	20	55	1.63	1.545	1.46	91	0	36	16.994925	-0.294	699.375	
	K 3	18	1	11	1.787	1.701	1.615	84	54	11	17.064245	1.522	700.035	HFL
	K 4	23	13	8	1.306	1.219	1.132	82	3	33	17.067912	2.381	702.376	

	K 5	338	33	31	1.841	1.748	1.655	90	53	29	18.595498	0.289	699.755	
	K 6	325	59	30	1.245	1.145	1.045	94	14	5	19.913751	-1.311	698.759	BL
	K 7	323	9	34	0.595	0.494	0.393	94	14	3	20.112863	-1.324	699.396	WL
	K 8	319	2	42	0.77	0.71	0.65	89	17	33	11.99817	0.148	700.652	
	K 9	318	47	22	0.76	0.64	0.52	86	14	18	23.896699	1.571	702.145	
	K 10	312	39	35	0.671	0.555	0.439	83	32	30	22.906476	2.593	703.252	
	K 11	306	42	23	0.49	0.36	0.23	79	1	5	25.056457	4.862	705.716	
	K 12	302	1	48	1.91	1.763	1.616	76	15	15	27.740046	6.786	706.237	
	BRI.F.	292	22	43	1.63	1.374	1.118	68	48	28	44.509143	17.257	717.097	
	0 + 125m Upstream													
	L 2	277	59	58	1.444	1.293	1.142	78	24	22	28.980	5.946	705.867	
	L 3	269	50	8	0.965	0.853	0.741	89	41	7	22.399	0.123	700.484	
	L 4	265	8	13	1.18	1.117	1.054	93	9	40	12.569	-0.623	699.474	WL
	L 5	224	8	4	1.112	1.066	1.02	93	9	8	9.177	-0.457	699.692	
	L 6	220	21	2	1.43	1.388	1.346	93	9	3	8.379	-0.417	699.019	BL
	L 8	172	33	21	1.024	0.991	0.958	93	7	50	6.583	-0.330	699.893	
	L 9	150	33	46	0.555	0.513	0.471	93	7	41	8.379	**-0.420**	700.281	HFL
	GAVION WALL													
	I 1	196	43	25	1.475	1.392	1.309	90	41	50	16.598	0.202	700.024	
	I 2	196	40	53	0.749	0.662	0.575	90	41	54	17.397	0.212	700.764	
	I 3	207	14	41	0.669	0.554	0.439	88	13	45	22.978	**0.710**	701.370	
	0 + 150m Upstream													
	M 1	210	14	33	0.8	0.62	0.44	88	13	51	35.966	1.111	701.705	WL
	M2	219	45	56	1.375	1.17	0.965	86	48	43	40.873	2.277	702.321	HFL
	M 4	231	23	35	1.81	1.554	1.298	83	12	44	50.485	6.009	705.669	
	M 5	188	31	36	1.76	1.601	1.442	86	43	19	31.696	1.815	701.428	
	M 6	180	17	52	2.11	1.965	1.82	86	43	1	28.905	1.658	700.907	BL

