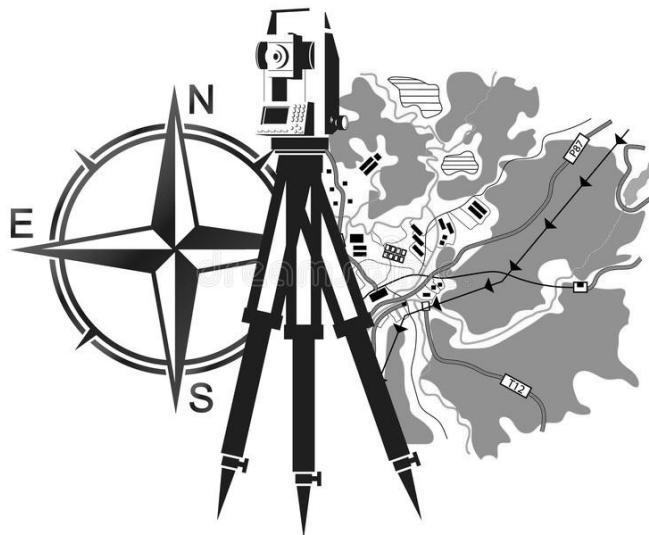




Tribhuwan University
Institute of Engineering
Central Campus, Pulchowk
Department of Civil Engineering

A Report on Survey Camp -2074



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Submitted To:

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ABSTRACT

Surveying is the process of determining the relative position of points on, above or under the surface of the earth, and is the most important part of Geomatics Engineering. The results of surveys are used to map the earth, prepare navigational charts, establish property boundaries, develop data of land used and natural resource information etc. Further survey maintains highways, railroads, buildings, bridges, tunnels, canals, dams and many more. Thus, the objective of survey camp was to make us gain the experience in this field by performing topographic survey in a large area, learning to propose road alignment and select suitable site for bridge axis. The report reflects the methodology, observations and calculations made by the students in the Camp with the corresponding drawings. The large portion of the course covered with elements of topographic surveying, and then those of road alignment and bridge site survey follow it. The main objective of the Survey Camp organized for us is to take an opportunity to consolidate and update our practical and theoretical knowledge in engineering surveying in the actual field condition. In this survey camp we have to prepare a topographic map of the given area, road and bridge site survey fulfilling all technical requirements. In this regard, we are required to carry out the necessary field works in our sub-group so that we will get ample opportunity to the decision on planning and execution of field works for the preparation of topographic map and detail road and bridge site survey. This survey camp helps us to build in our confidence to conduct engineering survey on required accuracy.

ACKNOWLEDGEMENT

The two-week SURVEY CAMP at Kirtipur acquainted us with Practical as well as theoretical knowledge for surveying in field. It also helped us to develop the co-operative feelings among ourselves regarding the practical aspects of the study because it stimulated group discussion, Co-operation, curiosity and motivation during the fieldwork.

We would like to thank Department of Civil Engineering, “Survey Instruction Committee”, Pulchowk Campus for initiating and facilitating this survey camp to further enhance our knowledge of surveying and its applications.

Out sincere appreciation goes to the teachers namely: Mr. Narayan Basnet, Mr. Bharat Bahadur Dhakal, Mr. Chandra Lal Gurung, Mr. Abhimanyu Lal Singh, Mr. Pradip Koirala, Mr. Bishnu Prasad Sharma, Mr Jayaram Maharjan. We would like to thank all teaching and non-teaching staffs for their kind co-operation with their friendly behavior and guidance during the whole survey work including fieldwork instructions, calculations, plotting and report preparation. We are also thankful to all our friends and colleagues for their support and help.

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

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ABSTRACT

This report is the outcome of two weeks Survey Camp 2076 (Kirtipur) organized by The Survey Instruction Committee, Department of Civil Engineering, IOE, Pulchowk Campus for the students of 074BCE Batch as per the Syllabus of BCE. The camp was held inside the Kathmandu Valley, in TU, Kirtipur from 18th Kartik to 27th Kartik, 2076 B.S.

The report reflects the methodology, observations, and calculations made by the students in the Camp with the corresponding drawings. The large portion is of course covered with elements of topographic surveying, and then those of road alignment and bridge site survey follow it.

Surveying is the science and art of determining the relative positions of above, on, or beneath the surface of earth, and is the most important part of Civil Engineering. The results of surveys are used to map the earth, prepare navigational charts, establish property boundaries, develop data of land used and natural resource information etc. Further survey maintains highways, railroads, buildings, bridges, tunnels, canals, dams and many more. Thus, the objective of survey camp was to make us gain the experience in this field by performing topographic survey in a large area, learning to propose road alignment and select suitable site for bridge axis.

The report is prepared with great efforts and dedications of the students who have devoted their immense from the very first time of fieldwork till today. The students are always learning for knowledge and promotions. Therefore, we feel that this report deserves the excuses and tolerances from the readers for any errors or blunders present, despite the best efforts.

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1 INTRODUCTION

Surveying is an art and science of determining the relative position of point on above or beneath the surface of the earth by means of angular and linear measurements. It is the most important subject matter 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 main objectives of surveying courses allocated for civil engineering students is to promote them the basic knowledge of different surveying techniques relevant to civil engineering works in their professional practice. The completion of all surveying courses including ten days survey camp work organized by the Department of Civil Engineering, “**Survey Instruction Committee**” of Pulchowk campus, IOE will give better enhancement to students to use all surveying technique covered in lecture classes.

Students of civil Engineering studying in third year were on survey camp 2076 in two shifts the first shift was from 18th Kartik to 27th Kartik, 2076 B.S. at TU Kirtipur, Kathmandu. The survey camp is the part of course of third-year, first part (III/I) civil engineering study.

This is a detail report of the works, which were performed by group no. 6, having five members, during the camp period. It briefly explains the working procedures and technique used by this group during that camp period. In addition, it also contains observations, calculations, methods of adjustment of error, main problem faced during work and their solution, results of all calculations and their assessments with some comments is presented in a concise form.

1.1 OBJECTIVES OF SURVEY CAMP

The main objectives of the survey camp are as follows:

- To become familiar with the surveying problems that are arise during the field works.
- To became familiar with the parts of the instruments, their functions and handling the surveying instruments for its use in surveying.
- To become familiar with the spirit and importance of teamwork, as surveying is not a single person work.
- To complete the given project in scheduled time and thus knows the value of time.
- To collect required data in the field in systematic ways.
- To compute and manipulate the observed data in the required accuracy and present it in diagrammatic and tabular form in order to understand by other engineers and related personnel easily.
- To tackle the mistake and incomplete data from the field while in office work.
- To know the complete method of report preparation.

1.2 LOCATION MAP



Figure 1

1.3 PROJECT AREA

Tribhuvan University, Kirtipur, Kathmandu.

1.4 LOCATION AND ACCESSIBILITY

Kirtipur is about 12km southern west part from Kathmandu. IswariRajmarg and Viswa Vidhyalayamarg links Kirtipur with Kathmandu. Kirtipur was also called Padma Kshetrapuri at ancient time. Kirtipur is assumed to be earth quake resistant area. The area to be surveyed is area under Tribhuvan University. The journey from Kathmandu to Kirtipur takes about 20minutes by bus.

- Country : Nepal
- Province : Bagmati
- District : Kathmandu
- Municipality : Kritipur
- Ward No. : 3
- Location : Tribhuvan University, Kirtipur Campus

1.5 TOPOGRAPHY AND GEOLOGY

Before starting our job, we should study about the existing position of the project area related to the natural grid line so that we can relate our result into the natural grid.

The latitude and longitude of Kirtipur are as follows:

Latitude : $29^{\circ} 22' 06''$ N

Longitude : $84^{\circ} 55' 00''$ E

Kirtipur is situated southern western part of Kathmandu valley and just below the Chandragiri Mountain. The average height of Kirtipur is 1414m above the mean sea level; area of Kirtipur is about 1400 hectares.

For conducting any type of work, we should know about the geology of that area. Geology plays a vital role for the construction maintenance and rehabilitation of any type of structure. Geologically Nepal is divided into five zones from south to north, which are extending towards east west direction and are separated by several geological structures called thrust. For our concern, the job site falls in “Lesser Himalaya Zone”.

Stratigraphically the central region of Nepal is divided into two major complexes, out of which one is Kathmandu Complex and another one is Nawakot complex. The Kathmandu valley and thus of course the survey camp site lies in Kathmandu complex which is separated from Nawakot complex by Mahabharat Thrust (M.T.).

1.6 TEMPERATURE, CLIMATE AND VARIATION

Kirtipur has very pleasant climate. The annual rainfall is about 3000mm. Major Crops grown in Kirtipur are maize, wheat, millet, paddy etc.

The altitude of Kirtipur is 1331.52 m from the sea level. Therefore, it has medium rainfall and temperate climate. Kirtipur lies in mid-hill region of Nepal hence the climate is pleasant. The variation of temperature in summer and winter at Kritipur are as follows:

Season	Max. Temperature °C	Min. Temperature °C	Rain Fall
Summer	34	16	90 mm
Winter	17	2	5 mm

Table 1-Temperature variation

The soil of Kritipur area seemed to be very vegetative. We saw a no. of fertile lands, dense vegetation and deciduous forest where oak, sal, bamboo trees are abundantly found.

1.7 OTHERS

Kirtipur is an ancient city with its unique history and pleasant environment. It has a number of places which are important from viewpoint of history, mythology and

tourism. The places of mythological importance include Bagh Bhairab Temple, Uma Maheswor Temple and Adhinath Temple. Kirtipur is one of Municipality City of Kathmandu district. The city is at a height more than the surrounding places so a beautiful view of Chobhar, Dharahara, Swoyambhu and Lalitpur can be seen from here. Kirtipur is gateway of Kathmandu valley. Kirtipur is important for its religious aspects. Kirtipur is famous for religious places as Bagh Bhairav Temple, Uma Maheswor Temple, Adinath Temple and antiquities archeology as Tribhuvan University, international cricket ground, Thai Bihar, Chiloncho Bihar etc. The main tribes of people are Newar about 90% people are newar rest of tribes is Brahman, Chhetri, Gurung, and Magar etc.

Tribhuvan University area lies at the center of the Kirtipur Municipality. It is oldest university of Nepal and biggest one from all campuses of Nepal. The campus is also important because it carries international cricket ground in its premises. The project area was divided into different parts for individual group. The main area of traversing includes almost all types of the land features like sloppy, dense forest, hedges, plain areas etc.

The whole area was sub-divided into various parts where the almost area covers educational buildings. The main buildings are Faculty of Education, Faculty of Humanities, Gandhi Bhawan, Library, CEDA building, Student's Club, Physical Science, Chemistry, Earth Science, Botany, Mathematics etc. and Coronation Park.

2 TOPOGRAPHIC SURVEY

2.1 OBJECTIVES

The main objective of the topographic survey is to prepare the topographic map of the given area with horizontal and vertical control at required accuracy. By topographical survey we can determine the positions both on plan and elevation, of the natural and artificial features of a locality for the purpose of delineating them by means of conventional sign upon a topographic Map.

2.2 BRIEF DESCRIPTION OF AREA

The area to be surveyed was a small part of Tribhuvan University, Kirtipur. Since the area over which the campus was situated was very large, the major traverse was run only to cover the small area, about one fifth area of the Tribhuvan University. Our objective was to prepare a topographic Map of the given small area, which is a part of the University. So, we are asked to prepare detail topographical map of the area which includes the following buildings and special ground features:

- ✓ Central Library
- ✓ Department of Economics
- ✓ Department of Management
- ✓ Administrative building (Clock Tower)
- ✓ Gandhi Bhawan
- ✓ CEDA
- ✓ TU Press
- ✓ Department of Education
- ✓ And other nearby small buildings and garden

These buildings and the important ground features are included between the minor traverse provided with one link traverse and four legs of major traverse.

2.3 TECHNICAL SPECIFICATION (Norms)

- Conduct reconnaissance survey of the given area. Form a close traverse (major and minor) around the perimeter of the area by making traverse station. In the selection of the traverse station maintain the ratio of maximum traverse leg to minimum traverse leg less than **2:1** for major and less than **3:1** for minor.
- Measure the traverse legs in the forward and reverse directions by means of a tape calibrated against the standard length provided in the field, note that discrepancy between forward and backward measurements should be better than **1:2000**.
- Measure traverse angle on two sets of reading by Total Station. The difference between face left and face right readings should be within $20''$. Note that difference between the mean angles of two sets reading should be within **1'**.
- Determine the R.L. of traverse stations by fly leveling from the given P.B.M. Perform two-peg test before the start of fly leveling. Note that collimation error should be less than **1:10000**. Maintain equal foresight and back sight distances to eliminate collimation error. The Permissible error for fly leveling is $(\pm 24\sqrt{K}) \text{ mm}$.
- Balance the traverse. The permissible angular error for the sum of interior angles of the traverse should be less than $\pm\sqrt{n} \times 30''$ for Major Traverse and $\pm\sqrt{n} \times 1'$ for Minor Traverse (n = no of traverse station). For major and minor traverse, the relative closing error should be less than **1: 5000** and **1: 3000** respectively.
- Plot the traverse stations by coordinate method in appropriate scale, i.e. **1:1000** for major traverse and **1:500** for minor traverses.
- Carry out the detail survey of the given area by tachometric method with reference to the major and minor traverse stations, which have been already plotted. Use conventional symbols for plotting.

2.4 EQUIPMENT AND ACCESSORIES

From our batch (072) the syllabus of the course study is changed. New course of study is designed to address the new change in surveying field practice. So, the study about total station is focused in this syllabus rather the theodolite as in earlier

batches. The followings are the main equipment's required and used during the field work:

- Total station
- Theodolite
- Leveling staffs (5m)
- Ranging Rods
- Measuring Tapes (30m & 5m)
- Leveling instrument
- Hammer
- Nails & pegs
- Plumb bob
- Compass
- Prism
- Prism holder
- Umbrella

2.5 METHODOLOGY

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

- I. Working from whole to a part.
- II. Independent check.
- III. Consistency of work.
- IV. Accuracy required

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

2.5.1 Traversing

Traversing is that type of surveying in which a number of connected survey lines form the frame work, which is used for housing, factory sides, determination of perimeter of lake, setting out and detailing of many engineering works. The main

purpose of traversing is to find control points. When there is large extend of chaining triangulation, generally traversing is used. It is the method of control survey.

The survey consists of the measurement of:

- I. Angle between the successive lines or bearing of each line.
- II. The length of each line.

The direction and the length of the survey lines are measured with the help of angle measuring instrument, theodolite and tape. If the coordinate of first station and bearing of first line are known, the coordinates of all successive points can be computed.

It eliminates the accumulation of errors which may happen when the scale and the protractor is used, as we can find out the coordinate of each station.

Traverse is of three types:

- 2.5.1.1 Close traverse (loop traverse)
- 2.5.1.2 Open traverse
- 2.3.1.3 Link traverse

2.5.1.1 Close traverse

If a traverse starts from a point, runs and ends on the same starting point then such traverse is called closed traverse. These types of traverse are run for a closed field survey. In this type of traverse, independent check is possible and adjustment can be done very easily.

2.5.1.2 Open traverse

If a traverse starts from a point, runs and ends at the point other than starting point is called open traverse. This type of traverse is run during the route survey like road, railway, canal, tunnel etc. In these types of traverse the error calculation and balancing is very difficult.

2.5.1.3 Link traverse

These are geometrically open but mathematically closed traverse. This type of traverse starts from a known point and ends at another known point. Also in this type of traverse the calculation and balancing of error can be done easily.

Depending upon the instrument used in determining the relative directions of the traverse lines, there are several methods of traversing such as:

1. Chain traversing
2. Chain and compass traversing
3. Transit tape traversing
4. Plane table traversing
5. Theodolite traversing

2.5.2 Balancing of Traverse

There are two methods of balancing of traverse: -

- II.3.2.1 Bowditch's method
- II.3.2.2 Transit method

2.5.2.1 Bowditch's method

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

$$= (\text{Total error in latitude (or departure)} * \text{length of that side}) / \text{Perimeter of traverse}$$

2.5.2.2 Transit method

In this method, the total error in latitude & departure is distributed in proportion to the latitude & departure of its side. This rule is adopted when angular measurements are precise rather than linear measurements. This rule provides correction to latitude & departure of any side.

Correction in Latitude (or Departure) of any side

$$\text{= } \frac{\text{Total error in latitude or departure} * \text{latitude (or departure) of that line}}{\text{Arithmetic sum of latitude (or departure)}}$$

2.5.2.3 Tachometry

Tachometry is the branch of angular surveying in which the horizontal and vertical distances of points are obtained by optical means as opposed to the ordinary slower process of measurements by tape or chain. This method is very rapid and convenient.

The primary objective of Tachometry is to prepare the contoured map or plans requiring both horizontal as well as vertical control. It also provides the check on distance measure with a tape of required. It is more suitable in the obstacles such as steep and broken ground, deep ravines, stretches of water or swamp and so on.

The formula for horizontal distances is:

$$H = k * s * \cos^2\theta + C * \cos \theta$$

The formula for vertical distance is:

$$V = (k * s * \sin 2\theta)/2 + C * \sin \theta$$

Where,

k = multiplying constant ($=100$)

C =additive constant ($=0$, for analectic lens)

s =staff intercept = Top reading – Bottom reading (T-B)

θ =angle of (elevation/depression)

2.5.2.4 Leveling

Leveling is a branch of surveying the object of which is

- ❖ To find the elevation of given points with respect to a given or assumed datum.

- ❖ To establish points at a given elevation or at different elevations with respect to a given or assumed datum.

The first operation is required to enable the works to be designed while the second operation is required in the setting out of all kinds of engineering works. Leveling deals with measurements in a vertical plane

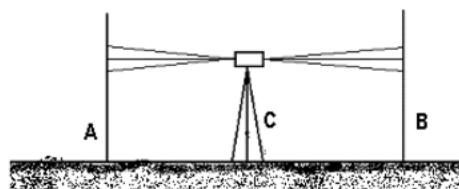
Temporary adjustments of Level:

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 eye-piece 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.

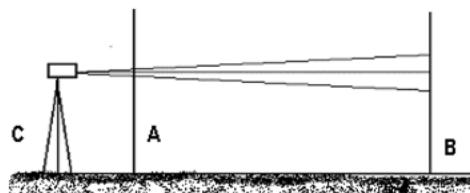
Permanent adjustments of Level:

To check for the permanent adjustments of level two-peg test method should be performed. Two staffs were placed at A and B of known length (about 60 m). First the instrument was setup on the line near B and both staff readings (Top, Middle, and Bottom) were taken. Then, the instrument was setup at the middle C on the line and again both staff readings on A and B was taken. Then computation was done in order to check whether the adjustment was within the required accuracy or not. No permanent adjustment was required since the error was within the permissible value.



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Two peg test arrangement

Two staffs were placed at A and B of known length (about 60m). First the instrument was setup at the middle point C and both staff readings (Top, Middle and Bottom) were taken. Then, the instrument was setup at D near the A on the line AB and again both staff readings were taken. Then computation was done in order to check whether the adjustment was required or not.

Booking and 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:

$$\Sigma B.S. - \Sigma F.S. = \text{Last R.L.} - \text{First R.L.}$$

2. Rise and Fall method
Arithmetic Check:

$$\Sigma B.S. - \Sigma F.S. = \Sigma \text{Rise} - \Sigma \text{Fall} = \text{Last R.L.} - \text{First R.L.}$$

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

Fly Leveling

The RL of Given TBM1 point was found by transferring the level from Known BM located at Lab School by the process of fly leveling. In this method auto level was used and the level was transferred directly by taking BS and FS at every Turning Point.

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:

$$\text{Permissible error} = \pm 24\sqrt{k} \text{ mm.}$$

Where k is perimeter in Km

$$\text{Actual Error (e)} = \sum \text{BS} - \sum \text{F.S.} = \text{Last R.L.} - \text{First R.L.}$$

$$\text{Correction } i^{\text{th}} \text{ leg} = -(e \times (L_1 + L_2 + \dots + L_i)) / P$$

Where L_1, L_2, L_i Length of 1st, 2nd, ..., ith leg.

P is perimeter

$$\text{Relative Precision} = 1/(p/e)$$

2.5.2.5 Contouring

Contour is the imaginary line joining the equal elevation, with reference to given or assumed datum, on the natural ground surface. The branch of surveying that deals with development of contour line is called contouring. Every fifth contour is made darker than other is called index contour. The elevation difference between two consecutive contours is called the contour interval. The contour interval is the important parameter to be considered during the surveying field work. The large contour interval is suitable for the steep hilly areas while small contour interval is suitable for the plain areas. The least horizontal distance between two consecutive contours is called the horizontal equivalent.