	M 7	176	47	17	1.31	1.161	1.012	85	17	45	29.600	2.436	702.489	
	CP 3	190	4	20	2.35	2.195	2.04	85	17	45	30.792	2.534	701.553	CP3
CP 3	IS 3	0	0	0										
	IS 4	175	0	2							11.976			IS 4
IS 4 HI = 1.45	**0 + 175m Upstream**													
	CP 3	0	0	0	1.38	1.32	1.26	93	25	32	11.976	-0.538	701.961	RL (IS 4)
	BRI.F.	225	37	30	2.545	2.398	2.251	76	17	9	27.748	6.771	707.785	
	N1	228	0	54	1.535	1.46	1.385	85	31	21	14.909	1.167	703.119	
	N2	215	59	57	1.726	1.659	1.592	91	2	27	13.396	-0.224	701.528	
	N3	181	38	8	1.311	1.249	1.187	91	2	9	12.396	-0.209	701.954	
	N4	167	1	2	1.66	1.594	1.528	93	15	27	13.170	-0.631	701.186	
	N5	153	6	53	1.914	1.835	1.756	92	26	50	15.788	-0.428	702.148	HFL
	N6	139	59	29	1.315	1.213	1.111	93	55	18	20.373	-0.739	701.459	WL
	N7	137	3	48	1.245	1.14	1.035	94	6	6	20.903	-1.424	700.847	BL
	N8	132	46	31	0.897	0.779	0.661	94	6	7	23.491	-1.601	701.032	
	0 + 200m Upstream													
	O 1	212	32	44	1.61	1.43	1.25	87	25	45	35.928	1.613	703.594	
	O 2	207	27	47	1.52	1.345	1.17	89	29	2	34.997	0.315	702.382	
	O 3	198	23	7	0.657	0.48	0.303	90	30	3	35.397	0.309	703.241	
	O 4	192	56	1	1.965	1.78	1.595	90	45	34	36.993	0.490	702.122	WL
	O 5	187	52	0	2.238	2.092	1.946	90	32	14	29.197	0.274	701.593	BL
	O 6	185	3	57	1.531	1.331	1.131	88	32	48	39.974	1.014	703.094	HFL
	O 7	177	54	47	2.449	2.236	2.023	88	32	43	42.573	1.081	702.256	
	O 8	160	58	15	2.63	2.38	2.13	88	32	39	49.968	1.270	702.301	
	O 9	158	48	56	3.682	3.404	3.126	88	32	39	55.564	1.412	701.419	
	O 10	156	36	35	2.858	2.58	2.302	88	33	34	55.565	1.397	702.229	

Institute Of Engineering (IOE)
Western Regional Campus
Lamachaur-16, Pokhara
BCE Survey Camp 2081

Observer: Group I
Date: 2081/01/25

Recorder: Group I
Weather: Sunny

22.Co-ordinates Calculation for Bridge Site

Inst.Station & Ht.of Instrument (m)	Sighted to	HCR			Distance D=KScos²θ (m)	Bearing (α)	Latitude = Lcos (m)	Departure =Lsinα (m)	Northing (m)	Easting (m)	Remarks
		D	M	S							
									1000	1000	A
A	NORTH	0	0	0							
	D	291	2	24	24.634	291.040	8.844	-22.992	1008.844	977.008	D
	B	198	47	56	35.714	198.799	-33.809	-11.509	966.191	988.491	B
B HI = 1.41	**Along the bridge axis**										
	D	0	0	0	43.893						
	B1	32	58	35	42.790	17.915	40.716	13.163	1006.907	1001.654	
	B2	32	58	35	39.023	17.915	37.131	12.004	1003.322	1000.495	
	B3	32	47	21	35.002	17.728	33.340	10.658	999.531	999.149	
	B4	33	12	0	29.270	18.139	27.815	9.112	994.006	997.603	
	B5	32	1.0	6	25.980	16.957	24.851	7.577	991.042	996.068	HFL
	B6	30	56	38	16.256	15.883	15.636	4.449	981.827	992.940	BL
	B7	40	37	31	9.836	25.564	8.873	4.244	975.064	992.735	
	B8	38	19	49	1.954	23.269	1.795	0.772	967.986	989.263	WL

	B9	35	29	31	2.256	20.431	2.114	0.787	968.305	989.278	
	B10	159	8	20	3.000	144.078	-2.429	1.760	963.762	990.251	
	B11	218	13	38	2.352	203.166	-2.163	-0.925	964.028	987.566	
	0+025 m Downstream										
	C1	58	25	28	45.687	43.364	33.215	31.370	999.406	1019.861	
	C2	59	46	46	42.525	44.719	30.217	29.921	996.408	1018.412	
	C3	58	31	13	40.391	43.459	29.319	27.783	995.510	1016.274	
	C4	61	33	10	34.393	46.492	23.678	24.944	989.869	1013.435	
	C5	61	28	27	30.994	46.413	21.369	22.450	987.560	1010.941	
	C6	63	30	54	26.714	48.454	17.718	19.994	983.909	1008.485	WL
	C7	106	41	0	23.873	91.622	-0.676	23.863	965.515	1012.354	BL
	C8	121	12	58	25.014	106.155	-6.960	24.026	959.231	1012.517	
	C9	124	39	25	24.883	109.596	-8.345	23.442	957.846	1011.933	HFL
	C10	128	46	35	25.694	113.715	-10.334	23.525	955.857	1012.016	
	C11	137	7	32	26.845	122.065	-14.251	22.750	951.940	1011.241	
	0 + 050m Downstream										
	D1	86	49	4	61.999	71.757	19.409	58.883	985.600	1047.374	
	D2	89	29	15	57.997	74.427	15.571	55.868	981.762	1044.359	
	D3	98	30	19	45.948	83.444	5.246	45.647	971.437	1034.138	HFL
	D4	104	46	29	47.945	89.714	0.239	47.945	966.430	1036.436	BL
	D5	115	12	13	51.518	100.143	-9.072	50.713	957.119	1039.204	
	D6	117	13	53	51.295	102.170	-10.814	50.142	955.377	1038.633	HFL
	D7	121	17	50	49.199	106.236	-13.756	47.237	952.435	1035.728	
	D8	124	43	51	48.516	109.670	-16.330	45.684	949.861	1034.175	

	CP1	85	33	43	37.790	70.501	12.614	35.623	978.805	1024.114	CP
CP 1	B	0	0	0							
	IS 1	129	29	13	53.746	121.014	-27.692	46.063	951.113	1070.177	
						301.014					
IS 1 HI =1.446	**0 + 075m Downstream**										
	CP1	0	0	0	53.746						RL (IS 1)
	E1	303	57	42	33.053	244.976	-13.981	-29.950	937.131	1040.226	
	E2	308	38	41	26.744	249.659	-9.296	-25.076	941.816	1045.101	
	E3	311	56	50	24.342	252.961	-7.133	-23.273	943.980	1046.904	
	E4	316	36	52	22.299	257.628	-4.778	-21.781	946.335	1048.395	HFL
	E5	324	20	38	20.456	265.358	-1.656	-20.389	949.457	1049.788	
	E6	330	5	46	14.985	271.110	0.290	-14.982	951.403	1055.195	BL
	E7	343	4	26	17.699	284.088	4.308	-17.166	955.421	1053.010	WL
	E8	355	43	11	16.976	296.734	7.636	-15.161	958.749	1055.016	
	E9	7	11	32	21.927	-51.794	13.562	-17.230	964.674	1052.946	
	E10	16	8	24	17.852	-42.846	13.089	-12.140	964.201	1058.037	
	E11	20	15	52	17.408	-38.722	13.582	-10.890	964.695	1059.287	
	E12	26	14	2	18.745	-32.752	15.765	-10.141	966.877	1060.036	
	0 + 100m Downstream										
	F1	252	30	54	17.331	193.529	-16.850	-4.054	934.263	1066.122	
	F2	248	50	7	20.884	189.849	-20.576	-3.572	930.537	1066.604	
	F3	249	2	27	19.746	190.055	-19.443	-3.448	931.669	1066.729	
	F4	243	33	19	17.388	184.569	-17.333	-1.385	933.779	1068.791	
	F5	226	42	20	12.539	167.720	-12.252	2.667	938.861	1072.844	BL
	F6	214	9	58	11.033	155.180	-10.014	4.631	941.099	1074.808	
	F7	207	59	41	9.431	149.009	-8.085	4.856	943.028	1075.033	WL
	F8	184	47	33	8.995	125.807	-5.263	7.295	945.850	1077.472	