2.5.2.5.1 Methods of contouring

There are two ways of contouring. They are namely:

2.5.2.5.1.1 The Direct method

2.5.2.5.1.1 The Indirect method

2.5.2.5.1.2 The Direct method

In this direct method, the contour to be plotted is actually traced on the ground. Only those points are surveyed which happen to be plotted.

2.5.2.5.1.3 The indirect method

In this method, some suitable guide points are selected and surveyed, the guide points need not necessarily be on the contours. These guide points, having been plotted, serve as the basis for the interpolation of contours. There are some of the indirect methods of locating the ground points:

- a. By squares
- b. By cross-sections
- c. By tachometric method
- d.

2.5.2.5.2 Contour Interpolation

The process of drawing contours proportionately between the plotted ground points or in between the plotted 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

2.5.2.5.3 Contour Characteristics

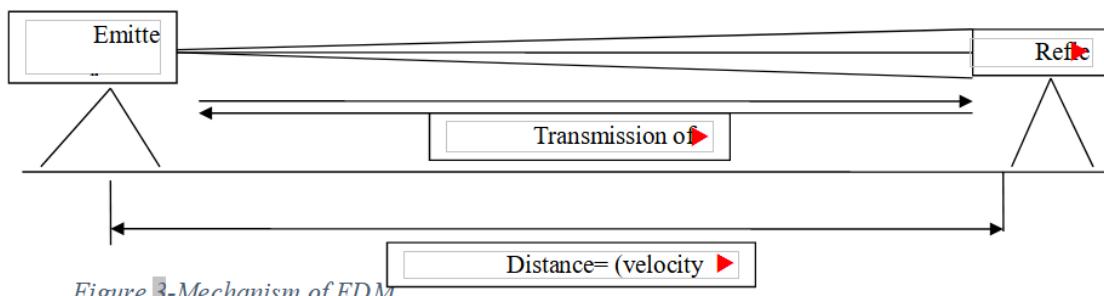
- ⦿ Two contours of different elevations do not cross each other except in the case of an overhanging cliff.
- ⦿ Contours of different elevations do not unite to form one contour except in the case of a vertical cliff.
- ⦿ Contours drawn closer depict a steep slope and if drawn apart, represent a gentle slope.
- ⦿ Contours equally spaced depict a uniform slope. When contours are parallel, equidistant and straight, these represent an inclined plane surface.
- ⦿ Contour at any point is perpendicular to the line of the steepest slope at the point.

- ⦿ A contour line must close itself but need not be necessarily within the limits of the map itself.
- ⦿ A set 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 the sides of a ridge or a valley.
- ⦿ Contours do not have sharp turnings.

2.5.2.6 Electronic Distance Measurement (EDM)

These are the instruments used to measure the distance between any two points. This system consists of the emitter and the reflectors. The emitter produces the electronic waves which travels to the reflector and then reflects back. The measured time interval between emission and receiving back the distance can be calculated easily. The emitter instruments emits the electromagnetic waves like radio wave, light wave etc.

$$\text{Distance} = (\text{Velocity of EMW} * \text{time interval})/2$$



2.6 RECONNAISSANCE

Recce means the exploration or scouting of an area. To prepare a good topographic map of any area, it is necessary to know about the area in proper way so that we can plan our work and complete it in systematic order and in short span of time with less effort. For this purpose, the detail inspection of the given area of Tribhuvan University was carried out by reconnaissance survey.

While doing reconnaissance we find out the major and minor traverse control points to form a closed traverse around the perimeter of the area. While selecting the major and minor control points following points should be taken into account:

- i. The adjacent stations should be clearly inter-visible and cover the whole area with least number of stations as far as possible. The traverse station should maintain the ratio of maximum traverse leg to minimum traverse leg less than 2:1.
- ii. The steep slopes and badly broken ground should be avoided as far as possible, which may cause inaccuracy in taping.
- iii. The stations should provide minimum level surface required to set up the tripod of the instrument.
- iv. The traverse line of sight should not be near the ground level to avoid the refraction.
- v. If possible, well-conditioned triangles should be formed to give good graphical intersection during plotting.

Walking around at least three times inspected the whole area and major ground features were noted. The possible location of major and minor control points was decided by inspecting the indivisibility of the stations. After sketching rough outlines of the area and possible station distances of legs were estimated to make them within specific range i.e. 1:2 ratios. For minor traverse, all the detail available was noted. After checking the requirements for a good station, the points were fixed for major and minor stations by driving wooden pegs on the ground and it was name by a marker. The measurements of each station from reference points such as permanent

objects near it were taken. Hence, the recce survey was completed after fixing all the control points.

2.7 MAJOR TRAVERSE

The skeleton of lines joining those control points, which covers the whole entire area, is called Major Traverse. Work on Major traverse must be precise. So two-set of reading should be taken for Major Traverse. For convenience, the readings are taken by setting the total station at $0^{\circ}0'0''$ for one set and $90^{\circ}00'00''$ for the second.

In the Kirtipur Survey Camp, two traverses - major and minor had to be established. The major traverse had 19 control stations including two given control points. The control stations were named as M1, M2,..., M17 along with CP1 and CP2 (the two given control points) .The leg ratio of maximum traverse leg to minimum traverse leg was maintained within 1:2. The discrepancy in length between the forward measurements and the backward measurements of all the traverse legs was within 1:5000. Two sets of theodolite readings were taken for measuring the horizontal traverse angles. The difference between the mean angles of two sets of readings was within a minute for all the angles.

The distances between the adjacent control points were measured accurately as far as possible for the accuracy of the whole traverse. To attain the accuracy required i.e. 1:5000 ratio, a two-way EDM measurement was done independently so that the length from each measurement was found within specified range.

2.7.1 Computation of Co-ordinates

According to the accuracy aimed and the nature of the ground, the lengths of traverse legs are measured directly on the ground either by chaining or taping. The traverse angles are measured with a theodolite by setting up the instrument at each station in turn and the vertical angle at each station measured will help to find the

tachometric distance and reduce level of that point. And the bearing of the any one of the traverse legs measured and the entire traverse angle measured, the bearing of all the legs can be calculated by:

$$\text{Bearing of a line} = (\text{bearing of previous line} + \text{included angle}) \pm (180) \text{ or } (540)$$

If θ is the bearing of line (c.p,A say), and L be the length of the line and provided that co-ordinate of the control point(c.p) is known then the co-ordinate of the point 'A' can be calculated as follow:-

$$X\text{-coordinate of A} = x\text{-coordinate of control point (c.p)} + L * \sin\theta$$

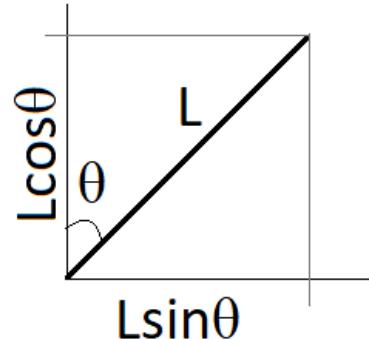
$$Y\text{-coordinate of A} = y\text{-coordinate of control point (c.p)} + L * \cos\theta$$

$$R.L \text{ or z-coordinate of A} = R.L \text{ of point (c.p)} + H.I \pm H * \tan\theta - \text{Height of signal.}$$

Where,

H.I = Height of instrument

H = horizontal distance = $L\cos\theta$



2.8 MINOR TRAVERSE

It is not sufficient to detail the area by enclosing with the help of major traverse. Minor traverse is that one which runs through the area to make detailing easy. Minor Traverse covers only small area. Less precise work than that of major traverse is acceptable so that single set reading is sufficient. The minor traverse had 7 control stations and enclosed the CNAS building and management building as the

major details. The control stations were named as 1M5, 1M6 and so on along with the seven control stations common for both the major and the minor traverses. The leg ratio of maximum traverse leg to minimum traverse leg was maintained within 1:3. The discrepancy in length between the forward measurements and the backward measurements of all the traverse legs was within 1:1000. Measurement of Horizontal and Vertical

Two set of horizontal angles was measured at each station and one set of vertical angle. And it was done in the following way:-

- i) One the face left temporary adjustment was done.
- ii) After setting zero to the first station the second station was sighted by unclamping the upper screw.
- iii) For better accuracy and exact bisection horizontal angle was measured at the bottom of the arrow.
- iv) And on the same setting or same face vertical angle at both the station was taken.
- v) Now again changing the face the horizontal angle was taken and vertical angle too.
- vi) Now setting the reading to ninety at the first station again one set of horizontal angles was taken but the vertical angle is enough, taken earlier.
- vii) Before shifting the instrument to the next station, the height of instrument was taken.
- viii) Similarly, the instrument was shifted to other station and in each station one set of vertical angles and two set of horizontal angle and height of instrument was measured.

For comparison of the tape distance and the Tachometric distance the stadia reading (top, mid, bottom) was taken at each station and for the calculation of the reduce level of each station we need to read mid reading which can be compared with the level transferred using auto level.

2.9 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 use total station while taking details during the camp. This takes less time and computation work.

2.10 Total Station

2.10.1 Introduction

A total station is an optical instrument used a lot in modern surveying and archaeology and, in a minor way, as well as by police, crime scene investigators, private accident reconstructionist and insurance companies to take measurements of scenes. It is a combination of an electronic theodolite (transit), an electronic distance meter (EDM) and software running on an external computer known as a data collector

With a total station one may determine angles and distances from the instrument to points to be surveyed. With the aid of trigonometry and triangulation, the angles and distances may be used to calculate the coordinates of actual positions (X, Y, and Z or northing, easting and elevation) of surveyed points, or the position of the instrument from known points, in absolute terms.

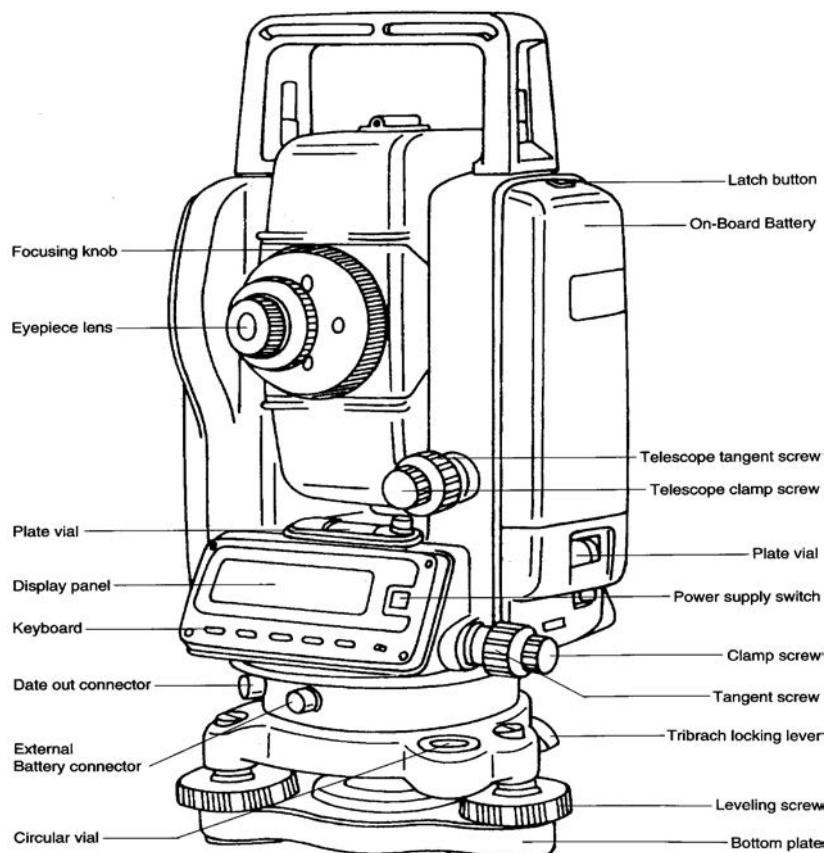


Figure 3-Totalstation

Some total stations also have a GPS interface which combines these two technologies to make use of the advantages of both (GPS - line of sight not required between measured points; Traditional Total Station - high precision measurement especially in the vertical axis compared with GPS) and reduce the consequences of each technology's disadvantages (GPS - poor accuracy in the vertical axis and lower accuracy without long occupation periods; Total Station - requires line of sight

observations and must be set up over a known point or within line of sight of 2 or more known points).

Most modern total station instruments measure angles by means of electro-optical scanning of extremely precise digital bar-codes etched on rotating glass cylinders or discs within the instrument. The best quality total stations are capable of measuring angles down to 0.5 arc-second. Inexpensive "**construction grade**" total stations can generally measure angles to 5 or 10 arc-seconds.

Measurement of distance is accomplished with a modulated microwave or infrared carrier signal, generated by a small solid-state emitter within the instrument's optical path, and bounced off of the object to be measured. The modulation pattern in the returning signal is read and interpreted by the onboard computer in the total station. The distance is determined by emitting and receiving multiple frequencies, and determining the integer number of wavelengths to the target for each frequency. Most total stations use a purpose-built glass Porro prism as the reflector for the EDM signal, and can measure distances out to a few kilometers, but some instruments are "**reflectorless**", and can measure distances to any object that is reasonably light in color, out to a few hundred meters. The typical Total Station EDM can measure distances accurate to about 3 millimeters or 1/100th of a foot.

Some modern total stations are '**robotic**' allowing the operator to control the instrument from a distance via remote control. This eliminates the need for an assistant staff member to hold the reflector prism over the point to be measured. The operator holds the reflector him/herself and controls the total station instrument from the observed point.

The basic principle of Total Station is that the distance between any two points can be known once the time light takes to travel the distance and back and the velocity of light is known. Then the following relation, which is already programmed in the

memory of the instrument along with other correction factors, calculates the required horizontal distance and is displayed on the LCD screen.

$$\text{Distance} = (\text{velocity of EMW} * \text{time taken})/2$$

2.10.2 Setup

1. Place tripod approximately over a known point locking legs at a convenient height so machine will be at or lower than eye level and the legs are at equal distances from each other. Eyeball the head of the tripod so it is as close to level as possible.
 - * Be sure the legs of the tripod are firmly planted into the ground.
 - * For smooth surfaces (such as concrete, asphalt, or tile), use folding metal tripod footing to secure the legs.
2. Remove instrument carefully from casing with both hands. Place on top (supporting with top handle) of tripod and tighten centering screw below platform into instrument, aligning the three corners of machine and platform. Use sight tangent screw on back side of LCD display to center the instrument over the exact known point to be surveyed.

2.10.3 Power and preparation

1. Attach one of the batteries to the side of instrument with the clamp side up. Press any one of the five buttons below the display to turn on machine. It shall beep and the display should indicate the instrument is not level and must be leveled and indexed (precisely level internal components).
 - * To switch power off, hold ESC button and press indicated button that corresponds to OFF on the display.
 - * If the battery is at a low level, the following will be displayed, “**Battery is low!**” -switch batteries and charge the drained one using provided jack.
 - * Prior to storing the instrument for its next use, check the status of both provided batteries. If either is only ENTIRELY drained, charge overnight using given equipment.
2. Locate the horizontal level bubble above the LCD display. Rotate instrument by loosening the horizontal clamp and align the display with any two of the leveling screws. Tighten or loosen the left screw so bubble is in center. Rotate instrument clockwise to the next two screws and again use the left one to center bubble. Rotate to the final two pair of screws and center bubble. Check stationary leveling bubble to see if it is center. If not, repeat previous leveling process.
 - * If the error message “**Tilt out of range**” is displayed, it is indicating the instrument is off-level. Relevel the instrument.

3. To index the vertical circles, loosen the vertical clamp, and manually rotate the telescope either way twice. The beep should be heard and the zenith angle (**ZA**vertical angle) will appear on the LCD display.
4. Loosen the horizontal clamp and rotate the instrument clockwise twice to index the horizontal circles. The beep is heard again and the horizontal angle (**HAR**) is displayed.
 - * Vertical and horizontal indexing has now been completed.
5. Note the menus displayed. Each option shown on the home page (reached by pressing **ESC**) opens a section which contains several (up to 3) pages. To scroll through these pages to reach other options, press button left of the yellow **ESC** button that reads →PX.
6. Set the target and instrument height by pressing **Ht.** in **S-O** mode. Measure the target height by reading the measurement on the reflector pole at the clamp (set at any arbitrary height suitable for job). Measure the instrument height by taping the distance from the black point on side of instrument (level with center of telescope) to the known point on ground.
 - * Be sure to note the units used (currently default set at feet and decimal fractions of feet; see manual to change to metric units) and height of instrument and target in the field book.
 - * When using two reflecting poles, be sure to set each at same height.

2.10.4 Angle measurement

1. Sight the first point (focus with eye piece and align center hairs with center of reflector) using the horizontal clamp and the fine motion screw. Set the angle to zero by pressing **OSET** in **THEO** mode. Sight the second target and read the **HAR** on the display.
 - * If you wish to read the angle by rotating the instrument to the left, press **R/L** in **THEO** mode (display will read **HAL** or **HAR** for left or right respectively).
2. For higher accuracy, the average of a number of readings can be taken using repetition. Sight the first target and press **REP** in **THEO** mode. Press **BS** (back sight) then sight the second target. Press **FS** (fore sight) and the angle between the two will be displayed. Sight the first target again, presses **BS**, and site the second target again and press **FS**. The average of the two readings will be displayed. Repeat up to 10 times for higher accuracy.
3. The slope of the line being shot can be displayed as a percentage by pressing **ZA%** in **THEO** mode. This is read as **VA** and gives the percentage grade of the line. Press it again to return to the **ZA** reading.
 - * **VA%** will be displayed when the parameter is set to “Horizontal 0” instead of “Zenith 0” but performs the same function.

2.10.5 Distance and angle measurement

This is the most useful and suggested method. The working procedure is described as follow:

1. Sight target and select for slope, horizontal, or height (**SHV**) measurement. Press **Sdistto** start the measurement and **STOP** to end. The distance, vertical, and horizontal angle are displayed. Press **SHV** to view the other measurements (Horizontal distance or Height difference).
2. To measure the horizontal distance several times and display the average, sight the target and press **Hdistin THEO** mode. Three measurements are taken and the average (**H-A**) is displayed after a few seconds.
 - * The most recently taken data can be recalled and displayed by pressing **RCL** in the **EDM** mode.

2.10.6 Coordinate measurement

This is not much more useful. So, co-ordinate measurement is not suggested for use.

1. In order to begin the coordinate measure, set the initial coordinates of the station. This is done by pressing the **S-O** button at the main menu. Then press the **Stn-P** button on the second page of the **S-O** menu. Choose the **Input** button, then set the initial coordinates and press **ENTER**.
2. Sight the target and press **COORD** in **S-O** mode, then press **STOP** to end the measurement. The coordinates of the target are given with respect to the initial starting position (0,0,0) and designated direction to be North.

2.10.7 Measuring the distance between two points

1. Sight the first position and press either **Sdist**, **Hdist**, or **Vdistin EDM** mode to start the measurement. Stop the measurement by pressing the **STOP** and sight the next point. Press **MLM** on the same page to start the measurement, then press **STOP** to stop the measurement. The slope, horizontal, and height difference between the two points is displayed. This can be repeated as many times as necessary.
2. The slope may be read as a percentage by pressing **S%** in the same mode after the missing line measurement has finished. This displays the percent grade between the two points.

2.10.8 Distance setting-out measurement

1. To find the direction and distance of a point set out a wanted distance from the instrument station, sight the reference direction and press **0SET** in **THEO** mode to set the **HAR** at 0. Turn theodolite until the required angle is displayed and locks the horizontal movement.
2. Press **ESC** to go to basic mode and go to **S-O** mode. Go to **S-O_D** for the data and input the desired distance to set out. Set the reflecting prism in the sighting line and press **SO_Hdto** start the distance measurement. The difference between the desired distance and the measured distance is displayed on the 1st line.
3. Move the reflecting prism towards or away from the Instrument until **H** distance becomes 0m to determine the point at the desired distance.
 - * If there is negative (-) data: Move prism away from Instr.
 - * If positive (+) data: Move prism towards Instr.
 - * Press **STOP** to end the measurement.

2.10.9 Coordinates setting-out measurement

1. Set the station coordinates and initial azimuth angle. Press **S-O_P** in **S-O** mode and input the desired coordinates for N and E and press **YES** to store the data. Press **SO_HA** in **S-O** mode to start the angle measurement. The setting-out horizontal angle, **dHA** is displayed. Use the horizontal clamp and fine motion screw to turn theodolite until **dHA** reads $0^\circ 00' 00''$ and lock the clamp.
2. Sight the reflecting prism on the sighting line and press **SO_HD** and move reflecting prism until **H** reads 0m as in part 3 of the distance setting-out measurement.