	F9	162	36	2	9.183	103.615	-2.162	8.925	948.951	1079.101	HFL
	F10	156	16	33	9.808	97.290	-1.244	9.728	949.868	1079.905	
	F11	139	55	6	12.202	80.932	1.923	12.049	953.036	1082.226	
	F12	133	35	37	15.572	74.608	4.133	15.013	955.246	1085.190	
D									1008.844	977.008	D
	A	0	0	0							
	IS2	125	33	0	14.4	236.590	-7.929	-12.020	1000.915	964.988	IS 2
						56.590					
IS 2 HI= 1.464	**0 + 025 m Upstream**										
	D	0	0	0	14.400						RL (IS 2)
	G 1	146	5	50	26.425	202.687	-24.380	-10.192	976.535	954.795	
	G 2	146	28	49	24.270	203.070	-22.329	-9.510	978.586	955.477	
	G 3	143	13	15	21.704	199.811	-20.419	-7.356	980.496	957.632	
	G 4	143	23	46	18.398	199.986	-17.290	-6.288	983.625	958.699	HFL
	G 5	142	26	50	15.999	199.037	-15.124	-5.219	985.791	959.769	
	G 6	142	7	50	13.588	198.721	-12.869	-4.361	988.046	960.626	BL
	G 7	130	42	53	5.595	187.305	-5.550	-0.711	995.365	964.276	
	G 8	121	33	24	4.196	178.147	-4.194	0.136	996.721	965.123	WL
	G 9	356	55	52	4.957	413.521	2.947	3.986	1003.862	968.973	
	G 10	0	27	11	13.078	57.043	7.114	10.973	1008.029	975.961	
	G 11	353	34	31	16.334	410.165	10.463	12.542	1011.378	977.530	
	G 12	350	6	53	20.562	406.705	14.101	14.966	1015.016	979.953	
	G 13	348	23	21	23.773	404.979	16.816	16.804	1017.731	981.791	
	G 14	347	45	10	25.219	404.343	18.036	17.627	1018.951	982.615	
	0 + 050 m Upstream										
	I 1	293	53	17	22.901	350.478	22.585	-3.788	1023.500	961.199	
	I 2	281	53	4	23.693	338.474	22.040	-8.693	1022.955	956.294	

	I 3	272	11	49	20.245	328.787	17.314	-10.491	1018.229	954.496	
	I 4	265	57	55	18.903	322.555	15.007	-11.493	1015.922	953.495	
	I 5	254	55	12	19.737	311.510	13.081	-14.780	1013.995	950.208	WL
	I 6	229	1	7	18.980	285.609	5.107	-18.280	1006.022	946.708	BL
	I 7	216	14	36	19.991	272.833	0.988	-19.967	1001.903	945.021	HFL
	I 8	201	25	42	18.800	258.018	-3.903	-18.390	997.012	946.597	
	I 9	194	34	14	25.996	251.161	-8.394	-24.603	992.521	940.385	
	I 10	193	23	22	26.989	249.979	-9.240	-25.358	991.675	939.629	
	0 + 075m Upstream										
	J 1	259	19	59	44.117	315.923	31.694	-30.689	1032.609	934.299	
	J 2	254	35	49	43.324	311.187	28.529	-32.604	1029.444	932.384	
	J 3	249	9	22	43.899	305.746	25.646	-35.629	1026.561	929.359	
	J 4	244	14	48	41.990	300.837	21.524	-36.054	1022.439	928.934	
	J 5	240	32	55	42.988	297.139	19.609	-38.255	1020.524	926.733	WL
	J 6	235	32	45	43.991	292.136	16.576	-40.748	1017.491	924.239	BL
	J 7	232	39	42	44.990	289.252	14.834	-42.474	1015.749	922.514	HFL
	J 8	226	36	42	44.993	283.202	10.276	-43.804	1011.190	921.183	
	J 9	219	57	37	48.998	276.550	5.589	-48.678	1006.504	916.309	
	CP 2	213	48	2	47.793	270.391	-4.672	-47.564	1001.241	917.196	CP2
CP 2	IS 2	0	0	0		90.391					
	IS 3	210	0	36	41.000	300.413	17.346	-38.238	1022.508	880.992	
						120.413					
	0 + 100m Upstream										
IS 3 HI = 1.442	CP 2	0	0	0	41.988						RL (IS 3)
	K 1	35	49	31	18.7872	156.256	-17.197	7.565	1005.311	888.557	
	K 2	7	20	55	16.99493	127.779	-10.411	13.432	1012.096	894.424	