2.11 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. Latitude of a survey line may be defined as its coordinate lengths 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:

$$\text{Latitude} = L \cos\theta$$

$$\text{Departure} = L \sin\theta$$

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,

$$\text{Closing error } (e) = \sqrt{(\sum L)^2 + (\sum D)^2}$$

$$\text{The relative error of closure} = e / p$$

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

After computing the co-ordinate of each of the control points, they were plotted in A1 size grid paper. Both major and minor 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 similar way to scale **1:500** over which later detailing by tachometry was done.

2.12 RESECTION

Resection is the determination of the observer's position by means of observations taken to previously fixed points. There are several methods of resection and they include:

- ✚ Observing horizontal angles from the unknown point to three known points.
- ✚ Observing horizontal angles from two unknown points to two known points.
- ✚ Observing horizontal angles from one unknown point to two known points when the Azimuth of one of them is known.

2.13 Comments and Conclusion

The site for survey camping was the campus area of TU, Kirtipur. The pattern was very suitable because all the facilities for engineering work were available with the good environment of doing work.

The arrangements of the survey instruments were appreciable although there were some faulty instruments that made the fieldwork time consuming. Some instruments like theodolite, levels etc. do not give the accurate reading. We hope that there will be sufficient number of instruments for next survey camp. The stationary accessories should be managed inside the campus area because it is difficult to take all the stationery goods from Kathmandu and there is no such stationery shop near the campus.

Some other problems during the field works were during fly leveling during transferring the R.L. from given benchmark to the T.B.M. due to the disturbance by traffics.

The given Topography survey camp work was finished satisfactorily within the given span of time. The subject survey needs practice as much as possible. For surveying, theory can only take as the introduction but if there is practice, there will be much gain of knowledge about the techniques of surveying. It is better to say that it provides us a confidence to perform survey and apply the techniques at any type of problem facing during the actual work in the future career.

All the groups prepared their topographic map of the given area of the TU campus areas in the same scale. The whole area was divided in such a way that area allocated for one group contains some part of the area allocated for another group. One traverse leg is also common to all groups and hence the combination of all groups' effort will provide a perfect and complete topographic map of TU after combining it.

3 BRIDGE SITE SURVEY

This part of the Survey Camp dealt with the bridge site survey at Kirtipur. Bridges are the structures that are constructed with the purpose of connecting two places separated by deep valleys or gorges or rivers and streams. Bridges are usually the cross drainage and hence a part of roads making them shorter and hence economical. In countries like Nepal, where the ground is undulated and where there are plenty of rivers, bridges are the most economic and efficient way to join two places. It is a very convenient way. That is why the task of bridge site surveying has been included in the curriculum of Bachelor's degree in Civil Engineering at Pulchowk Campus, IOE.

3.1 OBJECTIVES

The main objective of the bridge site survey is to give the students the preliminary knowledge on selection and planning of possible bridge site and axis for the future construction of the bridge. The purpose of the bridge site survey was not only to prepare plan and layout of the bridge site but also from the engineering point of view, the purpose is to collect the preliminary data about the site such as normal water flow level, high flood level, geological features of the ground for planning and designing of the bridge from the details taken during the surveying. Moreover, bridge construction is an important aspect in the development of transportation network. Surveying is required for topographical mapping, knowledge of longitudinal sections of the river and cross sections at both the upstream and in downstream side of the river for the construction of a bridge.

3.2 BRIEF DESCRIPTION OF THE SITE

Bridge site survey was conducted over a small rain spring on the T.U. facility. The spring collects water etc. coming from the departments and flows through a

ravine formed by two hill slopes. Our site was between the physics and chemistry departments and the coronation garden. The site was mossy and swampy. No huge boulders are to be found near the site. It was damp and hilly.

Hydrology, Geology & Soil

The site is surrounded with steep hill, which is covered with densely planted shrubs. The width of stream is not so big but high flood level covers large area. Water scoured marks on the sideshow that the highest flood level.

3.3 TECHNICAL SPECIFICATIONS (NORMS)

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

1. Control point fixing as well as determining the length of the bridge axis had to be done by the method of triangulation. While forming triangles, proper care had to be taken such that the triangles were well conditioned, i.e. none of the angles of the triangle were greater than 120° or less than 30° .
2. The triangulation angle had to be measured on two sets of readings by Theodolite and the difference between the mean angles of two sets of readings had to be within a minute.
3. Transferring the level from one bank to another bank had to be done by the method of reciprocal leveling.
4. The scale for plotting the topographical map was given to be 1:500
5. In order to plot the longitudinal section of the river, data had to be taken along the riverbed 150 m upstream and at least 50 m downstream. The plot for the longitudinal section along the flow line had to be done in a scale of 1:50 for vertical and 1:500 for horizontal, for cross-section $v=H=1:200$.
6. For the cross-section profile, data had to be taken at 25 m intervals both upstream and downstream, and one at the bridge axis. Observation had to cover minimally 20 m beyond the bank of river on either side.

3.4 EQUIPMENT & ACCESSORIES

The equipment's used in the survey during the preparation of topographic map in bridge site are as follows:

1. Total Station
2. Ranging Rods
3. Measuring Tapes
4. Leveling Staffs
5. Plumb Bob
6. Pegs & Arrows
7. Marker Pen
8. Compass
9. Prism & Prism Holder

3.5 METHODOLOGY

The various methods performed during the bridge site survey were triangulation, leveling, tachometry, cross section, and L-section. The brief descriptions of these methodologies are given below:

3.5.1 Site Selection

There are various factors for the selection of bridge site such as geological condition, socio-economic and ecological aspect etc. Therefore, the sites were chosen such that it should be laid on the very stable rocks at the bed of river as far as possible and not affect the ecological balance of the flora and fauna of the site area. The bridge axis should be so located that it should be fairly perpendicular to the flow direction and at the same time, the river width should be narrow from the economical point of view and the free board should be at least 5m. The starting point of bridge axis should not in any way lie or touch the curve of the road.

The site selected for the bridge axis was near the curve of the river with no community but with the temples and the shed house nearby. For the purpose of the

shortest span, the stations were set perpendicular to the river flow direction. The riverbanks were not eroded and were suitable for bridge construction. The chance of change of direction of river on the selected axis line was nominal.

3.5.2 Topographic Survey

For the topographic survey of bridge site, triangulation was done. The main purpose of the triangulation was to determine the length of the bridge axis. The triangulation also serves the control points for detailing. First, the bridge axis was set and horizontal control stations were fixed on either side. 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 a 1" total station with two sets. The bridge axis length or span was calculated by solving the triangles using the sine rule. Thus, the horizontal control for vertical control, the level was transferred from the arbitrary benchmark and RL was transferred to the stations on the next bank by reciprocal leveling while direct level transfer method was used or the same bank.

3.5.3 L Section & Cross Section

The L-Section of the river is required to give an idea about the bed slope, nature of the riverbed, and the variation in the elevations of the different points along the length of the river. Keeping the instrument at the control (traverse) stations on the river banks, the staff readings were taken at different points along the center line of the river up to 150 meters upstream and 50 m downstream. The R.Ls of the traverse stations being known previously, the levels of the different points on the river were calculated. Then the L-Section of the riverbed was plotted on a graph paper on scale for vertical and horizontal.

Cross-section of a river at a particular point is the profile of the lateral sides from the centerline of the river cut transverse to the L-Section at that point. The cross section can be used to calculate the volume and discharge of water at the particular

section if the velocity at the cross section is known. Cross sections were taken at an interval of about 25 m extending 150 m upstream and 50 m downstream of the river. Staff readings of points along a line perpendicular to the flow of river were taken from the stations points and the elevations of the points were calculated using tachometric methods. At some places, the "danda and tape" method was also applied. With all the calculations done and the required data in hand, the cross section was plotted on a graph paper on required scale.

3.5.4 Leveling

3.5.4.1 Transferring R.L. from B.M. to control points

The benchmark was on the stone near the chautara near the existing bridge. R.L. was transferred to the triangular station from the B.M. by fly leveling by taking the back sight-reading to the bench mark which should be within the given accuracy. The R.L. was transferred to the opposite bank of the river by reciprocal leveling.

3.5.4.2 Reciprocal Leveling

For transferring the RL across the bridge reciprocal leveling was performed. This method eliminates the error due to focusing, collimation, earth's curvature and refraction of atmosphere etc.

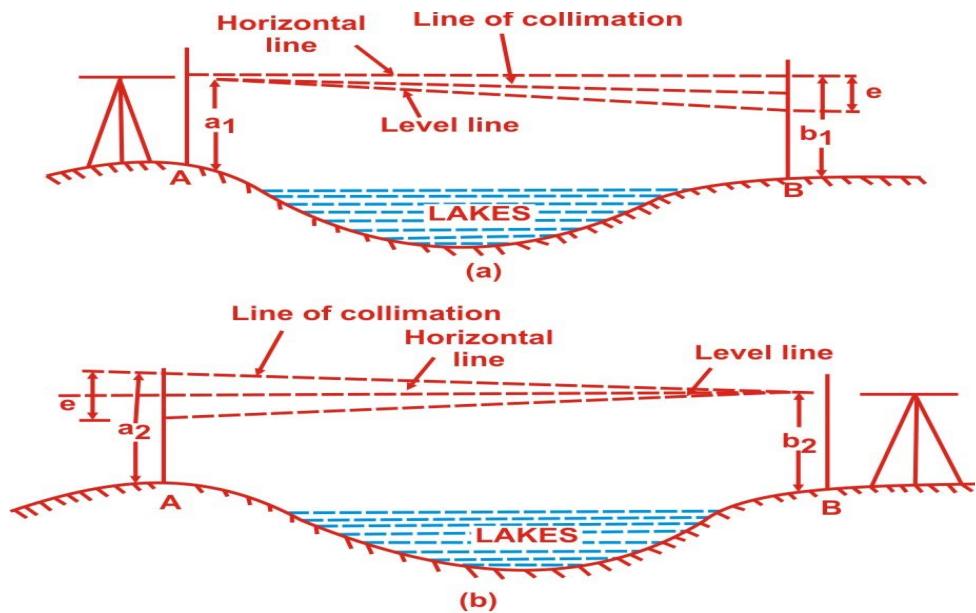


Figure 4-Reciprocal Leveling

True difference in elevation between A and B = $H = ha - (hb - e)$

Also the true difference in elevation = $H = (ha - e) - hb'$

Taking the average of the two differences we get the difference in elevation between A and B.

3.5.5 Detailing

Detailing of the entire bridge site was done by total station and tachometric method, the readings being taken with a theodolite stationed at the different traverse stations. The detailing was done with respect to the skeleton formed by triangulation. The vertices of triangles serve as a control point. With the help of tachometer, the details were booked, up to 100m upstream and 50m downstream. The important details not included in the cross-section data, were taken. Trigonometric Leveling was also done to find out the RL of the inaccessible points. The data and the calculations have been tabulated in a systematic way.

3.5.6 Computation & Plotting

The use of total station makes the detailing process easy and fast. The total station gives the direct values of the horizontal distances and vertical height difference between the station point and the detailing point. The RLs of the points can be calculated by using following formula.

$$\text{RL of detail} = \text{RL of station} + \text{HI} + \text{V-Target Height}$$

The following tachometric formulas were used for the calculation of the horizontal distance and R.L. of different points:

Horizontal distance of any point from the traverse station,

$$H = 100 \times S \times \cos^2\theta$$

Where, S = Staff intercept = Top - Bottom Stadia Reading

θ = Vertical Angle

And R.L. of any required Point is

$$\text{R.L.}_{(\text{point})} = \text{R.L. of Station} + \text{H.I} + H \times \tan \theta - \text{Mid Wire Reading}$$

The topographic map, 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.

3.5.7 Comments and Conclusion

As a civil engineer, we should design the bridge with the view point of economic and its durability. The bridge axis should be designed such that the span length should be minimum and in safe location. That means the bridge axis should not be below the flood level so that during course of monsoon it is affected by floods. From the geological and topographic and economic point of view, bridge span is found to be 71..... No springs and streams are added in the river up to the surveyed area, also the drainage and sewage have not been discharged into the river. At the

axis, the river width, the river width is about 10m and water flow is normal. The cross-section was taken at the banks of river and at the middle of the river to get the profile of the flowing river. Also, we marked the high flood level and low flood level.

There is a very little change due to the erosion of bank. The watermarks are at the level below the existing Foot track. Due to the low discharge the channel of river is not changing.

The instruments provided for the bridge site survey were not so precise than that of topographic survey performed at T.U. However, we managed to complete our job on the specified time.

4 ROAD ALIGNMENT & GEOMETRIC DESIGN

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.

Before the construction of the road, 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.

4.1 BRIEF DESCRIPTION OF THE PROJECT AREA

Road alignment is an important aspect in the development of the transportation network of the country. Road alignment is important part of the survey. Road alignment and bridge site survey goes side by side to run a road between two terminals and to carry a survey for the bridge construction along the route. This specific job is essential for an engineer combating with the mountainous topography of Nepal.

4.2 Geology, Hydrology & Soil

The road had to go along a damp route that was much undulated. The place was damp. 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 uniform throughout the whole length of the road. Although the road alignment has certain up and downs. Finally, the starting and ending point of the road has not significant level differences.

If along the potential slip surface in the soil the stress produced by gravity exceeds the shear strength of the soil along the potential failure surface, the slope will

become unstable. Obviously, the shear strength of soil is largely depending upon the type of soil. Cohesive soil has more shear strength than others do. The hard and dense soil is best for slopes. We found soft clayey soil that was very damp. Other kinds of soils were not found along our proposed route.

4.3 Technical Specifications (Norms)

Reece alignment selection was carried out of the road corridor considering permissible gradient, obligatory points, bridge site and geometry of tentative horizontal and vertical curves. The road setting horizontal curve, cross sectional detail in 15m interval and longitudinal profile were prepared.

The topographic map (scale 1:500) of road corridor was prepared. Geometric curves, road formation width, right of way, crossings and other details were shown in the map.

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

- ⊕ If the external deflection angle at the I.P. of the road is less than 3° , curves need not be fitted.
- ⊕ Simple horizontal curves had to be laid out where the road changed its direction, determining and pegging three points on the curve - the beginning of the curve, the middle point of the curve and the end of the curve along the centerline of the road.
- ⊕ The radius of the curve had to be chosen such that it was convenient and safe.
- ⊕ The gradient of the road had to be maintained below 8 %.
- ⊕ Cross sections had to be taken at 15 m intervals and at the beginning, middle and end of the curve, along the centerline of the road - observations being taken for at least 10 m on either side of the centerline.
- ⊕ Plan of the road had to be prepared on a scale of 1:500
- ⊕ L-Section of the road had to be plotted on a scale of 1:1000 horizontally and 1:100 vertically.
- ⊕ The cross section of the road had to be plotted on a scale of 1:100 (both vertical and horizontal).
- ⊕ The amount of cutting and filling required for the road construction had to be determined from the L-Section and the cross sections. However, the volume of cutting had to be roughly equal to the volume of filling.

4.4 Equipment's & Accessories

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

- Total Station
- Prism & Prism Holder
- Plumb Bob
- Leveling Instrument
- Leveling Staffs
- Ranging Rods
- Measuring Tape
- Pegs and Arrows
- Marker Pen

4.5 Methodology

4.5.1 Reconnaissance

The reconnaissance survey was performed along the given route. Then guess works were done for intersection points, where the direction had to be changed. While returning back the route, the IPs were fixed. For this the inter-visibility of the stations was checked and gradient between the two IPs was adjusted such that it does not exceed 12%, using the abney level. Meanwhile the pegs with IP no. were driven at these points.

4.5.2 Horizontal Alignment

Horizontal alignment is done for fixing the road direction in horizontal plane. For this, the bearing of initial line connecting two initial stations was measured using compass. The interior angles were observed using 1" Total station at each IP and then deflection angles were calculated.

$$\text{Deflection angle} = (360^{\circ} \text{ or } 180^{\circ}) - \text{observed angle}$$

If +ve, the survey line deflects right (clockwise) with the prolongation of preceding line and deflects left if -ve (anti-clockwise). The radius was assumed according to the deflection angle. Then the tangent length, EC, BC, apex distance along with their chainage were found by using following formulae,

$$\text{Tangent length (T L)} = R \times \tan(\Delta/2)$$

$$\text{Length of curve (L.C)} = 3.142 \times R \times \Delta/180$$

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

$$\text{Chainage of BC} = \text{Chainage of IP} - TL$$

$$\text{Chainage of MC} = \text{Chainage of BC} + LC/2$$

$$\text{Chainage of EC} = \text{Chainage of MC} + LC/2$$

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.

4.5.3 Vertical Alignment

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. Vertical curve may be either summit curve or valley curve. While setting the vertical alignment, it should keep in mind whether cutting and filling were balanced or not.

4.5.4 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 leveling on the entire length of the road, fly 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 $24\sqrt{k}$ mm, where k is the total distance in km.

4.5.5 L-section & Cross Section

The L-Section of the road is required to give the road engineer an idea about the nature of the ground and the variation in the elevations of the different points along the length of the road and also to determine the amount of cutting and filling required at the road site for maintaining a gentle slope. In order to obtain the data for L-Section, staff readings were taken at points at 15m 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 were calculated.

Cross sections at different points are drawn perpendicular to the longitudinal section of the road on either side of its centerline in order 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 15m 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**.

4.6 Curve Setting

A regular curved path followed by highway or railway alignment is curve. It is introduced wherever it is necessary to change the direction of motion due to the nature

of terrain. A curve may be circular, parabola or spiral and is always tangential to two straight directions.

There may be different types of curves:

Simple curve, Compound curve, Reverse curve, Transition curve.

4.6.1 Simple Circular Curve

A simple circular curve is the curve, which consists of a single arc of a circle. It is tangential to both the straight lines.

4.6.1.1 Setting Out Of Simple Circular Curves

4.6.1.1.1 Linear method

In this method, only a chain or tape is used. Linear methods are used when a high degree of accuracy is not required and the curve is short.

E.g.: Offsets from Long Chord

Offsets from Tangents

Successive bisection of Chords

Offsets from Chords produced

4.6.1.1.2 Angular method

In this method, an instrument like theodolite is used with or without chain or tape.

E.g.: Rankine's Method of Tangential Deflection Angles

Two Theodolite Method

➤ Offset from Long Cord Method

Mid-ordinate can be determined by the relation

$$O_o = R - \sqrt{R^2 - (L/2)^2}$$

The Ordinate at a distance 'x' is given by,

$$O_x = \sqrt{[(R^2 - X^2) - (R - O_o)]}$$

Where,

O_o = mid-ordinate

O_x = ordinate at distance x from the midpoint of the chord

L = length of the long chord

R = Radius of the curve

➤ Rankine's Method

In Rankine's method, it's assumed that the length of the curve and the chord length are equal (case for larger radius). The deflection angle to any point on the curve is an angle at the point of contact between the back tangent and the chord joining the point of contact and that point.

The angle subtended by first sub-chord is given by,

$$\delta_1 = 1718.9 C_1/R \text{ minutes}$$

The angle subtended by each normal chord is given by the formula,
 $\delta = 1718.9 C/R \text{ minutes}$

If $\delta_1, \delta_2, \dots, \delta_n$ are the tangential angles made by successive chords with their tangents and $\Delta_1, \Delta_2, \dots, \Delta_n$ are the total deflection angles, then

$$\Delta_1 = \delta_1$$

$$\Delta_2 = \Delta_1 + \delta_1 = \delta_1 + \delta_2$$

.....

Similarly,

$$\Delta_n = \Delta_{n-1} + \delta_n = \delta_1 + \delta_2 + \delta_3 + \dots + \delta_n = \Delta/2$$

Field Procedure

1. The instrument is set at T_1 and zero is set along P.I.
 2. Then the theodolite is set to read an angle of $\delta_1 (= \Delta_1)$.
 3. With T_1 as center and C_1 as radius, the tape is swung and arrow was marked at intersection of the tape with crosshairs.
 4. Then angle Δ_2 was set on the theodolite and with length of normal chord as radius, the next point on the curve was marked at the pt of intersection.
- This procedure is continued till the point of tangency is located.

4.7 Comments and Conclusion

Survey of the road alignment is done to make most economical, comfortable, and durable. Extra care is taken to avoid any soil erosion and any other ecological

damage. Vertical and horizontal curves are set according to Road Design Standards for comfort and other factors.

While setting the road alignment, it should be kept in mind that the minimum IP points should be taken as far as possible and deflection angles should be minimal as far as possible. The task was challengeable and tough due to the route high altitude.