	K 3	18	1	11	17.06424	138.450	-12.771	11.318	1009.737	892.310	HFL
	K 4	23	13	8	17.06791	143.649	-13.747	10.117	1008.761	891.108	
	K 5	338	33	31	18.5955	458.989	-2.906	18.367	1019.602	899.359	
	K 6	325	59	30	19.91375	446.422	1.243	19.875	1023.750	900.867	BL
	K 7	323	9	34	20.11286	443.590	2.245	19.987	1024.753	900.979	WL
	K 8	319	2	42	11.99817	439.476	2.192	11.796	1024.699	892.788	
	K 9	318	47	22	23.8967	439.220	4.470	23.475	1026.977	904.467	
	K 10	312	39	35	22.90648	433.090	6.663	21.916	1029.170	902.908	
	K 11	306	42	23	25.05646	427.137	9.735	23.088	1032.243	904.080	
	K 12	302	1	48	27.74005	422.461	12.826	24.597	1035.333	905.589	
	BRI.F.	292	22	43	44.50914	412.809	26.905	35.457	1049.412	916.449	
	0 + 125m Upstream										
	L 2	277	59	58	28.980	398.430	22.702	18.013	1045.210	899.005	
	L 3	269	50	8	22.399	390.266	19.346	11.290	1041.854	892.281	
	L 4	265	8	13	12.569	385.568	11.338	5.424	1033.846	886.416	WL
	L 5	224	8	4	9.177	344.565	8.846	-2.442	1031.354	878.549	
	L 6	220	21	2	8.379	340.781	7.912	-2.758	1030.420	878.234	BL
	L 8	172	33	21	6.583	292.986	2.571	-6.061	1025.078	874.931	
	L 9	150	33	46	8.379	270.993	0.145	-8.378	1022.653	872.614	HFL
	GAVION WALL										
	11	196	43	25	16.598	317.154	12.169	-11.287	1034.677	869.705	
	12	196	40	53	17.397	317.112	12.747	-11.840	1035.254	869.152	
	13	207	14	41	22.978	327.675	19.417	-12.287	1041.925	868.705	
	0 + 150m Upstream										
	M 1	210	14	33	35.966	330.673	31.356	-17.616	1053.864	863.376	WL
	M2	219	45	56	40.873	340.196	38.456	-13.848	1060.963	867.144	HFL
	M 4	231	23	35	50.485	351.824	49.972	-7.180	1072.479	873.812	

	K 3	18	1	11	17.06424	138.450	-12.771	11.318	1009.737	892.310	HFL
	K 4	23	13	8	17.06791	143.649	-13.747	10.117	1008.761	891.108	
	K 5	338	33	31	18.5955	458.989	-2.906	18.367	1019.602	899.359	
	K 6	325	59	30	19.91375	446.422	1.243	19.875	1023.750	900.867	BL
	K 7	323	9	34	20.11286	443.590	2.245	19.987	1024.753	900.979	WL
	K 8	319	2	42	11.99817	439.476	2.192	11.796	1024.699	892.788	
	K 9	318	47	22	23.8967	439.220	4.470	23.475	1026.977	904.467	
	K 10	312	39	35	22.90648	433.090	6.663	21.916	1029.170	902.908	
	K 11	306	42	23	25.05646	427.137	9.735	23.088	1032.243	904.080	
	K 12	302	1	48	27.74005	422.461	12.826	24.597	1035.333	905.589	
	BRI.F.	292	22	43	44.50914	412.809	26.905	35.457	1049.412	916.449	
	0 + 125m Upstream										
	L 2	277	59	58	28.980	398.430	22.702	18.013	1045.210	899.005	
	L 3	269	50	8	22.399	390.266	19.346	11.290	1041.854	892.281	
	L 4	265	8	13	12.569	385.568	11.338	5.424	1033.846	886.416	WL
	L 5	224	8	4	9.177	344.565	8.846	-2.442	1031.354	878.549	
	L 6	220	21	2	8.379	340.781	7.912	-2.758	1030.420	878.234	BL
	L 8	172	33	21	6.583	292.986	2.571	-6.061	1025.078	874.931	
	L 9	150	33	46	8.379	270.993	0.145	-8.378	1022.653	872.614	HFL
	GAVION WALL										
	I 1	196	43	25	16.598	317.154	12.169	-11.287	1034.677	869.705	
	I 2	196	40	53	17.397	317.112	12.747	-11.840	1035.254	869.152	
	I 3	207	14	41	22.978	327.675	19.417	-12.287	1041.925	868.705	
	0 + 150m Upstream										
	M 1	210	14	33	35.966	330.673	31.356	-17.616	1053.864	863.376	WL
	M2	219	45	56	40.873	340.196	38.456	-13.848	1060.963	867.144	HFL
	M 4	231	23	35	50.485	351.824	49.972	-7.180	1072.479	873.812	