5 CONCLUDING REMARKS

With the helpful regard of teacher and cooperative behavior of all friends all the work is completed as scheduled in routine time assigned to us although we faced minor difficulties during our orientation. The management team had arranged the total station instrument for our daily field work. This had made our work easy, reliable; less time consuming and competitive as total station is the instrument which is widely used in the surveying works nowadays. Use of Total Station had allowed the camp organizer to shorten the fieldwork duration from 14 days to 10 days. All results we obtained were within the limits given to us. This camp really helped us with the practical parts of survey fieldwork as we were working in conditions we will surely have to face in the future. It increased our confidence in handling instruments as well as completing projects within given deadlines. This trip also offered us relief from the monotony of performing all survey practical within the college compound. It was also a chance to get to know our friends from other sections, work closely, and interact with them. This trip is a good experience in dealing with locals and other people who were interested in our work. We also learned to explain what we were doing to laymen in simple terms. We think I.O.E should organize such trips frequently and for all possible subjects, as practical knowledge is better. In these trips, we gain first hand concept of the subject matter that makes it easier for us to grasp the concept. All in this entire trip was very informative, effective and enjoyable.

Any suggestion and comment are heartily acceptable. During report preparation all confusion are cleared by teacher whom we are very grateful.

HCR & Distance Observation

From	To	HCR; Set-I	H. Angle	HCR; Set-II	H. Angle	Mean H. Angle	H. Distance	Mean	H. Distance Precision	V. Distance	Pole Ht.
M3	M2	00°00'00"	201°27'05"	90°00'00"	201°27'06"	201°27'06"	105.981	105.974	7065	3.670	1.400
		180°00'00"		270°00'02"			113.554	113.545	6308	-3.529	1.285
	M4	201°27'03"		291°27'06"			113.536			3.746	1.400
		381°27'07"		471°27'08"			121.376	121.381	12138	-4.942	1.600
M4	M3	00°00'00"	158°07'11"	90°00'00"	158°07'15"	158°07'13"	121.386			5.149	1.400
		180°00'12"		270°00'04"			78.108	78.104	8678	-7.763	1.300
	M5	158°07'24"		248°07'18"			61.790			-3.870	1.300
		338°07'09"		428°07'16"			61.789	61.790	61790	3.750	1.350
M5	M4	00°00'00"	137°36'34"	90°00'00"	137°36'25"	137°36'30"	102.340	102.342	34114	3.636	1.305
		180°00'03"		180°00'01"			88.996			-3.384	1.330
	M6	137°36'44"		227°36'22"			102.343			1.826	1.300
		317°36'28"		317°36'28"			88.997	88996.500		1.826	1.300
M6	M5	00°00'00"	148°52'36"	90°00'00"	148°52'37"	148°52'36"	78.099	78.104	8678	7.552	1.300
		179°59'56"		270°00'04"			61.790			-3.870	1.300
	M7	148°52'40"		238°52'35"			61.789	61.790	61790	3.750	1.350
		328°52'28"		418°52'42"			102.340			-3.636	1.305
M7	M6	00°00'00"	161°35'25"	90°00'00"	161°35'26"	161°35'26"	102.343	102.342	34114	-3.384	1.330
		179°59'56"		270°00'04"			88.996			1.826	1.300
	M8	161°35'26"		251°35'25"			88.997	88996.500		1.826	1.300
		341°35'20"		431°35'32"			88.997			1.826	1.300
M8	M7	00°00'00"	258°33'07"	90°00'00"	258°33'10"	258°33'09"	102.343	102.342	34114	3.636	1.305
		180°00'12"		270°00'08"			88.996			-3.384	1.330
	M9	258°33'21"		348°33'12"			88.997	88996.500		1.826	1.300
		438°33'05"		528°33'16"			88.997			1.826	1.300

Tribhuwan University
Institute of Engineering
 Central Campus, Pulchowk
 Department of Civil Engineering
 Survey Instruction Committee

HCR & Distance Observation

From	To	HCR; Set-I	H. Angle	HCR; Set-II	H. Angle	Mean H. Angle	H. Distance	Mean	H. Distance Precision	V. Distance	Pole Ht.		
M9	M8	00°00'00"	143°49'34"	90°00'00"	143°49'31"	143°49'32"	88.997	64.722	8090	-1.837	1.400		
		179°59'54"		269°59'58"			64.726			2.160	1.530		
	M10	143°49'31"		233°49'32"			64.718			-1.162	2.150		
		323°49'30"		413°49'28"						-1.853	1.350		
M10	M9	00°00'00"	127°18'34"	90°00'00"	127°18'32"	127°18'33"	64.718	69.386	8673	2.002	1.310		
		180°00'12"		270°00'01"			69.390			10.017	2.100		
	M11	127°18'47"		217°18'35"			96.554			0.812	2.100		
		307°18'32"		397°18'30"						-0.714	2.100		
M11	M10	00°00'00"	140°37'54"	90°00'00"	140°37'54"	140°37'54"	69.382	96.557	19311	-8.398	2.150		
		180°00'00"		270°00'07"			96.554			1.214	1.700		
	M12	140°38'00"		230°37'56"			71.871			1.127	1.300		
		320°37'48"		410°37'59"						-1.258	1.350		
M12	M11	00°00'00"	174°15'09"	90°00'00"	174°15'11"	174°15'10"	96.559	71.872	35936	5.534	1.350		
		180°00'14"		269°59'58"			96.559			112.032	112032.500		
	M13	174°15'11"		264°15'08"			78.024			112.033	112032.500		
		354°15'21"		444°15'12"						112.033	112032.500		
M13	M12	00°00'00"	98°31'26"	90°00'00"	98°31'13"	98°31'20"	71.873	78.021	11146	5.534	1.350		
		179°59'54"		270°00'11"			71.873			112.032	112032.500		
	M14	98°31'24"		188°31'25"			88.800			112.033	112032.500		
		278°31'22"		368°31'12"						112.033	112032.500		
M14	M13	00°00'00"	260°37'07"	90°00'00"	260°36'59"	260°37'03"	78.017	88.796	9866	5.534	1.350		
		179°59'59"		270°00'05"			78.017			112.032	112032.500		
	M15	260°37'09"		350°37'06"			88.796			112.033	112032.500		
		440°37'04"		530°36'58"						112.033	112032.500		
M15	M14	00°00'00"	162°07'12"	90°00'00"	162°07'11"	162°07'11"	88.791	112.033	112032.500	5.534	1.350		
		179°59'46"		269°59'57"			88.791			112.032	112032.500		
	M16	162°07'06"		252°07'10"			112.032			112.033	112032.500		
		342°07'04"		432°07'08"						112.033	112032.500		

HCR & Distance Observation

From	To	HCR; Set-I	H. Angle	HCR; Set-II	H. Angle	Mean H. Angle	H. Distance	Mean	H. Distance Precision	V. Distance	Pole Ht.
M16	M15	00°00'00"	121°26'19"	90°00'00"	121°26'22"	121°26'21"	112.033			-5.692	1.300
		180°00'01"		270°00'03"							
	M17	121°26'18"		211°26'22"			115.656	115.652	14456	2.542	1.350
		301°26'21"		391°26'25"						-2.807	1.300
M17	M16	00°00'00"	199°15'05"	90°00'00"	199°15'00"	199°15'03"	115.648			5.220	1.800
		180°00'08"		270°00'13"						-4.925	1.400
	CP1	199°15'04"		289°15'08"			88.119	88.112	6294	-2.743	1.550
		379°15'15"		469°15'05"						3.444	2.000
CP1	M17	00°00'00"	114°54'53"	90°00'00"	114°54'57"	114°54'55"	88.105			-1.616	1.300
		180°00'10"		270°00'05"						-0.902	1.750
	CP2	114°55'02"		204°54'56"			126.755	126.747	7922	1.186	1.600
		294°54'54"		384°55'03"						-3.364	1.650
CP2	CP1	00°00'00"	191°31'43"	90°00'00"	191°31'31"	191°31'37"	126.739			1.788	1.600
		179°59'48"		269°59'55"						-0.902	1.750
	M1	191°31'46"		281°31'33"			91.696	91.688	5393	1.186	1.600
		371°31'28"		461°31'25"						-3.364	1.650
M1	CP2	00°00'00"	148°48'59"	90°00'00"	148°49'02"	148°49'00"	91.679			1.186	1.600
		179°59'52"		270°00'06"						-0.902	1.750
	M2	148°48'50"		238°49'03"			92.477	92.485	6166	1.186	1.600
		328°49'00"		418°49'06"						-3.364	1.650
M2	M1	00°00'00"	110°33'37"	90°00'00"	110°33'36"	110°33'36"	92.492			1.186	1.600
		180°00'01"		270°00'02"						-0.902	1.750
	M3	110°33'40"		200°33'36"			105.966	105.974	7065	1.186	1.600
		290°33'34"		380°33'38"						-3.364	1.650

Calculation for Resection

Location	Easting	Northing	A	a	Coeff
Syambhu	627464.718	3066928.474	145.41858	147.07055	10.70260
Chobhar	627611.753	3061479.468	11.02610	161.67527	0.12268
Clock Tower	626832.547	3063142.819	23.55531	51.25416	0.67055
R	626884.744	3063086			

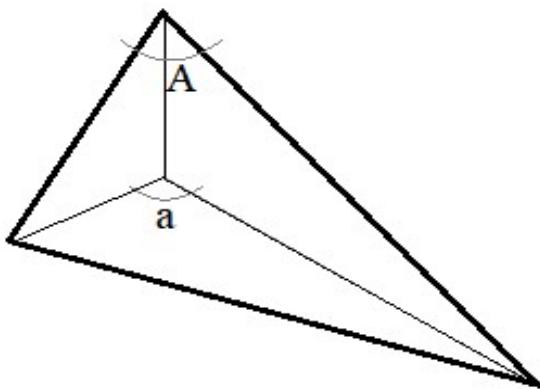


fig.: Trientra's triangle

Location	Departure	Lalitude	Easting	Northing
R			626884.744	3063086.195
CP1	-4.813	-23.234	626879.931	3063062.871
CP2	-36.174	121.526	626843.757	3063184.397

Resection

Instrument At	Sighted To	Face	Set I						Set II						Mean Horizontal Angle														
			HCR Reading			Mean		Horizontal Angle			HCR Reading			Mean		Horizontal Angle													
			D	M	S	M	S	D	M	S	D	M	S	M	S	D	M	S	D	M	S								
R	Syambhu	L	0	0	0	0	0				90	0	0	0	3														
	Syambhu	R	180	0	0						270	0	5																
	Chobhar	L	147	4	13	4	8	147	4	8	237	4	24	4	20														
	Chobhar	R	327	4	3						57	4	15																
	CP2	L	183	4	32	4	31	36	0	22	273	4	29	4	30														
	CP2	R	3	4	29						93	4	30																
	Clock Tower	L	308	44	27	44	26	125	39	56	38	45	15	45	33														
	Clock Tower	R	128	44	25						218	44	51																
	Syambhu	L	0	0	3	0	0	51	15	34	89	59	55	51	14														
	Syambhu	R	179	59	57						270	0	2																
CP2	R	L	0	0	0	59	57																						
	R	R	179	59	54																								
	CP1	L	28	14	2	14	6	28	14	9																			
	CP1	R	208	14	9																								

Two Peg Test

Distance Between A & B = 40m

When instrument is at midway of two pegs:						
Instrument	Sighted to	Staff Readings (m)			Mean	True Height Difference
		Top	Mid	Bottom		
P	A	1.216	1.115	1.015	1.115333	0.050
	B	1.265	1.165	1.064	1.164667	

When instrument is at near one peg (A):						
Instrument	Sighted to	Staff Readings (m)			Mean	True Height Difference
		Top	Mid	Bottom		
Q	A	1.167	1.147	1.127	1.147	0.056
	B	1.384	1.203	1.022	1.203	

Collimation Error =	0.006
Precision =	5333.333333

Level Transfer

TBM3 to TBM5 [Forward]

Stations Chainage	BS			Mean BS	S_1	FS			Mean FS	S_2	Rise	Fall	Stadia Interval	Horizontal Distance
	Top	Mid	Bottom			Top	Mid	Bottom						
TBM3	0.790	0.720	0.650	0.720	0.140								0.140	14.0
TP1	1.836	1.724	1.618	1.726	0.218	1.265	1.194	1.123	1.194	0.142		0.474	0.360	36.0
TP2	1.708	1.636	1.565	1.636	0.143	1.288	1.182	1.078	1.183	0.210	0.543		0.353	35.3
TP3	1.664	1.585	1.506	1.585	0.158	0.939	0.866	0.795	0.867	0.144	0.770		0.302	30.2
TP4	1.698	1.599	1.499	1.599	0.199	1.110	1.031	0.952	1.031	0.158	0.554		0.357	35.7
TP5	1.080	0.965	0.850	0.965	0.230	1.621	1.524	1.426	1.524	0.195	0.075		0.425	42.5
TP6	1.223	1.130	1.034	1.129	0.189	1.510	1.394	1.277	1.394	0.233		0.429	0.422	42.2
TP7	1.250	1.147	1.041	1.146	0.209	1.531	1.441	1.350	1.441	0.181		0.312	0.390	39.0
TP8	1.428	1.351	1.275	1.351	0.153	1.751	1.646	1.542	1.646	0.209		0.500	0.362	36.2
TP9	1.341	1.270	1.199	1.270	0.142	1.566	1.490	1.413	1.490	0.153		0.138	0.295	29.5
TP10	1.455	1.383	1.310	1.383	0.145	1.509	1.435	1.362	1.435	0.147		0.165	0.292	29.2
TP11	1.462	1.396	1.330	1.396	0.132	1.294	1.225	1.155	1.225	0.139	0.158		0.271	27.1
TP12	1.405	1.337	1.269	1.337	0.136	1.369	1.304	1.239	1.304	0.130	0.092		0.266	26.6
TP13	1.459	1.386	1.315	1.387	0.144	1.476	1.404	1.335	1.405	0.141		0.068	0.285	28.5
TP14	1.638	1.569	1.499	1.569	0.139	1.234	1.165	1.098	1.166	0.136	0.221		0.275	27.5
TP15	1.670	1.600	1.530	1.600	0.140	1.060	0.988	0.916	0.988	0.144	0.581		0.284	28.4
TP16	1.610	1.555	1.503	1.556	0.107	1.250	1.180	1.110	1.180	0.140	0.420		0.247	24.7
TBM5						0.865	0.807	0.752	0.808	0.113	0.748		0.113	11.3
Σ				23.354					21.279		4.162	2.086	5.439	543.9

Arithmetic Check:

Σ BS - Σ FS = 2.075
Σ Rise - Σ Fall = 2.075

Level Transfer

TBM5 to TBM3 [Backward]

Stations Chainage	BS			Mean BS	S	FS			Mean FS	S	Rise	Fall	Stadia Interval	Horizontal Distance
	Top	Mid	Bottom			Top	Mid	Bottom						
TBM5	0.908	0.835	0.762	0.835	0.146								0.146	14.6
TP1	1.148	1.078	1.009	1.078	0.139	1.741	1.672	1.600	1.671	0.141		0.836	0.280	28.0
TP2	1.080	1.014	0.948	1.014	0.132	1.663	1.598	1.532	1.598	0.131		0.519	0.263	26.3
TP3	1.275	1.202	1.131	1.203	0.144	1.529	1.460	1.390	1.460	0.139		0.446	0.283	28.3
TP4	1.412	1.340	1.268	1.340	0.144	1.440	1.365	1.290	1.365	0.150		0.162	0.294	29.4
TP5	1.334	1.262	1.190	1.262	0.144	1.350	1.280	1.209	1.280	0.141	0.060		0.285	28.5
TP6	1.350	1.291	1.234	1.292	0.116	1.461	1.390	1.318	1.390	0.143		0.128	0.259	25.9
TP7[M17]	1.784	1.704	1.632	1.707	0.152	1.312	1.250	1.188	1.250	0.124	0.042		0.276	27.6
TP8	1.753	1.688	1.623	1.688	0.130	1.620	1.547	1.475	1.547	0.145	0.159		0.275	27.5
TP9	1.609	1.543	1.472	1.541	0.137	1.506	1.442	1.372	1.440	0.134	0.248		0.271	27.1
TP10	1.567	1.503	1.438	1.503	0.129	1.148	1.080	1.012	1.080	0.136	0.461		0.265	26.5
TP11	1.532	1.468	1.403	1.468	0.129	1.440	1.377	1.314	1.377	0.126	0.126		0.255	25.5
TP12	1.602	1.534	1.472	1.536	0.130	1.326	1.264	1.202	1.264	0.124	0.204		0.254	25.4
TP13	1.566	1.503	1.441	1.503	0.125	1.321	1.259	1.196	1.259	0.125	0.277		0.250	25.0
TP14	1.506	1.442	1.379	1.442	0.127	1.288	1.224	1.160	1.224	0.128	0.279		0.255	25.5
TP15	1.200	1.127	1.055	1.127	0.145	1.370	1.307	1.245	1.307	0.125	0.135		0.270	27.0
TP16	0.794	0.731	0.668	0.731	0.126	1.614	1.543	1.471	1.543	0.143		0.415	0.269	26.9
TP17	1.065	1.002	0.940	1.002	0.125	1.840	1.780	1.720	1.780	0.120		1.049	0.245	24.5
TP18	1.368	1.308	1.248	1.308	0.120	1.598	1.536	1.474	1.536	0.124		0.534	0.244	24.4
TP19	1.287	1.223	1.158	1.223	0.129	1.647	1.587	1.527	1.587	0.120		0.279	0.249	24.9
TP20	1.410	1.345	1.280	1.345	0.130	1.643	1.580	1.515	1.579	0.128		0.357	0.258	25.8
TBM3						0.758	0.695	0.634	0.696	0.124	0.649		0.124	12.4
Σ				27.148					29.232		2.641	4.725		557.0

Arithmetic Check:

$\sum \text{BS} - \sum \text{FS} = -2.084$
$\sum \text{Rise} - \sum \text{Fall} = -2.084$

Mean Height Difference = 2.080

Discrepancy = 0.008
Required Precision = 0.025

RL(TBM5) = RL(TBM3) + 2.080

$$\begin{aligned}
 &= 1331.314 + 2.080 \\
 &= 1333.394
 \end{aligned}$$

Level Transfer

TBM5 to M17 [Forward]

Stations Chainage	BS			Mean BS	S	FS			Mean FS	S	Rise	Fall	Stadia Interval	Horizontal Distance
	Top	Mid	Bottom			Top	Mid	Bottom						
TBM5	0.908	0.835	0.762	0.835	0.146								0.146	14.6
TP1	1.148	1.078	1.009	1.078	0.139	1.741	1.672	1.600	1.671	0.141		0.836	0.280	28.0
TP2	1.080	1.014	0.948	1.014	0.132	1.663	1.598	1.532	1.598	0.131		0.519	0.263	26.3
TP3	1.275	1.202	1.131	1.203	0.144	1.529	1.460	1.390	1.460	0.139		0.446	0.283	28.3
TP4	1.412	1.340	1.268	1.340	0.144	1.440	1.365	1.290	1.365	0.150		0.162	0.294	29.4
TP5	1.334	1.262	1.190	1.262	0.144	1.350	1.280	1.209	1.280	0.141	0.060		0.285	28.5
TP6	1.350	1.291	1.234	1.292	0.116	1.461	1.390	1.318	1.390	0.143		0.128	0.259	25.9
M17						1.312	1.250	1.188	1.250	0.124	0.042		0.124	12.4
Σ				8.024					10.013		0.102	2.091	1.934	193.4

Arithmetic Check:

$\sum \text{BS} - \sum \text{FS} = -1.989$
$\sum \text{Rise} - \sum \text{Fall} = -1.989$

Level Transfer

M17 to TBM5 [Backward]

Stations Chainage	BS			Mean BS	S	FS			Mean FS	S	Rise	Fall	Stadia Interval	Horizontal Distance
	Top	Mid	Bottom			Top	Mid	Bottom						
M17	1.440	1.364	1.288	1.364	0.152								0.152	15.2
TP1	1.504	1.440	1.376	1.440	0.128	1.500	1.425	1.350	1.425	0.150		0.061	0.278	27.8
TP2	1.350	1.288	1.225	1.288	0.125	1.355	1.295	1.235	1.295	0.120	0.145		0.245	24.5
TP3	1.311	1.251	1.191	1.251	0.120	1.395	1.334	1.272	1.334	0.123		0.046	0.243	24.3
TP4	1.514	1.454	1.392	1.453	0.122	1.305	1.250	1.195	1.250	0.110	0.001		0.232	23.2
TP5	1.593	1.530	1.468	1.530	0.125	1.148	1.085	1.024	1.086	0.124	0.368		0.249	24.9
TP6	1.574	1.510	1.447	1.510	0.127	1.105	1.045	0.985	1.045	0.120	0.485		0.247	24.7
TP7	1.437	1.390	1.343	1.390	0.094	1.090	1.030	0.970	1.030	0.120	0.480		0.214	21.4
TBM5						0.812	0.766	0.720	0.766	0.092	0.624		0.092	9.2
Σ				11.227					9.230		2.103	0.107	1.952	195.2

Arithmetic Check:

$\sum \text{BS} - \sum \text{FS} = 1.996$
$\sum \text{Rise} - \sum \text{Fall} = 1.996$

Mean Height Difference = -1.993

Discrepancy = 0.007
Required Precision = 0.015

$\therefore \text{RL(M17)} = \text{RL(TBM5)} - 1.993$

$$= 1333.394 - 1.993 \\ = 1331.401$$

Minor Traverse Levelling

Turning Point	Station/Chainage	BS	FS	Rise	Fall	Elevation	Correction	Corrected Elevation
	M17	1.285				1331.401	0.000	1331.401
TP1		0.920	1.713		0.428	1330.973	0.000	1330.973
TP2		0.806	1.774		0.854	1330.119	0.001	1330.120
TP3		1.190	1.838		1.032	1329.087	0.001	1329.088
TP4	M16	0.750	1.440		0.250	1328.837	0.002	1328.838
TP5		0.880	1.870		1.120	1327.717	0.002	1327.719
TP6		0.994	1.730		0.850	1326.867	0.002	1326.869
TP7		0.952	1.737		0.743	1326.124	0.003	1326.127
TP8		0.798	1.758		0.806	1325.318	0.003	1325.321
TP9		0.824	1.795		0.997	1324.321	0.004	1324.324
TP10	M15	1.230	1.852		1.028	1323.293	0.004	1323.297
TP11		1.035	1.708		0.478	1322.815	0.004	1322.819
TP12	M14	1.373	1.755		0.720	1322.095	0.005	1322.100
TP13		1.005	1.385		0.012	1322.083	0.005	1322.088
TP14	m1	1.664	1.632		0.627	1321.456	0.005	1321.461
TP15	m2	0.722	1.490	0.174		1321.630	0.006	1321.636
TP16		0.642	1.814		1.092	1320.538	0.006	1320.544
TP17		0.621	2.412		1.770	1318.768	0.007	1318.774
TP18	m3	0.965	0.629		0.008	1318.760	0.007	1318.767
TP19		1.064	2.119		1.154	1317.606	0.007	1317.613
TP20	m4	0.693	1.483		0.419	1317.187	0.008	1317.195
TP21		1.547	1.348		0.655	1316.532	0.008	1316.540
TP22		1.962	0.732	0.815		1317.347	0.009	1317.355
TP23	m5	2.176	0.974	0.988		1318.335	0.009	1318.344
TP24		2.461	0.612	1.564		1319.899	0.009	1319.908
TP25		2.365	0.717	1.744		1321.643	0.010	1321.653
TP26	m6	1.716	0.732	1.633		1323.276	0.010	1323.286
TP27	m7	2.604	0.794	0.922		1324.198	0.011	1324.208
TP28	m8	1.541	0.869	1.735		1325.933	0.011	1325.944
TP29		1.718	1.222	0.319		1326.252	0.011	1326.263
TP30		1.642	1.030	0.688		1326.940	0.012	1326.952
TP31	m9	1.488	1.024	0.618		1327.558	0.012	1327.570
TP32		1.883	0.912	0.576		1328.134	0.012	1328.146
TP33		1.804	0.775	1.108		1329.242	0.013	1329.255
TP34	m10	2.032	1.458	0.346		1329.588	0.013	1329.601
TP35		1.561	0.905	1.127		1330.715	0.014	1330.728
TP36	M17		0.889	0.672		1331.387	0.014	1331.401
Σ		48.913	48.927	15.029	15.043			

Arithmetic Check:

$\sum \text{BS} - \sum \text{FS} = -0.014$
$\sum \text{Rise} - \sum \text{Fall} = -0.014$

Discrepancy = -0.014

Loop Perimeter = 959.590 m
Required Precision = 0.024

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
M 14	m 1		00°00'00"			94°53'38"			3063320.904	627166.397	1322.100	
1.448	1	1.5	03°11'01"	75.945	-0.391	98°04'39"	-10.671	75.192	3063310.233	627241.588	1321.657	
	2	1.5	01°38'01"	77.609	-0.399	96°31'39"	-8.823	77.106	3063312.082	627243.503	1321.649	
	3	1.5	01°52'45"	81.116	-0.680	96°46'23"	-9.567	80.550	3063311.338	627246.947	1321.368	
	4	1.5	359°00'30"	69.623	-0.323	93°54'08"	-4.738	69.462	3063316.166	627235.858	1321.725	
	5	1.5	01°54'45"	83.117	-0.959	96°48'23"	-9.851	82.531	3063311.054	627248.928	1321.089	
	6	1.5	354°19'24"	62.023	-0.068	89°13'02"	0.847	62.017	3063321.752	627228.414	1321.980	
	7	1.5	01°59'28"	86.157	-0.968	96°53'06"	-10.328	85.536	3063310.576	627251.932	1321.080	
	8	1.5	259°08'41"	8.933	0.015	354°02'19"	8.885	-0.928	3063329.789	627165.469	1322.063	
	9	1.5	191°49'02"	22.077	0.171	286°42'40"	6.348	-21.145	3063327.253	627145.252	1322.219	
	10	1.5	174°33'57"	19.568	0.280	269°27'35"	-0.185	-19.567	3063320.720	627146.830	1322.328	
	11	1.5	294°17'44"	3.308	-0.019	29°11'22"	2.888	1.613	3063323.792	627168.010	1322.029	
	12	1.5	234°47'18"	13.392	-0.200	329°40'56"	11.560	-6.760	3063332.465	627159.637	1321.848	
	13	1.5	165°11'01"	9.378	0.190	260°04'39"	-1.616	-9.238	3063319.288	627157.159	1322.238	
	14	1.5	220°58'58"	15.834	-0.316	315°52'36"	11.366	-11.024	3063332.271	627155.373	1321.732	
	15	1.5	144°24'46"	12.303	-0.696	239°18'24"	-6.280	-10.579	3063314.624	627155.817	1321.352	
	16	1.5	253°51'03"	25.633	-0.412	348°44'41"	25.140	-5.003	3063346.044	627161.394	1321.636	
	17	1.5	250°19'52"	19.236	-0.298	345°13'30"	18.600	-4.906	3063339.504	627161.491	1321.750	
	18	1.5	145°25'19"	14.666	0.763	240°18'57"	-7.263	-12.741	3063313.642	627153.655	1322.811	
	19	1.5	245°03'20"	19.727	-0.293	339°56'58"	18.531	-6.763	3063339.436	627159.633	1321.755	
	20	1.5	130°31'05"	13.642	1.375	225°24'43"	-9.577	-9.715	3063311.328	627156.681	1323.423	
	21	1.5	121°07'47"	13.499	1.371	216°01'25"	-10.918	-7.939	3063309.987	627158.458	1323.419	
	22	1.5	265°50'37"	40.541	0.080	00°44'15"	40.538	0.522	3063361.442	627166.919	1322.128	
	23	1.5	67°03'15"	23.334	0.714	161°56'53"	-22.185	7.231	3063298.719	627173.628	1322.762	
	24	1.5	62°20'56"	21.597	0.385	157°14'34"	-19.916	8.354	3063300.989	627174.751	1322.433	
	25	1.5	53°07'33"	24.773	-0.495	148°01'11"	-21.013	13.120	3063299.891	627179.517	1321.553	
	26	1.5	30°23'41"	13.313	-0.525	125°17'19"	-7.691	10.867	3063313.214	627177.264	1321.523	
	27	1.5	254°53'35"	41.352	-0.281	349°47'13"	40.697	-7.332	3063361.601	627159.065	1321.767	
	28	1.5	34°44'25"	21.676	-0.499	129°38'03"	-13.827	16.693	3063307.078	627183.090	1321.549	
	29	1.5	39°43'29"	22.735	-0.545	134°37'07"	-15.969	16.183	3063304.936	627182.580	1321.503	
	30	1.5	323°35'36"	36.410	-0.174	58°29'14"	19.031	31.040	3063339.935	627197.437	1321.874	
	31	1.5	37°11'39"	24.662	-0.475	132°05'17"	-16.530	18.302	3063304.374	627184.699	1321.573	
	32	1.5	320°34'10"	21.687	-0.003	55°27'48"	12.295	17.865	3063333.199	627184.262	1322.045	
	33	1.5	15°56'26"	41.828	-0.602	110°50'04"	-14.877	39.093	3063306.027	627205.490	1321.446	
	34	1.5	316°19'27"	24.147	-0.132	51°13'05"	15.125	18.823	3063336.029	627185.220	1321.916	
	35	1.5	19°13'27"	41.871	-0.485	114°07'05"	-17.109	38.216	3063303.795	627204.613	1321.563	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
36	1.5		314°02'33"	26.101	-0.421	48°56'11"	17.146	19.680	3063338.050	627186.076	1321.627	
37	1.5		21°39'42"	34.058	-0.448	116°33'20"	-15.226	30.465	3063305.678	627196.862	1321.600	
38	1.5		310°21'30"	28.182	-0.629	45°15'08"	19.840	20.015	3063340.744	627186.412	1321.419	
39	1.5		21°25'59"	23.288	-0.507	116°19'37"	-10.328	20.873	3063310.576	627187.269	1321.541	
40	1.5		304°57'16"	22.612	-0.501	39°50'54"	17.360	14.489	3063338.265	627180.886	1321.547	
41	1.5		305°29'15"	20.675	-0.315	40°22'53"	15.749	13.395	3063336.654	627179.792	1321.733	
42	1.5		364°02'02"	15.872	-0.073	98°55'40"	-2.463	15.680	3063318.441	627182.076	1321.975	
43	1.5		48°57'19"	30.560	-0.552	143°50'57"	-24.676	18.028	3063296.228	627184.425	1321.496	
44	1.5		252°34'23"	9.744	0.022	347°28'01"	9.512	-2.114	3063330.416	627164.282	1322.070	
45	1.5		254°03'52"	16.622	-0.317	348°57'30"	16.314	-3.183	3063337.219	627163.213	1321.731	
46	1.5		61°05'05"	37.763	-0.538	155°58'43"	-34.492	15.372	3063286.412	627181.769	1321.510	
47	1.5		267°31'05"	25.194	-0.622	02°24'43"	25.172	1.060	3063346.076	627167.457	1321.426	
48	1.5		259°03'44"	27.476	-0.450	353°57'22"	27.323	-2.893	3063348.228	627163.504	1321.598	
49	1.5		34°34'09"	45.679	-0.055	129°27'47"	-29.033	35.266	3063291.872	627201.663	1321.993	
50	1.5		32°07'38"	50.401	-0.061	127°01'16"	-30.347	40.241	3063290.557	627206.638	1321.987	
51	1.5		274°18'39"	16.076	-0.143	09°12'17"	15.869	2.572	3063336.773	627168.968	1321.905	
52	1.5		12°27'02"	41.734	-0.277	107°20'40"	-12.442	39.836	3063308.463	627206.233	1321.771	
53	1.5		284°54'01"	31.487	-0.580	19°47'39"	29.627	10.663	3063350.531	627177.060	1321.468	
54	1.5		14°50'52"	39.413	-0.876	109°44'30"	-13.313	37.097	3063307.591	627203.493	1321.172	
55	1.5		15°03'07"	3.400	0.309	109°56'45"	-1.160	3.196	3063319.745	627169.593	1322.357	
56	1.5		16°55'45"	6.112	-0.089	111°49'23"	-2.272	5.674	3063318.632	627172.071	1321.959	
57	1.5		03°44'29"	7.794	0.358	98°38'07"	-1.170	7.706	3063319.734	627174.102	1322.406	
58	1.5		83°24'04"	7.700	-0.081	178°17'42"	-7.697	0.229	3063313.208	627166.626	1321.967	
59	1.5		06°09'26"	11.056	-0.010	101°03'04"	-2.119	10.851	3063318.785	627177.248	1322.038	
60	1.5		350°09'06"	14.433	0.403	85°02'44"	1.246	14.379	3063322.151	627180.776	1322.451	
61	1.5		02°03'38"	23.816	-0.107	96°57'16"	-2.884	23.641	3063318.021	627190.038	1321.941	
62	1.5		00°46'48"	25.658	0.442	95°40'26"	-2.537	25.532	3063318.368	627191.929	1322.490	
63	1.5		345°52'48"	21.994	-0.030	80°46'26"	3.526	21.709	3063324.431	627188.106	1322.018	
64	1.5		79°56'43"	11.129	0.695	174°50'21"	-11.084	1.001	3063309.821	627167.398	1322.743	
65	1.5		78°11'10"	13.504	0.853	173°04'48"	-13.406	1.627	3063307.499	627168.024	1322.901	
66	1.5		69°16'54"	15.429	0.199	164°10'32"	-14.844	4.207	3063306.060	627170.604	1322.247	
67	1.5		62°22'25"	19.148	-0.036	157°16'03"	-17.661	7.399	3063303.244	627173.796	1322.012	
68	1.5		55°47'31"	16.340	-0.568	150°41'09"	-14.248	8.000	3063306.657	627174.397	1321.480	
69	1.5		44°24'58"	14.480	-0.765	139°18'36"	-10.979	9.440	3063309.925	627175.837	1321.283	
70	1.5		62°54'21"	12.117	-0.322	157°47'59"	-11.219	4.578	3063309.686	627170.975	1321.726	
71	1.5		32°44'09"	7.509	-0.067	127°37'47"	-4.585	5.947	3063316.320	627172.344	1321.981	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	72	1.5	98°03'22"	8.339	0.465	192°57'00"	-8.127	-1.869	3063312.777	627164.528	1322.513	
	73	1.5	86°35'49"	10.053	0.526	181°29'27"	-10.050	-0.262	3063310.855	627166.135	1322.574	
	74	1.5	18°13'33"	19.967	-0.560	113°07'11"	-7.840	18.363	3063313.064	627184.760	1321.488	
	75	1.5	09°59'44"	19.832	-0.199	104°53'22"	-5.096	19.166	3063315.808	627185.563	1321.849	
	76	1.5	16°12'09"	27.392	-0.685	111°05'47"	-9.859	25.556	3063311.045	627191.953	1321.363	
	77	1.5	08°42'47"	27.479	-0.077	103°36'25"	-6.465	26.708	3063314.440	627193.105	1321.971	
	78	1.5	13°48'33"	32.823	-0.256	108°42'11"	-10.525	31.090	3063310.379	627197.487	1321.792	
	79	1.5	10°58'04"	38.723	-0.025	105°51'42"	-10.584	37.249	3063310.321	627203.645	1322.023	
	80	1.5	20°32'41"	40.974	-0.506	115°26'19"	-17.600	37.001	3063303.304	627203.398	1321.542	
	81	1.5	29°19'57"	24.888	-0.550	124°13'35"	-13.999	20.578	3063306.906	627186.975	1321.498	
	82	1.5	43°10'24"	28.418	-0.518	138°04'02"	-21.141	18.991	3063299.763	627185.387	1321.530	
	83	1.5	30°55'43"	39.662	-0.529	125°49'21"	-23.213	32.159	3063297.691	627198.556	1321.519	
m1	m2		00°00'00"			198°15'52"			3063314.322	627243.267	1321.461	
1.425	84	1.3	266°39'29"	34.254	-1.064	104°55'21"	-8.821	33.099	3063305.501	627276.366	1320.522	
	85	1.5	302°50'49"	40.355	-0.934	141°06'41"	-31.411	25.335	3063282.911	627268.603	1320.452	
	86	1.5	318°24'36"	50.828	-0.898	156°40'28"	-46.674	20.126	3063267.648	627263.393	1320.488	
	87	1.5	307°21'42"	27.426	-0.721	145°37'34"	-22.637	15.484	3063291.685	627258.752	1320.665	
	88	1.5	311°53'31"	29.303	-0.709	150°09'23"	-25.417	14.582	3063288.905	627257.850	1320.677	
	89	1.5	324°06'51"	19.625	-0.284	162°22'43"	-18.704	5.941	3063295.618	627249.208	1321.102	
	90	1.5	331°39'45"	23.141	-0.268	169°55'37"	-22.784	4.047	3063291.537	627247.315	1321.118	
	91	1.5	00°45'43"	55.051	0.269	199°01'35"	-52.043	-17.947	3063262.278	627225.321	1321.655	
	92	1.5	341°10'26"	21.485	-0.298	179°26'18"	-21.484	0.211	3063292.838	627243.478	1321.088	
	93	1.5	359°30'58"	51.688	0.188	197°46'50"	-49.219	-15.784	3063265.103	627227.483	1321.574	
	94	1.5	336°08'00"	17.013	-0.260	174°23'52"	-16.932	1.661	3063297.390	627244.928	1321.126	
	95	1.5	340°10'56"	15.474	0.006	178°26'48"	-15.468	0.419	3063298.853	627243.687	1321.392	
	96	1.5	21°11'43"	50.716	0.210	219°27'35"	-39.156	-32.232	3063275.165	627211.036	1321.596	
	97	1.5	28°48'26"	15.916	0.152	227°04'18"	-10.840	-11.654	3063303.482	627231.614	1321.538	
	98	1.5	25°39'27"	18.904	0.200	223°55'19"	-13.616	-13.113	3063300.705	627230.154	1321.586	
	99	1.5	30°45'33"	42.509	0.200	229°01'25"	-27.875	-32.093	3063286.446	627211.174	1321.586	
	100	1.5	19°05'20"	41.863	0.154	217°21'12"	-33.277	-25.399	3063281.044	627217.868	1321.540	
	101	1.5	12°50'57"	24.750	0.301	211°06'49"	-21.190	-12.789	3063293.132	627230.478	1321.687	
	102	1.5	08°35'25"	28.089	0.458	206°51'17"	-25.060	-12.689	3063289.262	627230.579	1321.844	
	103	1.5	07°05'39"	42.673	0.081	205°21'31"	-38.561	-18.276	3063275.760	627224.991	1321.467	
	104	1.5	349°33'47"	34.026	0.417	187°49'39"	-33.709	-4.634	3063280.613	627238.633	1321.803	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	105	1.5	00°57'37"	40.025	0.030	199°13'29"	-37.793	-13.179	3063276.529	627230.088	1321.416	
	106	1.5	351°41'38"	38.401	0.458	189°57'30"	-37.822	-6.641	3063276.499	627236.627	1321.844	
	107	1.5	339°28'43"	40.813	-0.241	177°44'35"	-40.781	1.607	3063273.540	627244.875	1321.145	
	108	1.5	359°22'26"	37.325	0.435	197°38'18"	-35.570	-11.310	3063278.751	627231.958	1321.821	
	109	1.5	20°54'19"	35.728	0.601	219°10'11"	-27.699	-22.567	3063286.623	627220.701	1321.987	
	110	1.5	28°03'00"	36.407	0.568	226°18'52"	-25.146	-26.327	3063289.175	627216.940	1321.954	
	111	1.5	30°39'01"	37.887	0.335	228°54'53"	-24.899	-28.557	3063289.423	627214.711	1321.721	
	112	1.5	35°30'15"	38.165	0.564	233°46'07"	-22.557	-30.785	3063291.764	627212.482	1321.950	
	113	1.5	87°08'49"	8.430	0.186	285°24'41"	2.240	-8.127	3063316.562	627235.141	1321.572	
	114	1.5	162°23'03"	3.276	0.182	00°38'55"	3.276	0.037	3063317.597	627243.305	1321.568	
	115	1.5	141°51'05"	10.231	0.250	340°06'57"	9.621	-3.480	3063323.943	627239.788	1321.636	
	116	1.5	53°14'12"	41.976	0.913	251°30'04"	-13.318	-39.807	3063301.003	627203.460	1322.299	
	117	1.5	48°49'09"	39.478	0.933	247°05'01"	-15.372	-36.362	3063298.949	627206.905	1322.319	
	118	1.5	77°28'33"	29.470	1.359	275°44'25"	2.948	-29.322	3063317.269	627213.945	1322.745	
	119	1.5	350°45'28"	14.460	0.621	189°01'20"	-14.281	-2.268	3063300.041	627241.000	1322.007	
	120	1.5	15°30'18"	12.989	0.690	213°46'10"	-10.798	-7.220	3063303.524	627236.048	1322.076	
	121	1.5	36°31'20"	9.685	0.318	234°47'12"	-5.585	-7.913	3063308.737	627235.355	1321.704	
	122	1.5	355°45'02"	5.655	0.056	194°00'54"	-5.487	-1.370	3063308.835	627241.898	1321.442	
	123	1.5	17°56'20"	21.523	0.258	216°12'12"	-17.367	-12.713	3063296.954	627230.555	1321.644	
	124	1.5	309°03'15"	8.242	-0.076	147°19'07"	-6.937	4.450	3063307.385	627247.718	1321.310	
	125	1.5	09°20'53"	23.398	0.241	207°36'45"	-20.733	-10.845	3063293.589	627232.423	1321.627	
	126	1.5	335°01'28"	14.016	-0.038	173°17'20"	-13.920	1.638	3063300.402	627244.905	1321.348	
	127	1.5	355°21'43"	26.023	0.206	193°37'35"	-25.291	-6.131	3063289.031	627237.137	1321.592	
	128	1.5	350°33'21"	30.248	0.260	188°49'13"	-29.890	-4.638	3063284.431	627238.629	1321.646	
	129	1.5	310°53'34"	38.716	-0.851	149°09'26"	-33.241	19.849	3063281.081	627263.117	1320.535	
	130	1.5	349°51'29"	20.646	0.066	188°07'21"	-20.439	-2.917	3063293.883	627240.350	1321.452	
	131	1.5	290°16'45"	31.353	-0.903	128°32'37"	-19.536	24.522	3063294.785	627267.790	1320.483	
m2	m3		00°00'00"			142°34'03"			3063244.701	627220.290	1321.636	
1.404	132	1.5	07°09'16"	11.313	-0.545	149°43'19"	-9.770	5.704	3063234.932	627225.994	1320.995	
	133	1.5	281°40'24"	11.100	-0.123	64°14'27"	4.824	9.997	3063249.525	627230.287	1321.417	
	134	1.5	01°42'05"	19.103	-1.274	144°16'08"	-15.507	11.156	3063229.194	627231.446	1320.266	
	135	1.5	354°02'00"	19.790	-1.378	136°36'03"	-14.379	13.597	3063230.322	627233.887	1320.162	
	136	0.12	337°39'08"	8.047	-1.479	120°13'11"	-4.050	6.953	3063240.651	627227.243	1321.441	
	137	1.5	353°44'02"	9.337	-0.455	136°18'05"	-6.751	6.451	3063237.951	627226.741	1321.085	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
138	1.5	312°22'21"	5.276	-0.107	94°56'24"	-0.454	5.256	3063244.247	627225.546	1321.433		
139	1.5	27°59'52"	3.330	-0.008	170°33'55"	-3.285	0.546	3063241.417	627220.836	1321.532		
140	1.5	156°00'14"	4.855	-0.247	298°34'17"	2.322	-4.264	3063247.023	627216.026	1321.293		
141	1.5	252°40'38"	7.044	0.067	35°14'41"	5.753	4.065	3063250.454	627224.355	1321.607		
142	1.5	221°23'58"	10.411	-0.180	03°58'01"	10.386	0.720	3063255.088	627221.010	1321.360		
143	1.5	255°59'01"	16.441	-0.019	38°33'04"	12.858	10.246	3063257.559	627230.536	1321.521		
144	1.5	233°18'08"	18.300	-0.178	15°52'11"	17.603	5.004	3063262.304	627225.294	1321.362		
145	1.5	253°08'44"	27.563	0.015	35°42'47"	22.380	16.089	3063267.081	627236.379	1321.555		
146	1.5	137°35'02"	22.059	0.082	280°09'05"	3.888	-21.714	3063248.589	627198.576	1321.622		
147	1.5	144°28'46"	22.672	-0.147	287°02'49"	6.646	-21.676	3063251.348	627198.614	1321.393		
148	1.5	247°26'37"	33.489	0.041	30°00'40"	28.999	16.750	3063273.701	627237.040	1321.581		
149	1.5	147°51'03"	29.608	-0.184	290°25'06"	10.329	-27.748	3063255.031	627192.542	1321.356		
150	1.5	251°08'35"	34.446	0.102	33°42'38"	28.654	19.117	3063273.355	627239.407	1321.642		
151	1.5	256°32'19"	29.378	0.034	39°06'22"	22.797	18.530	3063267.498	627238.820	1321.574		
152	1.5	261°53'09"	22.281	-0.037	44°27'12"	15.905	15.604	3063260.606	627235.894	1321.503		
153	1.5	266°57'19"	12.620	-0.005	49°31'22"	8.192	9.600	3063252.894	627229.890	1321.535		
154	1.5	108°51'44"	2.210	0.316	251°25'47"	-0.704	-2.095	3063243.998	627218.195	1321.856		
155	1.5	313°17'01"	5.313	-0.109	95°51'04"	-0.542	5.285	3063244.160	627225.575	1321.431		
156	1.5	125°59'39"	2.603	0.428	268°33'42"	-0.065	-2.602	3063244.636	627217.688	1321.968		
157	1.5	108°27'12"	3.032	0.794	251°01'15"	-0.986	-2.867	3063243.715	627217.423	1322.334		
158	1.5	119°26'40"	5.442	0.364	262°00'43"	-0.756	-5.389	3063243.945	627214.901	1321.904		
159	1.5	139°35'17"	5.633	-0.203	282°09'20"	1.186	-5.507	3063245.888	627214.783	1321.337		
160	1.5	311°47'15"	7.183	-0.627	94°21'18"	-0.545	7.162	3063244.156	627227.452	1320.913		
161	1.5	190°44'13"	3.618	-0.214	333°18'16"	3.232	-1.625	3063247.934	627218.665	1321.326		
162	1.5	231°37'58"	9.615	-0.251	14°12'01"	9.321	2.359	3063254.023	627222.649	1321.289		
163	1.5	345°30'44"	7.845	-0.431	128°04'47"	-4.838	6.175	3063239.863	627226.465	1321.109		
164	1.5	350°48'10"	12.049	-0.654	133°22'13"	-8.274	8.759	3063236.427	627229.049	1320.886		
165	1.5	158°06'53"	25.557	-0.150	300°40'56"	13.041	-21.979	3063257.743	627198.311	1321.390		
166	1.5	353°51'25"	18.339	-1.174	136°25'28"	-13.286	12.641	3063231.415	627232.931	1320.366		
167	1.5	31°07'51"	4.894	0.387	173°41'54"	-4.864	0.537	3063239.837	627220.827	1321.927		
168	1.5	03°46'38"	17.807	-1.110	146°20'41"	-14.822	9.869	3063229.879	627230.159	1320.430		
169	1.5	52°44'58"	8.978	0.704	195°19'01"	-8.659	-2.372	3063236.042	627217.918	1322.244		
170	1.5	16°06'52"	14.741	-0.109	158°40'55"	-13.732	5.359	3063230.969	627225.649	1321.431		
171	1.5	33°44'08"	7.663	0.152	176°18'11"	-7.647	0.494	3063237.054	627220.784	1321.692		
172	1.5	06°44'44"	14.383	-0.804	149°18'47"	-12.369	7.340	3063232.333	627227.630	1320.736		
173	1.5	20°56'31"	9.419	0.196	163°30'34"	-9.032	2.674	3063235.670	627222.964	1321.736		