	M 5	188	31	36	31.696	308.957	19.929	-24.647	1042.436	856.345	
	M 6	180	17	52	28.905	300.728	14.769	-24.847	1037.277	856.145	BL
	M 7	176	47	17	29.600	297.219	13.538	-26.322	1036.046	854.670	
	CP 3	190	4	20	30.792	310.503	19.999	-23.413	1042.506	857.579	CP3
CP 3	IS 3	0	0	0							
	IS 4	175	0	2	11.976	305.503	6.955	-9.750	1049.461	847.829	IS 4
						125.503					
IS 4 HI = 1.45	**0 + 175m Upstream**										
	CP 3	0	0	0	11.976						RL (IS 4)
	BRI.F.	225	37	30	27.748	351.128	27.416	-4.280	1076.877	843.550	
	N1	228	0	54	14.909	353.518	14.813	-1.683	1064.274	846.146	
	N2	215	59	57	13.396	341.502	12.704	-4.250	1062.165	843.579	
	N3	181	38	8	12.396	307.138	7.484	-9.882	1056.945	837.947	
	N4	167	1	2	13.170	292.520	5.044	-12.166	1054.505	835.664	
	N5	153	6	53	15.788	278.618	2.366	-15.610	1051.827	832.219	HFL
	N6	139	59	29	20.373	265.494	-1.601	-20.310	1047.861	827.519	WL
	N7	137	3	48	20.903	262.566	-2.704	-20.727	1046.757	827.102	BL
	N8	132	46	31	23.491	258.278	-4.772	-23.001	1044.689	824.828	
	0 + 200m Upstream										
	O 1	212	32	44	35.928	338.048	33.323	-13.431	1082.784	834.399	
	O 2	207	27	47	34.997	332.966	31.173	-15.907	1080.634	831.922	
	O 3	198	23	7	35.397	323.888	28.596	-20.862	1078.057	826.967	
	O 4	192	56	1	36.993	318.436	27.679	-24.543	1077.140	823.286	WL
	O 5	187	52	0	29.197	313.369	20.050	-21.225	1069.511	826.604	BL
	O 6	185	3	57	39.974	310.569	25.998	-30.366	1075.459	817.464	HFL

	O 7	177	54	47	42.573	303.416	23.445	-35.535	1072.906	812.294	
	O 8	160	58	15	49.968	286.474	14.170	-47.917	1063.631	799.913	
	O 9	158	48	56	55.564	284.318	13.742	-53.838	1063.203	793.991	
	O 10	156	36	35	55.565	282.113	11.659	-54.328	1061.120	793.501	

Institute Of Engineering (IOE)
Western Regional Campus
Lamachaur-16, Pokhara
BCE Survey Camp 2081

Observer: Group I　　　　Date: 2081/01/22

Recorder: Group I　　　　Weather: Cloudy

23. Profile Level and Cross Sectioning of River

Chainage	Point	Distance	Orientation	Elevation	Remarks
0+000 m (Along The Bridge Axis)	B1	26.551	Left	703.899	
	B2	25.777	Left	702.343	
	B3	24.435	Left	700.031	
	B4	18.297	Left	699.450	
	B5	16.161	Left	697.709	HFL
	B6	0.000	Center	696.592	BL
	B7	12.832	Right	696.717	
	B8	20.172	Right	696.786	WL
	B9	19.526	Right	697.943	
	B10	21.883	Right	698.484	
	B11	21.159	Right	700.546	
0+025m D/S	C1	34.712	Left	704.068	
	C2	31.481	Left	701.671	
	C3	30.250	Left	699.783	
	C4	24.378	Left	699.414	
	C5	22.090	Left	698.460	
	C6	18.796	Left	696.671	WL
	C7	0.000	Center	696.240	BL
	C8	6.286	Right	697.159	
	C9	7.681	Right	697.360	HFL
	C10	9.664	Right	698.919	
	C11	13.621	Right	701.917	
0+050 m D/S	D1	22.070	Left	698.338	
	D2	17.258	Left	697.659	
	D3	5.508	Left	696.303	HFL
	D4	0.000	Center	695.079	BL
	D5	9.714	Right	695.317	
	D6	11.270	Right	695.812	WL
	D7	14.013	Right	698.399	
	D8	16.723	Right	698.557	
0+075 m D/S	E1	20.682	Right	700.216	
	E2	13.921	Right	699.230	
	E3	11.129	Right	697.825	
	E4	8.481	Right	695.335	HFL

	E5	5.746	Right	694.885	
	E6	0.000	Center	694.614	BL
	E7	4.573	Left	695.109	WL
	E8	7.348	Left	695.574	
	E9	13.461	Left	696.523	
	E10	13.110	Left	697.593	
	E11	13.907	Left	698.396	
	E12	16.214	Left	700.175	
0+100 m D/S	F1	8.143	Right	697.577	
	F2	10.403	Right	699.181	
	F3	9.439	Right	697.295	
	F4	6.499	Right	695.676	
	F5	0.000	Center	694.124	BL
	F6	2.978	Left	694.324	
	F7	4.707	Left	694.542	WL
	F8	8.383	Left	694.972	
	F9	11.873	Left	695.574	HFL
	F10	13.078	Left	698.360	
	F11	16.999	Left	700.535	
	F12	20.516	Left	703.389	
0+025 m U/S	G1	12.904	Right	704.016	
	G2	10.770	Right	702.357	
	G3	8.122	Right	699.031	
	G4	4.822	Right	697.847	HFL
	G5	2.412	Right	697.642	
	G6	0.000	Center	697.093	BL
	G7	8.179	Left	697.284	
	G8	9.772	Left	697.398	WL
	G9	17.884	Left	698.843	
	G10	25.189	Left	701.124	
	G11	28.812	Left	701.637	
	G12	33.180	Left	704.167	
	G13	36.458	Left	706.950	
	G14	37.929	Left	708.461	
0+050 m U/S	I1	22.705	Left	704.163	
	I2	19.459	Left	702.549	
	I3	14.480	Left	702.156	
	I4	12.004	Left	700.118	
	I5	8.708	Left	698.868	
	I6	0.000	Center	697.599	BL
	I7	4.451	Right	698.009	WL
	I8	9.010	Right	697.727	
	I9	14.909	Right	698.662	
	I10	15.998	Right	699.212	HFL
0+075 m U/S	J1	18.159	Left	703.633	
	J2	14.464	Left	703.689	

	J3	10.415	Left	699.431	
	J4	6.820	Left	697.977	
	J5	3.926	Left	698.698	WL
	J6	0.000	Center	697.810	BL
	J7	2.452	Right	699.076	HFL
	J8	7.002	Right	699.023	
	J9	13.549	Right	698.796	
0+100 m U/S	K1	22.171	Right	705.387	
	K2	13.316	Right	699.375	
	K3	16.419	Right	700.035	HFL
	K4	17.886	Right	702.376	
	K5	4.414	Right	699.755	
	K6	0.000	Center	698.759	BL
	K7	1.009	Center	699.396	WL
	K9	4.835	Center	702.145	
	K10	5.792	Center	703.252	
	K11	9.080	Center	705.716	
	K12	12.509	Center	706.237	
0+125 m U/s	L2	25.499	Left	705.867	
	L3	18.113	Left	700.484	
	L4	8.871	Left	699.474	WL
	L5	0.986	Left	699.692	
	L6	0.000	Center	699.019	BL
	L8	6.280	Right	699.893	
	L9	9.587	Right	700.281	HFL
0+150 m U/S	M1	18.094	Left	701.214	WL
	M2	26.115	Left	702.321	HFL
	M4	39.387	Left	705.669	
	M5	5.163	Left	701.428	
	M6	0.000	Center	700.907	BL
	M7	1.921	Right	702.489	
0+175 m U/S	N1	28.949	Left	703.119	
	N2	25.632	Left	701.528	
	N3	17.954	Left	701.954	
	N4	14.621	Left	701.186	
	N5	10.275	Left	702.148	HFL
	N6	4.160	Left	701.459	WL
	N7	0.000	Center	701.032	BL
	N8	3.712	Right	708.234	
0+200 m U/S	O1	15.392	Left	703.594	
	O2	12.329	Left	702.382	
	O3	8.554	Left	703.241	
	O4	8.320	Left	702.122	WL
	O5	0.000	Center	701.593	BL
	O6	10.905	Right	703.094	HFL
	O7	14.708	Right	702.256	