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	174	1.5	12°47'58"	11.433	-0.488	155°22'01"	-10.393	4.765	3063234.309	627225.055	1321.052	
	175	1.5	09°25'49"	9.547	-0.413	151°59'52"	-8.429	4.482	3063236.272	627224.772	1321.127	
	176	1.5	15°40'04"	5.186	-0.161	158°14'07"	-4.816	1.923	3063239.885	627222.213	1321.379	
m3	m4		00°00'00"			258°07'30"			3063213.219	627244.388	1318.767	
1.321	177	1.5	09°05'26"	3.731	0.141	267°12'56"	-0.181	-3.727	3063213.038	627240.661	1318.729	
	178	1.5	311°06'31"	2.972	0.083	209°14'01"	-2.593	-1.451	3063210.626	627242.936	1318.671	
	179	1.5	40°05'00"	8.570	0.639	298°12'30"	4.051	-7.552	3063217.270	627236.835	1319.227	
	180	1.5	260°25'07"	4.850	-0.085	158°32'37"	-4.514	1.774	3063208.706	627246.162	1318.503	
	181	1.5	62°27'52"	8.066	0.724	320°35'22"	6.232	-5.121	3063219.451	627239.267	1319.312	
	182	1.5	58°27'23"	12.321	1.448	316°34'53"	8.949	-8.469	3063222.169	627235.919	1320.036	
	183	1.5	241°54'15"	7.457	-0.270	140°01'45"	-5.715	4.790	3063207.505	627249.178	1318.318	
	184	2.15	69°47'45"	17.382	3.068	327°55'15"	14.728	-9.231	3063227.947	627235.156	1321.006	
	185	1.5	62°20'02"	17.429	2.419	320°27'32"	13.441	-11.096	3063226.660	627233.292	1321.007	
	186	1.5	241°50'14"	7.543	-0.287	139°57'44"	-5.775	4.852	3063207.444	627249.240	1318.301	
	187	1.5	294°37'27"	25.850	-1.879	192°44'57"	-25.213	-5.705	3063188.007	627238.683	1316.709	
	188	2.15	276°04'27"	24.114	-1.773	174°11'57"	-23.991	2.437	3063189.229	627246.825	1316.165	
	189	2.15	283°48'50"	21.235	-1.437	181°56'20"	-21.223	-0.718	3063191.997	627243.669	1316.501	
	190	2.15	59°07'44"	17.974	2.565	317°15'14"	13.200	-12.200	3063226.419	627232.188	1320.503	
	191	2.15	278°03'57"	21.700	-1.523	176°11'27"	-21.652	1.442	3063191.567	627245.829	1316.415	
	192	2.15	275°49'47"	20.252	-1.584	173°57'17"	-20.139	2.133	3063193.080	627246.520	1316.354	
	193	2.15	277°05'15"	12.651	-0.782	175°12'45"	-12.607	1.056	3063200.613	627245.443	1317.156	
	194	2.15	286°16'25"	18.472	-1.330	184°23'55"	-18.418	-1.417	3063194.802	627242.971	1316.608	
	195	2.15	278°23'55"	8.479	-0.773	176°31'25"	-8.463	0.514	3063204.756	627244.902	1317.165	
	196	2.15	299°54'38"	9.677	-0.259	198°02'08"	-9.202	-2.996	3063204.018	627241.392	1317.679	
	197	2.15	286°29'24"	15.966	-0.923	184°36'54"	-15.914	-1.285	3063197.305	627243.103	1317.015	
	198	2.15	260°00'53"	10.343	-0.947	158°08'23"	-9.599	3.851	3063203.620	627248.239	1316.991	
	199	2.15	258°05'38"	12.090	-1.580	156°13'08"	-11.063	4.875	3063202.156	627249.263	1316.358	
	200	2.15	260°06'58"	13.250	-0.929	158°14'28"	-12.306	4.912	3063200.913	627249.299	1317.009	
	201	2.15	287°31'04"	13.894	-0.712	185°38'34"	-13.827	-1.366	3063199.393	627243.021	1317.226	
	202	2.15	254°17'04"	14.310	-1.449	152°24'34"	-12.683	6.628	3063200.537	627251.015	1316.489	
	203	2.15	301°43'11"	25.000	-1.373	199°50'41"	-23.515	-8.487	3063189.704	627235.901	1316.565	
	204	2.15	301°06'55"	21.978	-1.374	199°14'25"	-20.750	-7.242	3063192.469	627237.145	1316.564	
	205	2.15	307°59'02"	18.543	-0.899	206°06'32"	-16.651	-8.160	3063196.569	627236.227	1317.039	
	206	2.15	307°53'28"	22.528	-1.225	206°00'58"	-20.245	-9.881	3063192.974	627234.506	1316.713	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	207	2.15	305°25'19"	25.736	-1.566	203°32'49"	-23.593	-10.282	3063189.626	627234.106	1316.372	
	208	2.15	23°17'25"	9.960	0.906	281°24'55"	1.971	-9.763	3063215.191	627234.625	1318.844	
	209	2.15	27°37'07"	11.886	0.755	285°44'37"	3.225	-11.440	3063216.444	627232.947	1318.693	
	210	2.15	347°09'42"	10.807	0.683	245°17'12"	-4.518	-9.817	3063208.701	627234.570	1318.621	
	211	2.15	359°37'28"	16.032	0.465	257°44'58"	-3.402	-15.667	3063209.818	627228.721	1318.403	
	212	2.15	19°20'35"	14.023	0.558	277°28'05"	1.823	-13.904	3063215.042	627230.484	1318.496	
	213	2.15	346°04'11"	13.424	0.374	244°11'41"	-5.844	-12.085	3063207.376	627232.302	1318.312	
	214	2.15	14°54'20"	20.968	0.516	273°01'50"	1.109	-20.939	3063214.328	627223.449	1318.454	
	215	2.15	350°31'31"	19.470	0.375	248°39'01"	-7.088	-18.134	3063206.131	627226.254	1318.313	
m4	m5		00°00'00"			276°08'13"			3063200.632	627184.529	1317.195	
1.426	216	1.5	24°20'10"	6.134	-0.860	300°28'23"	3.111	-5.287	3063203.743	627179.242	1316.261	
	217	1.5	11°57'53"	3.208	-0.151	288°06'06"	0.997	-3.049	3063201.629	627181.479	1316.970	
	218	1.5	294°05'41"	1.693	-0.112	210°13'54"	-1.463	-0.852	3063199.169	627183.676	1317.009	
	219	1.5	232°56'25"	4.118	-0.230	149°04'38"	-3.533	2.116	3063197.100	627186.645	1316.891	
	220	1.5	253°16'25"	5.518	-1.097	169°24'38"	-5.424	1.014	3063195.208	627185.543	1316.024	
	221	1.5	304°07'00"	4.262	-1.055	220°15'13"	-3.253	-2.754	3063197.379	627181.775	1316.066	
	222	1.5	354°35'06"	6.519	-1.055	270°43'19"	0.082	-6.518	3063200.714	627178.010	1316.066	
	223	1.5	346°08'52"	9.539	-1.228	262°17'05"	-1.281	-9.453	3063199.352	627175.076	1315.893	
	224	1.5	324°22'43"	9.516	-1.309	240°30'56"	-4.684	-8.284	3063195.949	627176.245	1315.812	
	225	1.5	296°20'42"	7.222	-1.388	212°28'55"	-6.092	-3.878	3063194.540	627180.650	1315.733	
	226	1.5	263°41'55"	7.574	-1.229	179°50'08"	-7.574	0.022	3063193.058	627184.550	1315.892	
	227	1.5	326°20'04"	11.550	-2.204	242°28'17"	-5.338	-10.242	3063195.294	627174.286	1314.917	
	228	1.5	295°09'58"	9.068	-2.375	211°18'11"	-7.748	-4.711	3063192.884	627179.817	1314.746	
	229	1.5	296°51'29"	13.132	-2.558	212°59'42"	-11.014	-7.151	3063189.618	627177.377	1314.563	
	230	1.5	96°44'28"	6.651	0.157	12°52'41"	6.484	1.482	3063207.116	627186.011	1317.278	
	231	1.5	96°01'03"	7.751	0.414	12°09'16"	7.577	1.632	3063208.209	627186.161	1317.535	
	232	1.5	95°07'51"	10.792	0.608	11°16'04"	10.584	2.109	3063211.216	627186.637	1317.729	
	233	1.5	94°15'26"	13.047	1.386	10°23'39"	12.833	2.354	3063213.465	627186.883	1318.507	
	234	2.15	78°32'28"	13.152	2.097	354°40'41"	13.095	-1.220	3063213.727	627183.309	1318.568	
	235	2.15	62°01'27"	14.137	2.138	338°09'40"	13.122	-5.259	3063213.755	627179.270	1318.609	
	236	2.15	56°40'28"	11.424	1.174	332°48'41"	10.162	-5.220	3063210.794	627179.309	1317.645	
	237	2.15	41°14'16"	7.894	0.655	317°22'29"	5.808	-5.346	3063206.441	627179.183	1317.126	
	238	1.5	317°39'12"	15.946	-2.671	233°47'25"	-9.420	-12.866	3063191.212	627171.662	1314.450	
	239	1.5	157°27'14"	10.127	0.074	73°35'27"	2.861	9.715	3063203.493	627194.243	1317.195	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	240	1.5	141°26'21"	13.390	0.513	57°34'34"	7.179	11.303	3063207.812	627195.831	1317.634	
	241	1.5	158°57'22"	19.253	0.113	75°05'35"	4.953	18.605	3063205.585	627203.134	1317.234	
	242	1.5	164°09'12"	25.914	0.308	80°17'25"	4.371	25.543	3063205.003	627210.071	1317.429	
	243	1.5	200°43'00"	17.181	-0.326	116°51'13"	-7.761	15.328	3063192.871	627199.857	1316.795	
	244	1.5	330°02'19"	14.268	-2.633	246°10'32"	-5.763	-13.052	3063194.869	627171.476	1314.488	
	245	1.5	328°08'10"	16.232	-3.246	244°16'23"	-7.046	-14.623	3063193.586	627169.906	1313.875	
	246	1.5	340°35'46"	11.755	-2.217	256°43'59"	-2.698	-11.441	3063197.935	627173.087	1314.904	
	247	2.15	03°45'27"	13.168	-1.169	279°53'40"	2.263	-12.972	3063202.895	627171.557	1315.302	
	248	2.15	355°23'51"	10.112	-0.479	271°32'04"	0.271	-10.108	3063200.903	627174.420	1315.992	
	249	2.15	05°48'57"	21.247	-1.110	281°57'10"	4.400	-20.786	3063205.033	627163.742	1315.361	
	250	2.15	06°09'54"	29.312	-1.111	282°18'07"	6.245	-28.639	3063206.877	627155.890	1315.360	
	251	2.15	05°44'41"	34.943	-0.587	281°52'54"	7.194	-34.194	3063207.827	627150.334	1315.884	
	252	2.15	334°03'58"	21.026	-2.228	250°12'11"	-7.121	-19.783	3063193.511	627164.745	1314.243	
	253	2.15	05°44'21"	37.887	0.089	281°52'34"	7.797	-37.076	3063208.429	627147.453	1316.560	
	254	2.15	335°48'17"	31.878	-2.211	251°56'30"	-9.882	-30.308	3063190.750	627154.221	1314.260	
	255	2.15	07°52'06"	42.381	1.178	284°00'19"	10.257	-41.121	3063210.889	627143.407	1317.649	
	256	2.15	05°22'13"	46.600	1.342	281°30'26"	9.296	-45.663	3063209.928	627138.865	1317.813	
	257	2.15	342°31'27"	32.977	-2.175	258°39'40"	-6.484	-32.333	3063194.149	627152.195	1314.296	
	258	2.15	03°20'37"	44.426	0.136	279°28'50"	7.318	-43.819	3063207.950	627140.709	1316.607	
	259	2.15	342°31'08"	32.917	-2.168	258°39'21"	-6.475	-32.274	3063194.157	627152.255	1314.303	
	260	2.15	02°26'53"	41.036	-0.499	278°35'06"	6.126	-40.576	3063206.758	627143.952	1315.972	
	261	1.7	354°58'07"	56.936	-0.599	271°06'20"	1.099	-56.925	3063201.731	627127.603	1316.322	
m5	m6		00°00'00"			350°24'46"			3063208.015	627115.8645	1318.344	
1.58	262	1.5	297°55'19"	16.454	0.409	288°20'05"	5.176	-15.619	3063213.191	627100.246	1318.833	
	263	1.5	329°44'50"	12.868	0.517	320°09'36"	9.881	-8.244	3063217.895	627107.621	1318.941	
	264	1.5	300°44'05"	12.340	0.377	291°08'51"	4.452	-11.509	3063212.467	627104.356	1318.801	
	265	1.8	283°33'38"	19.522	0.703	273°58'24"	1.353	-19.475	3063209.368	627096.389	1318.827	
	266	1.8	278°28'52"	25.389	0.784	268°53'38"	-0.490	-25.384	3063207.525	627090.480	1318.908	
	267	1.8	274°17'20"	26.339	0.257	264°42'06"	-2.432	-26.226	3063205.583	627089.638	1318.381	
	268	1.8	276°46'31"	9.459	0.535	267°11'17"	-0.464	-9.448	3063207.551	627106.417	1318.659	
	269	1.8	337°44'13"	4.262	0.363	328°08'59"	3.620	-2.249	3063211.635	627113.615	1318.487	
	270	1.8	17°19'45"	0.655	0.641	07°44'31"	0.649	0.088	3063208.664	627115.953	1318.765	
	271	1.8	33°06'58"	9.816	0.834	23°31'44"	9.000	3.919	3063217.015	627119.783	1318.958	
	272	1.8	51°58'29"	10.993	0.637	42°23'15"	8.119	7.411	3063216.134	627123.275	1318.761	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	273	1.8	62°21'39"	8.563	0.723	52°46'25"	5.180	6.818	3063213.195	627122.683	1318.847	
	274	1.8	76°25'03"	3.833	0.295	66°49'49"	1.508	3.524	3063209.523	627119.388	1318.419	
	275	1.8	344°52'45"	13.842	1.076	335°17'31"	12.575	-5.786	3063220.590	627110.079	1319.200	
	276	1.8	348°48'45"	14.001	1.071	339°13'31"	13.091	-4.966	3063221.106	627110.898	1319.195	
	277	1.8	346°29'50"	14.821	1.130	336°54'36"	13.634	-5.812	3063221.649	627110.052	1319.254	
	278	1.8	344°02'15"	14.413	1.096	334°27'01"	13.004	-6.216	3063221.018	627109.648	1319.220	
	279	1.8	357°34'00"	21.952	1.851	347°58'46"	21.471	-4.572	3063229.486	627111.293	1319.975	
	280	1.8	354°30'46"	1.925	1.690	344°55'32"	1.859	-0.501	3063209.874	627115.364	1319.814	
	281	1.8	357°03'46"	19.832	1.808	347°28'32"	19.360	-4.301	3063227.375	627111.564	1319.932	
	282	1.8	348°13'47"	17.297	0.914	338°38'33"	16.109	-6.299	3063224.124	627109.565	1319.038	
	283	1.8	72°37'16"	1.981	0.252	63°02'02"	0.898	1.766	3063208.913	627117.630	1318.376	
	284	1.8	87°47'15"	1.878	0.057	78°12'01"	0.384	1.838	3063208.399	627117.703	1318.181	
	285	1.8	108°59'23"	1.770	-0.102	99°24'09"	-0.289	1.746	3063207.726	627117.611	1318.022	
	286	1.8	97°21'48"	2.338	-0.301	87°46'34"	0.091	2.336	3063208.106	627118.201	1317.823	
	287	1.8	49°47'59"	2.980	0.390	40°12'45"	2.276	1.924	3063210.291	627117.788	1318.514	
	288	1.8	61°15'12"	4.241	0.317	51°39'58"	2.630	3.327	3063210.645	627119.191	1318.441	
	289	1.8	75°33'38"	3.900	0.320	65°58'24"	1.588	3.562	3063209.603	627119.427	1318.444	
	290	1.8	85°38'37"	4.052	0.132	76°03'23"	0.976	3.933	3063208.991	627119.797	1318.256	
	291	1.8	90°01'39"	3.676	-0.051	80°26'25"	0.610	3.625	3063208.625	627119.489	1318.073	
	292	1.8	95°35'54"	3.682	-0.286	86°00'40"	0.256	3.673	3063208.271	627119.538	1317.838	
	293	1.8	95°45'14"	4.793	-0.304	86°10'00"	0.320	4.782	3063208.335	627120.647	1317.820	
	294	1.8	147°17'04"	1.713	-0.131	137°41'50"	-1.267	1.153	3063206.748	627117.017	1317.993	
	295	1.8	157°11'38"	2.847	-0.369	147°36'24"	-2.404	1.525	3063205.611	627117.390	1317.755	
	296	1.8	150°34'36"	4.523	-0.998	140°59'22"	-3.515	2.847	3063204.500	627118.712	1317.126	
	297	1.8	146°16'50"	5.534	-1.132	136°41'36"	-4.027	3.796	3063203.988	627119.660	1316.992	
	298	1.8	151°10'35"	9.685	-1.174	141°35'21"	-7.589	6.017	3063200.426	627121.882	1316.950	
	299	1.8	146°35'24"	7.652	-1.671	137°00'10"	-5.597	5.218	3063202.418	627121.083	1316.453	
	300	1.8	156°25'52"	6.822	-1.459	146°50'38"	-5.711	3.731	3063202.304	627119.596	1316.665	
	301	1.8	142°44'27"	8.524	-1.785	133°09'13"	-5.830	6.218	3063202.185	627122.083	1316.339	
	302	1.8	143°49'51"	10.088	-2.270	134°14'37"	-7.039	7.227	3063200.976	627123.091	1315.854	
	303	1.8	140°06'06"	12.459	-2.366	130°30'52"	-8.094	9.472	3063199.921	627125.336	1315.758	
	304	1.8	139°16'04"	14.153	-2.461	129°40'50"	-9.037	10.892	3063198.978	627126.757	1315.663	
	305	1.8	154°26'40"	12.040	-2.379	144°51'26"	-9.845	6.930	3063198.170	627122.795	1315.745	
m6	m7		00°00'00"			280°57'16"			3063242.105	627110.1064	1323.286	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
1.369	306	0.12	167°13'16"	30.435	-1.667	88°10'32"	0.969	30.420	3063243.074	627140.526	1322.868	
	307	1.5	108°17'15"	6.123	0.464	29°14'31"	5.343	2.991	3063247.448	627113.098	1323.619	
	308	1.5	75°32'15"	5.916	0.469	356°29'31"	5.905	-0.362	3063248.010	627109.744	1323.624	
	309	1.5	161°03'43"	17.300	-0.466	82°00'59"	2.403	17.132	3063244.508	627127.239	1322.689	
	310	1.5	118°56'04"	5.739	-0.439	39°53'20"	4.403	3.680	3063246.509	627113.787	1322.716	
	311	1.5	130°27'06"	4.324	-0.375	51°24'22"	2.697	3.380	3063244.803	627113.486	1322.780	
	312	1.5	55°31'37"	3.753	-0.328	336°28'53"	3.441	-1.498	3063245.546	627108.609	1322.827	
	313	1.5	64°51'41"	5.429	-0.366	345°48'57"	5.263	-1.330	3063247.369	627108.776	1322.789	
	314	1.7	18°43'07"	14.165	-0.143	299°40'23"	7.012	-12.307	3063249.118	627097.799	1322.812	
	315	1.5	243°40'20"	4.626	0.131	164°37'36"	-4.460	1.226	3063237.645	627111.333	1323.286	
	316	1.5	265°48'38"	7.399	0.015	186°45'54"	-7.347	-0.872	3063234.758	627109.235	1323.170	
	317	1.5	280°04'59"	7.825	-0.013	201°02'15"	-7.303	-2.809	3063234.802	627107.297	1323.142	
	318	1.5	276°08'24"	8.057	-0.076	197°05'40"	-7.701	-2.368	3063234.404	627107.738	1323.079	
	319	1.5	299°38'30"	8.046	0.061	220°35'46"	-6.109	-5.236	3063235.996	627104.871	1323.216	
	320	1.5	315°53'21"	6.804	0.202	236°50'37"	-3.721	-5.696	3063238.384	627104.410	1323.357	
	321	1.5	314°42'40"	5.442	0.140	235°39'56"	-3.069	-4.494	3063239.036	627105.613	1323.295	
	322	1.5	316°07'01"	3.977	0.145	237°04'17"	-2.162	-3.338	3063239.943	627106.768	1323.300	
	323	1.5	322°32'44"	4.793	0.159	243°30'00"	-2.139	-4.289	3063239.967	627105.817	1323.314	
	324	1.5	309°10'12"	4.341	0.142	230°07'28"	-2.783	-3.331	3063239.322	627106.775	1323.297	
	325	1.5	316°20'02"	4.777	0.064	237°17'18"	-2.582	-4.019	3063239.524	627106.087	1323.219	
	326	1.5	335°42'16"	4.509	0.255	256°39'32"	-1.040	-4.387	3063241.065	627105.719	1323.410	
	327	1.5	346°49'08"	5.146	0.367	267°46'24"	-0.200	-5.142	3063241.905	627104.964	1323.522	
	328	1.5	331°23'16"	7.044	0.375	252°20'32"	-2.137	-6.712	3063239.969	627103.394	1323.530	
	329	1.5	329°52'56"	8.519	0.456	250°50'12"	-2.796	-8.047	3063239.309	627102.059	1323.611	
	330	1.5	323°34'16"	10.153	0.462	244°31'32"	-4.367	-9.166	3063237.738	627100.941	1323.617	
	331	1.5	332°18'29"	10.454	0.868	253°15'45"	-3.011	-10.011	3063239.095	627100.095	1324.023	
	332	1.5	331°34'39"	11.824	0.990	252°31'55"	-3.549	-11.279	3063238.556	627098.828	1324.145	
	333	1.5	312°05'29"	12.501	0.534	233°02'45"	-7.515	-9.990	3063234.590	627100.117	1323.689	
	334	1.5	260°23'04"	1.653	-0.153	181°20'20"	-1.653	-0.039	3063240.453	627110.068	1323.002	
	335	1.5	199°31'20"	3.195	-0.593	120°28'36"	-1.620	2.754	3063240.485	627112.860	1322.562	
	336	1.5	205°20'23"	6.050	-1.163	126°17'39"	-3.581	4.876	3063238.524	627114.983	1321.992	
	337	1.5	213°30'21"	8.491	-1.668	134°27'37"	-5.947	6.060	3063236.158	627116.167	1321.487	
	338	1.5	219°42'00"	9.544	-2.194	140°39'16"	-7.381	6.051	3063234.725	627116.157	1320.961	
	339	1.5	278°29'27"	10.369	-2.615	199°26'43"	-9.778	-3.452	3063232.328	627106.655	1320.540	
	340	1.5	155°12'36"	3.101	0.297	76°09'52"	0.742	3.011	3063242.847	627113.117	1323.452	
	341	1.5	103°20'40"	4.955	-0.063	24°17'56"	4.516	2.039	3063246.621	627112.145	1323.092	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	342	1.5	188°46'35"	6.611	-0.609	109°43'51"	-2.232	6.223	3063239.873	627116.329	1322.546	