	O8	27.332	Right	702.301	
	O9	33.218	Right	701.419	
	O10	34.150	Right	702.229	

7.REFERENCES

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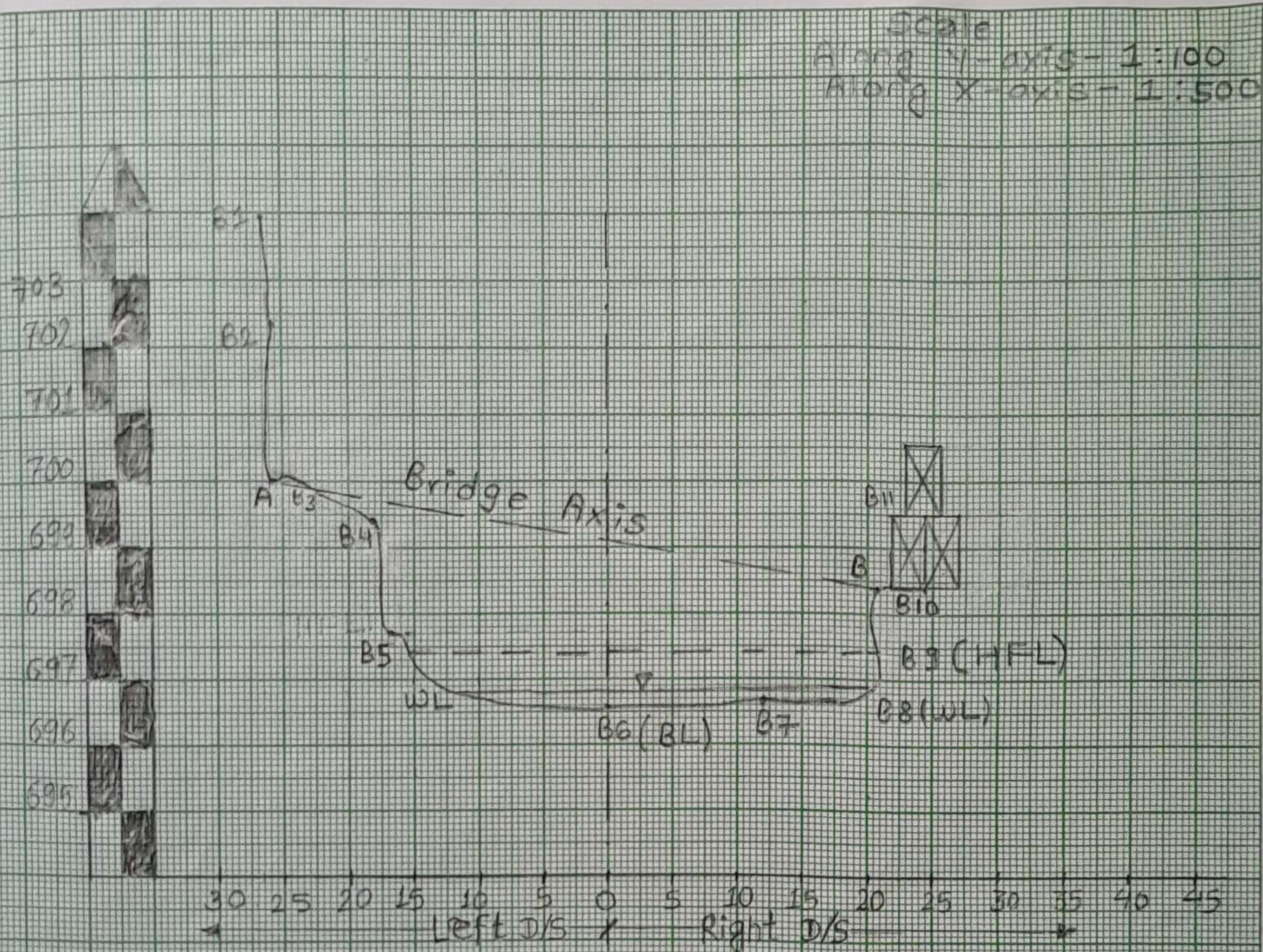
Annex – I

Name:
Level:
Roll No.:

Subject: . . . .

Date:

Page No.



CHAINAGE - 0+000 m
Bridge - Axis.

Bed level - 696.592 m

Water level - 696.786 m

High flood level - 697.709 m

Free board = B - B9
= 1 m.