	343	1.5	190°28'55"	9.065	-1.196	111°26'11"	-3.313	8.438	3063238.792	627118.544	1321.959	
	344	1.5	237°04'30"	3.677	-0.903	158°01'46"	-3.410	1.376	3063238.695	627111.482	1322.252	
	345	1.5	34°58'24"	3.516	1.110	315°55'40"	2.526	-2.446	3063244.631	627107.661	1324.265	
	346	1.5	29°38'53"	4.474	0.636	310°36'09"	2.912	-3.397	3063245.017	627106.710	1323.791	
	347	1.5	02°26'26"	8.079	0.263	283°23'42"	1.872	-7.859	3063243.977	627102.247	1323.418	
	348	2.15	33°33'20"	7.108	-0.763	314°30'36"	4.983	-5.069	3063247.088	627105.038	1321.742	
	349	2.15	18°51'04"	12.191	0.011	299°48'20"	6.060	-10.578	3063248.165	627099.528	1322.516	
	350	1.5	13°26'19"	11.808	0.490	294°23'35"	4.877	-10.754	3063246.982	627099.352	1323.645	
m7	m8		00°00'00"			323°09'44"			3063248.686	627076.1053	1324.208	
1.465	351	1.5	123°55'50"	10.251	-0.530	87°05'34"	0.520	10.238	3063249.206	627086.343	1323.643	
	352	1.5	116°32'17"	14.767	-1.153	79°42'01"	2.640	14.529	3063251.326	627090.634	1323.020	
	353	1.5	124°58'50"	14.599	-0.839	88°08'34"	0.473	14.591	3063249.159	627090.697	1323.334	
	354	1.5	125°32'47"	16.977	-1.046	88°42'31"	0.383	16.973	3063249.069	627093.078	1323.127	
	355	1.5	130°45'28"	19.477	-0.187	93°55'12"	-1.332	19.431	3063247.355	627095.537	1323.986	
	356	1.5	06°50'19"	28.457	3.000	330°00'03"	24.645	-14.228	3063273.331	627061.877	1327.173	
	357	1.5	137°16'28"	21.450	-0.556	100°26'12"	-3.886	21.095	3063244.801	627097.200	1323.617	
	358	1.5	130°56'43"	18.311	-0.468	94°06'27"	-1.312	18.264	3063247.375	627094.369	1323.705	
	359	1.5	43°08'21"	4.580	-1.316	06°18'05"	4.552	0.503	3063253.238	627076.608	1322.857	
	360	1.5	143°22'22"	18.008	-0.547	106°32'06"	-5.125	17.263	3063243.561	627093.369	1323.626	
	361	1.5	150°15'28"	18.530	-0.343	113°25'12"	-7.365	17.003	3063241.321	627093.109	1323.830	
	362	1.5	171°49'35"	5.766	-0.578	134°59'19"	-4.076	4.078	3063244.610	627080.183	1323.595	
	363	1.5	215°47'47"	11.159	-0.614	178°57'31"	-11.157	0.203	3063237.529	627076.308	1323.559	
	364	1.5	194°33'48"	16.254	-0.591	157°43'32"	-15.041	6.161	3063233.645	627082.266	1323.582	
	365	1.5	180°26'09"	17.610	-0.558	143°35'53"	-14.174	10.451	3063234.512	627086.556	1323.615	
	366	1.5	172°09'42"	17.371	-0.555	135°19'26"	-12.352	12.214	3063236.334	627088.319	1323.618	
	367	1.5	157°20'47"	17.066	-0.596	120°30'31"	-8.664	14.703	3063240.022	627090.809	1323.577	
	368	1.5	146°30'52"	10.364	-0.624	109°40'36"	-3.490	9.759	3063245.196	627085.864	1323.549	
	369	1.5	193°40'33"	3.471	-0.287	156°50'17"	-3.191	1.365	3063245.495	627077.471	1323.886	
	370	1.5	229°49'24"	14.903	-0.327	192°59'08"	-14.522	-3.349	3063234.164	627072.757	1323.846	
	371	1.5	253°33'45"	4.552	-0.360	216°43'29"	-3.649	-2.722	3063245.038	627073.383	1323.813	
	372	1.5	117°56'09"	4.169	-0.281	81°05'53"	0.645	4.119	3063249.331	627080.224	1323.892	
	373	1.5	102°02'13"	4.741	-0.759	65°11'57"	1.989	4.304	3063250.675	627080.409	1323.414	
	374	1.5	06°38'10"	2.843	-0.340	329°47'54"	2.457	-1.430	3063251.143	627074.675	1323.833	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	375	1.5	78°52'06"	3.477	-0.879	42°01'50"	2.583	2.328	3063251.269	627078.433	1323.294	
	376	1.5	67°34'10"	3.488	-1.107	30°43'54"	2.998	1.782	3063251.684	627077.888	1323.066	
	377	1.5	52°01'13"	3.066	-1.083	15°10'57"	2.959	0.803	3063251.645	627076.908	1323.090	
	378	1.5	355°03'11"	2.420	0.042	318°12'55"	1.804	-1.613	3063250.491	627074.493	1324.215	
	379	1.5	356°54'40"	13.108	0.586	320°04'24"	10.052	-8.413	3063258.738	627067.693	1324.759	
	380	1.5	359°41'03"	25.375	1.123	322°50'47"	20.224	-15.325	3063268.911	627060.780	1325.296	
	381	1.5	01°55'19"	34.873	1.540	325°05'03"	28.596	-19.960	3063277.282	627056.145	1325.713	
	382	1.5	03°21'21"	40.688	1.484	326°31'05"	33.936	-22.447	3063282.622	627053.659	1325.657	
	383	1.5	05°37'22"	39.290	1.481	328°47'06"	33.602	-20.362	3063282.288	627055.743	1325.654	
	384	1.5	359°44'51"	43.940	1.612	322°54'35"	35.050	-26.499	3063283.736	627049.606	1325.785	
	385	1.5	359°57'05"	38.086	1.550	323°06'49"	30.462	-22.860	3063279.148	627053.245	1325.723	
	386	1.5	356°55'35"	22.271	1.167	320°05'19"	17.083	-14.289	3063265.769	627061.816	1325.340	
	387	1.5	355°30'48"	19.205	1.289	318°40'32"	14.423	-12.681	3063263.109	627063.424	1325.462	
	388	1.5	351°19'21"	17.662	0.879	314°29'05"	12.376	-12.601	3063261.062	627063.505	1325.052	
	389	1.5	354°05'31"	16.130	1.103	317°15'15"	11.845	-10.948	3063260.532	627065.157	1325.276	
	390	2.15	343°51'45"	15.635	1.834	307°01'29"	9.415	-12.483	3063258.101	627063.623	1325.357	
	391	2.15	350°05'34"	13.601	1.687	313°15'18"	9.320	-9.906	3063258.006	627066.200	1325.210	
	392	2.15	348°19'05"	11.979	1.942	311°28'49"	7.934	-8.974	3063256.621	627067.131	1325.465	
	393	1.5	344°38'47"	8.185	0.769	307°48'31"	5.018	-6.467	3063253.704	627069.639	1324.942	
	394	1.5	328°06'50"	7.106	1.319	291°16'34"	2.579	-6.622	3063251.265	627069.484	1325.492	
	395	2.15	290°28'51"	9.369	1.796	253°38'35"	-2.639	-8.990	3063246.048	627067.116	1325.319	
	396	2.15	286°00'19"	8.934	1.159	249°10'03"	-3.177	-8.350	3063245.509	627067.755	1324.682	
	397	1.5	61°18'21"	2.374	-0.614	24°28'05"	2.161	0.983	3063250.847	627077.089	1323.559	
	398	1.5	34°13'30"	2.324	-0.336	357°23'14"	2.322	-0.106	3063251.008	627075.999	1323.837	
	399	1.5	13°33'57"	3.578	-0.368	336°43'41"	3.287	-1.414	3063251.973	627074.692	1323.805	
	400	1.5	15°09'10"	4.322	-0.759	338°18'54"	4.016	-1.597	3063252.702	627074.508	1323.414	
	401	1.5	05°39'47"	6.387	-0.356	328°49'31"	5.465	-3.306	3063254.151	627072.799	1323.817	
	402	1.5	09°25'25"	6.586	-0.740	332°35'09"	5.846	-3.032	3063254.533	627073.073	1323.433	
	403	1.5	01°32'49"	9.659	0.059	324°42'33"	7.884	-5.580	3063256.570	627070.525	1324.232	
	404	1.5	05°40'46"	9.541	-0.586	328°50'30"	8.165	-4.937	3063256.851	627071.169	1323.587	
	405	1.3	144°56'10"	7.564	-0.424	108°05'54"	-2.350	7.190	3063246.336	627083.295	1323.949	
	406	1.5	125°54'13"	6.085	-0.265	89°03'57"	0.099	6.084	3063248.785	627082.190	1323.908	
m8	m9		00°00'00"		0.000	199°11'38"			3063293.724	627042.3663	1325.944	
1.39	407	1.5	163°07'46"	17.934	-0.251	02°19'24"	17.919	0.727	3063311.643	627043.093	1325.583	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	408	1.5	175°03'41"	17.232	-0.282	14°15'19"	16.701	4.243	3063310.425	627046.610	1325.552	
	409	1.5	325°38'08"	2.860	-0.058	164°49'46"	-2.760	0.748	3063290.963	627043.115	1325.776	
	410	1.5	03°11'19"	26.368	0.236	202°22'57"	-24.381	-10.041	3063269.342	627032.326	1326.070	
	411	1.5	355°41'23"	18.375	0.065	194°53'01"	-17.759	-4.720	3063275.965	627037.647	1325.899	
	412	1.5	10°31'27"	26.718	0.250	209°43'05"	-23.204	-13.245	3063270.520	627029.121	1326.084	
	413	1.5	357°23'58"	44.427	0.323	196°35'36"	-42.577	-12.687	3063251.147	627029.679	1326.157	
	414	1.5	08°14'48"	36.083	0.364	207°26'26"	-32.023	-16.628	3063261.700	627025.738	1326.198	
	415	1.5	315°09'17"	6.575	-0.425	154°20'55"	-5.927	2.846	3063287.797	627045.213	1325.409	
	416	1.5	329°44'32"	5.711	-0.303	168°56'10"	-5.605	1.096	3063288.119	627043.462	1325.531	
	417	1.5	14°46'38"	38.870	-0.497	213°58'16"	-32.236	-21.720	3063261.488	627020.647	1325.337	
	418	2	353°32'23"	29.811	0.169	192°44'01"	-29.078	-6.571	3063264.646	627035.795	1325.503	
	419	1.8	12°34'22"	45.305	0.789	211°46'00"	-38.518	-23.851	3063255.205	627018.515	1326.323	
	420	0.12	70°33'53"	29.574	0.882	269°45'31"	-0.125	-29.574	3063293.599	627012.793	1328.096	
	421	1.5	14°22'07"	45.722	1.485	213°33'45"	-38.099	-25.277	3063255.624	627017.089	1327.319	
	422	1.5	83°17'57"	33.280	2.248	282°29'35"	7.199	-32.492	3063300.923	627009.874	1328.082	
	423	1.5	17°32'22"	36.392	1.486	216°44'00"	-29.166	-21.766	3063264.558	627020.601	1327.320	
	424	1.5	85°06'06"	48.656	2.228	284°17'44"	12.014	-47.149	3063305.738	626995.217	1328.062	
	425	1.5	57°23'54"	25.111	0.591	256°35'32"	-5.823	-24.427	3063287.901	627017.940	1326.425	
	426	1.45	30°32'05"	39.680	1.496	229°43'43"	-25.650	-30.275	3063268.074	627012.091	1327.380	
	427	1.45	55°14'18"	25.676	1.847	254°25'56"	-6.891	-24.734	3063286.833	627017.632	1327.731	
	428	2.15	156°06'12"	17.959	-0.101	355°17'50"	17.899	-1.472	3063311.622	627040.894	1325.083	
	429	2.1	38°20'17"	43.730	2.102	237°31'55"	-23.476	-36.895	3063270.248	627005.472	1327.336	
	430	0.12	79°55'26"	28.426	0.884	279°07'04"	4.505	-28.067	3063298.228	627014.300	1328.098	
	431	1.5	136°43'37"	18.185	0.086	335°55'15"	16.603	-7.419	3063310.326	627034.947	1325.920	
	432	1.5	145°48'46"	18.036	-0.367	345°00'24"	17.422	-4.666	3063311.146	627037.700	1325.467	
	433	2	150°51'12"	18.326	-0.222	350°02'50"	18.050	-3.167	3063311.774	627039.199	1325.112	
	434	2	152°59'15"	16.614	-0.202	352°10'53"	16.460	-2.260	3063310.183	627040.106	1325.132	
	435	2	144°16'13"	17.000	0.110	343°27'51"	16.297	-4.838	3063310.020	627037.528	1325.444	
	436	2	142°17'19"	13.446	-0.498	341°28'57"	12.750	-4.270	3063306.473	627038.096	1324.836	
	437	1.5	86°54'37"	43.090	2.472	286°06'15"	11.952	-41.399	3063305.676	627000.967	1328.306	
	438	1.5	130°36'06"	13.278	-0.185	329°47'44"	11.475	-6.680	3063305.199	627035.686	1325.649	
	439	1.5	88°56'57"	38.386	2.545	288°08'35"	11.953	-36.478	3063305.677	627005.889	1328.379	
	440	1.5	138°43'01"	10.039	-0.237	337°54'39"	9.302	-3.775	3063303.026	627038.591	1325.597	
	441	1.5	79°35'42"	26.832	2.208	278°47'20"	4.100	-26.517	3063297.823	627015.849	1328.042	
	442	1.5	119°07'07"	12.059	0.419	318°18'45"	9.005	-8.020	3063302.729	627034.346	1326.253	
	443	1.5	102°24'54"	10.341	0.147	301°36'32"	5.420	-8.807	3063299.143	627033.559	1325.981	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	444	1.5	79°01'20"	22.423	1.859	278°12'58"	3.204	-22.193	3063296.928	627020.173	1327.693	
	445	1.5	97°34'53"	8.232	-0.743	296°46'31"	3.708	-7.349	3063297.432	627035.017	1325.091	
	446	1.5	63°49'01"	23.931	1.960	263°00'39"	-2.912	-23.753	3063290.812	627018.613	1327.794	
	447	1.5	72°37'31"	7.441	-0.216	271°49'09"	0.236	-7.437	3063293.960	627034.929	1325.618	
	448	1.3	70°57'26"	25.683	1.960	270°09'04"	0.068	-25.683	3063293.791	627016.683	1327.994	
	449	1.5	74°16'04"	9.820	0.185	273°27'42"	0.593	-9.802	3063294.316	627032.564	1326.019	
	450	1.5	86°51'01"	11.171	-0.982	286°02'39"	3.087	-10.736	3063296.811	627031.630	1324.852	
	451	1.5	105°26'30"	13.197	0.827	304°38'08"	7.501	-10.858	3063301.224	627031.508	1326.661	
	452	1.5	49°02'43"	33.092	2.335	248°14'21"	-12.268	-30.734	3063281.455	627011.632	1328.169	
	453	1.5	92°42'45"	14.826	1.087	291°54'23"	5.531	-13.755	3063299.255	627028.611	1326.921	
	454	1.5	41°02'45"	14.826	1.057	240°14'23"	-7.359	-12.871	3063286.364	627029.496	1326.891	
	455	1.5	103°28'57"	16.335	1.041	302°40'35"	8.819	-13.750	3063302.543	627028.617	1326.875	
	456	1.5	55°50'33"	17.474	1.255	255°02'11"	-4.512	-16.881	3063289.212	627025.485	1327.089	
	457	1.5	133°36'54"	16.923	0.604	332°48'32"	15.053	-7.733	3063308.776	627034.633	1326.438	
	458	1.5	53°07'28"	23.634	1.464	252°19'06"	-7.178	-22.517	3063286.545	627019.849	1327.298	
	459	1.5	103°33'33"	22.465	0.904	302°45'11"	12.154	-18.893	3063305.878	627023.473	1326.738	
	460	1.5	34°48'27"	26.548	1.542	234°00'05"	-15.604	-21.478	3063278.120	627020.888	1327.376	
	461	1.5	98°21'07"	24.615	1.308	297°32'45"	11.383	-21.825	3063305.107	627020.542	1327.142	
	462	1.5	37°48'58"	36.647	1.595	237°00'36"	-19.954	-30.738	3063273.770	627011.628	1327.429	
	463	1.5	106°56'22"	31.734	1.067	306°08'00"	18.712	-25.630	3063312.436	627016.736	1326.901	
	464	1.5	114°56'14"	33.048	0.340	314°07'52"	23.011	-23.720	3063316.735	627018.646	1326.174	
	465	1.5	19°21'31"	38.273	1.382	218°33'09"	-29.931	-23.853	3063263.793	627018.513	1327.216	
	466	1.5	111°10'02"	35.494	0.908	310°21'40"	22.986	-27.046	3063316.710	627015.321	1326.742	
	467	1.5	19°29'19"	32.713	0.733	218°40'57"	-25.536	-20.446	3063268.187	627021.921	1326.567	
	468	1.5	95°43'11"	35.300	1.635	294°54'49"	14.870	-32.015	3063308.594	627010.351	1327.469	
	469	1.5	23°38'19"	22.840	0.106	222°49'57"	-16.750	-15.528	3063276.974	627026.838	1325.940	
m9	m10		00°00'00"			275°20'14"			3063212.113	627013.9559	1327.570	
1.31	470	1.3	42°10'49"	29.311	0.620	317°31'03"	21.616	-19.796	3063233.729	626994.160	1328.200	
	471	1.3	27°33'50"	37.782	0.613	302°54'04"	20.523	-31.722	3063232.636	626982.234	1328.193	
	472	1.3	351°35'22"	16.774	0.255	266°55'36"	-0.899	-16.750	3063211.214	626997.206	1327.835	
	473	1.3	144°00'07"	35.437	1.046	59°20'21"	18.071	30.483	3063230.184	627044.439	1328.626	
	474	1.3	341°41'22"	18.850	0.285	257°01'36"	-4.232	-18.369	3063207.881	626995.587	1327.865	
	475	1.3	355°55'54"	37.740	0.992	271°16'08"	0.836	-37.731	3063212.949	626976.225	1328.572	
	476	1.3	72°13'58"	8.937	-0.428	347°34'12"	8.728	-1.924	3063220.840	627012.032	1327.152	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
477	2	96°17'03"	38.541	-0.500	11°37'17"	37.751	7.764	3063249.864	627021.720	1326.380		
478	1.3	103°08'31"	33.613	-1.165	18°28'45"	31.880	10.654	3063243.993	627024.610	1326.415		
479	1.3	101°13'54"	8.388	-0.474	16°34'08"	8.040	2.392	3063220.153	627016.348	1327.106		
480	1.3	304°53'35"	5.281	-0.010	220°13'49"	-4.032	-3.411	3063208.081	627010.545	1327.570		
481	1.3	257°05'50"	4.918	-0.505	172°26'04"	-4.875	0.648	3063207.238	627014.603	1327.075		
482	1.3	70°45'19"	35.123	-0.450	346°05'33"	34.093	-8.442	3063246.206	627005.514	1327.130		
483	1.3	75°48'19"	43.232	-0.175	351°08'33"	42.716	-6.657	3063254.829	627007.299	1327.405		
484	1.3	112°25'04"	34.324	-1.397	27°45'18"	30.375	15.984	3063242.488	627029.940	1326.183		
485	1.3	199°58'01"	26.670	-0.479	115°18'15"	-11.399	24.111	3063200.714	627038.067	1327.101		
486	1.3	217°00'32"	9.098	-1.431	132°20'46"	-6.128	6.724	3063205.984	627020.680	1326.149		
487	1.3	321°12'42"	30.440	-0.204	236°32'56"	-16.779	-25.398	3063195.334	626988.558	1327.376		
488	1.3	323°10'17"	10.249	0.145	238°30'31"	-5.354	-8.740	3063206.759	627005.216	1327.725		
489	1.3	23°39'08"	47.741	1.392	298°59'22"	23.138	-41.759	3063235.251	626972.196	1328.972		
490	1.3	10°36'05"	5.933	-0.170	285°56'19"	1.629	-5.705	3063213.742	627008.251	1327.410		
491	1.3	75°38'22"	12.868	-0.725	350°58'36"	12.709	-2.018	3063224.822	627011.938	1326.855		
492	1.3	71°21'00"	13.523	-1.196	346°41'14"	13.160	-3.114	3063225.273	627010.842	1326.384		
493	1.3	29°12'12"	7.434	-0.979	304°32'26"	4.215	-6.124	3063216.328	627007.832	1326.601		
494	1.3	25°21'38"	9.749	-0.148	300°41'52"	4.977	-8.383	3063217.090	627005.573	1327.432		
495	1.3	58°44'14"	13.951	-0.166	334°04'28"	12.547	-6.099	3063224.660	627007.856	1327.414		
496	1.3	70°24'08"	17.878	-0.212	345°44'22"	17.327	-4.404	3063229.440	627009.552	1327.368		
497	1.3	67°54'11"	22.649	-0.075	343°14'25"	21.687	-6.531	3063233.800	627007.425	1327.505		
498	1.3	79°41'01"	23.337	-1.026	355°01'15"	23.249	-2.026	3063235.362	627011.930	1326.554		
499	1.3	85°49'59"	23.627	-1.428	01°10'13"	23.622	0.483	3063235.735	627014.438	1326.152		
500	1.3	89°14'25"	22.379	-0.952	04°34'39"	22.308	1.786	3063234.421	627015.742	1326.628		
501	1.3	82°20'24"	33.816	-0.780	357°40'38"	33.788	-1.371	3063245.901	627012.585	1326.800		
502	1.3	90°31'33"	32.843	-1.596	05°51'47"	32.671	3.355	3063244.784	627017.311	1325.984		
503	1.3	93°24'00"	34.367	-1.010	08°44'14"	33.968	5.220	3063246.081	627019.176	1326.570		
504	1.3	92°27'27"	41.209	-1.473	07°47'41"	40.828	5.589	3063252.941	627019.545	1326.107		
505	1.3	86°59'48"	42.821	-0.302	02°20'02"	42.785	1.744	3063254.898	627015.700	1327.278		
506	1.3	82°58'06"	36.969	-0.161	358°18'20"	36.953	-1.093	3063249.066	627012.863	1327.419		
507	1.3	82°26'43"	33.649	-0.796	357°46'57"	33.624	-1.302	3063245.737	627012.654	1326.784		
508	1.3	79°15'10"	33.233	-0.129	354°35'24"	33.085	-3.133	3063245.198	627010.823	1327.451		
509	1.3	74°41'55"	28.463	-0.123	350°02'09"	28.034	-4.925	3063240.147	627009.031	1327.457		
510	1.3	74°30'43"	24.919	-0.912	349°50'57"	24.529	-4.392	3063236.642	627009.564	1326.668		
511	1.3	82°11'24"	27.960	-0.996	357°31'38"	27.934	-1.206	3063240.047	627012.750	1326.584		
512	1.3	66°49'56"	30.529	-0.017	342°10'10"	29.063	-9.348	3063241.175	627004.608	1327.563		

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	513	1.3	57°50'03"	25.482	0.037	333°10'17"	22.739	-11.501	3063234.852	627002.455	1327.617	
	514	1.3	27°32'58"	18.614	-0.032	302°53'12"	10.107	-15.631	3063222.220	626998.325	1327.548	
	515	1.3	07°37'53"	20.079	0.436	282°58'07"	4.506	-19.567	3063216.619	626994.389	1328.016	
	516	1.3	35°44'14"	22.109	0.552	311°04'28"	14.526	-16.667	3063226.639	626997.289	1328.132	
	517	1.5	64°14'05"	32.290	0.685	339°34'19"	30.259	-11.270	3063242.372	627002.686	1328.065	
	518	1.3	27°39'00"	30.073	0.635	302°59'14"	16.373	-25.225	3063228.486	626988.731	1328.215	
	519	1.3	09°15'45"	30.285	0.613	284°35'59"	7.634	-29.307	3063219.747	626984.649	1328.193	
	520	1.3	21°45'11"	48.675	0.908	297°05'25"	22.166	-43.335	3063234.279	626970.621	1328.488	
	521	1.3	22°02'53"	52.231	1.863	297°23'07"	24.025	-46.378	3063236.138	626967.578	1329.443	
	522	1.3	16°51'48"	53.464	1.860	292°12'02"	20.201	-49.501	3063232.314	626964.455	1329.440	
	523	1.3	108°48'12"	7.492	-0.517	24°08'26"	6.837	3.064	3063218.950	627017.020	1327.063	
	524	1.3	129°23'59"	8.174	-1.793	44°44'13"	5.806	5.753	3063217.919	627019.709	1325.787	
	525	1.3	116°12'36"	16.295	-1.852	31°32'50"	13.887	8.526	3063226.000	627022.481	1325.728	
	526	1.3	104°47'11"	17.296	-0.850	20°07'25"	16.240	5.951	3063228.353	627019.907	1326.730	
	527	1.3	104°44'13"	28.430	-1.185	20°04'27"	26.703	9.758	3063238.816	627023.714	1326.395	
	528	1.3	109°11'52"	29.104	-1.404	24°32'06"	26.476	12.085	3063238.589	627026.041	1326.176	
	529	1.3	111°34'50"	29.031	-2.302	26°55'04"	25.886	13.143	3063237.999	627027.099	1325.278	
	530	1.3	112°31'18"	24.175	-1.979	27°51'32"	21.373	11.297	3063233.486	627025.253	1325.601	
	531	1.3	327°40'13"	14.525	0.031	243°00'27"	-6.593	-12.943	3063205.520	627001.013	1327.611	
	532	1.5	328°20'34"	16.134	-0.055	243°40'48"	-7.154	-14.461	3063204.959	626999.494	1327.325	
	533	1.5	345°25'48"	22.615	0.368	260°46'02"	-3.628	-22.322	3063208.484	626991.634	1327.748	
	534	1.5	342°15'32"	23.463	0.077	257°35'46"	-5.040	-22.915	3063207.073	626991.041	1327.457	
m10	M17		00°00'00"			307°58'31"			3063218.843	626941.9191	1329.601	
1.349	535	1.3	356°39'58"	12.892	0.706	304°38'29"	7.328	-10.607	3063226.172	626931.313	1330.356	
	536	1.3	12°50'16"	14.016	0.776	320°48'47"	10.864	-8.856	3063229.707	626933.063	1330.426	
	537	1.3	353°02'45"	32.546	1.450	301°01'16"	16.773	-27.891	3063235.616	626914.028	1331.100	
	538	2	347°38'15"	25.147	1.777	295°36'46"	10.871	-22.676	3063229.714	626919.243	1330.727	
	539	1.3	151°34'59"	33.782	-1.334	99°33'30"	-5.610	33.313	3063213.234	626975.232	1328.316	
	540	1.3	145°40'40"	37.061	-1.148	93°39'11"	-2.361	36.986	3063216.482	626978.905	1328.502	
	541	2.17	88°42'49"	11.530	1.254	36°41'20"	9.246	6.889	3063228.089	626948.808	1330.034	
	542	2.55	359°47'22"	30.689	1.807	307°45'53"	18.795	-24.261	3063237.638	626917.659	1330.207	
	543	2.15	346°34'18"	11.136	0.757	294°32'49"	4.626	-10.130	3063223.470	626931.790	1329.557	
	544	1.5	158°51'25"	6.215	0.526	106°49'56"	-1.800	5.949	3063217.044	626947.868	1329.976	
	545	1.5	348°36'23"	4.123	0.043	296°34'54"	1.845	-3.687	3063220.688	626938.232	1329.493	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	546	1.5	136°02'09"	9.644	0.109	84°00'40"	1.006	9.591	3063219.849	626951.511	1329.559	
	547	1.5	152°41'40"	9.831	-0.610	100°40'11"	-1.820	9.661	3063217.023	626951.580	1328.840	
	548	1.3	151°20'28"	26.782	-0.850	99°18'59"	-4.336	26.429	3063214.508	626968.348	1328.800	
	549	1.3	156°56'08"	26.127	-1.304	104°54'39"	-6.723	25.247	3063212.120	626967.166	1328.346	
M17	M16		00°00'00"			29°53'00"			3063242.544	626911.5561	1331.401	
1.45	550	1.3	324°43'29"	8.845	-0.271	354°36'29"	8.806	-0.831	3063251.350	626910.725	1331.280	
	551	1.3	331°32'33"	24.586	-0.433	01°25'33"	24.578	0.612	3063267.123	626912.168	1331.118	
	552	1.3	333°48'31"	31.601	-0.475	03°41'31"	31.535	2.035	3063274.080	626913.591	1331.076	
	553	1.3	337°14'55"	39.796	-0.572	07°07'55"	39.488	4.941	3063282.032	626916.497	1330.979	
	554	1.3	331°33'20"	45.119	-0.504	01°26'20"	45.105	1.133	3063287.649	626912.689	1331.047	
	555	1.3	323°40'01"	51.944	-0.349	353°33'01"	51.615	-5.835	3063294.159	626905.721	1331.202	
	556	1.3	317°44'51"	79.748	-0.247	347°37'51"	77.897	-17.083	3063320.441	626894.473	1331.304	
	557	1.3	324°08'06"	73.107	0.060	354°01'06"	72.709	-7.618	3063315.253	626903.938	1331.611	
	558	1.3	333°36'09"	53.414	-0.490	03°29'09"	53.315	3.248	3063295.859	626914.804	1331.061	
	559	1.3	313°48'46"	24.644	0.122	343°41'46"	23.653	-6.918	3063266.197	626904.638	1331.673	
	560	1.3	317°03'34"	21.493	-0.229	346°56'34"	20.937	-4.856	3063263.481	626906.700	1331.322	
	561	1.3	316°25'47"	31.427	-0.266	346°18'47"	30.535	-7.436	3063273.079	626904.120	1331.285	
	562	1.3	174°32'53"	22.704	0.093	204°25'53"	-20.671	-9.390	3063221.873	626902.166	1331.644	
	563	1.3	97°29'02"	30.966	0.305	127°22'02"	-18.794	24.611	3063223.750	626936.167	1331.856	
	564	1.3	194°37'06"	34.399	0.733	224°30'06"	-24.534	-24.111	3063218.010	626887.445	1332.284	
	565	1.3	213°48'59"	45.103	2.515	243°41'59"	-19.984	-40.434	3063222.560	626871.122	1334.066	
	566	1.3	214°30'58"	40.002	2.116	244°23'58"	-17.285	-36.075	3063225.260	626875.481	1333.667	
	567	1.3	181°43'34"	20.100	-0.099	211°36'34"	-17.118	-10.535	3063225.426	626901.021	1331.452	
	568	1.9	07°59'25"	79.481	-1.192	37°52'25"	62.740	48.795	3063305.284	626960.351	1329.759	
	569	1.8	35°43'30"	9.724	-0.989	65°36'30"	4.016	8.856	3063246.560	626920.412	1330.062	
	570	1.3	298°24'35"	3.951	0.037	328°17'35"	3.361	-2.077	3063245.905	626909.480	1331.588	
	571	1.3	296°55'48"	27.681	-0.108	326°48'48"	23.166	-15.152	3063265.710	626896.404	1331.443	
	572	1.3	271°34'55"	25.084	0.169	301°27'55"	13.093	-21.396	3063255.638	626890.161	1331.720	
	573	1.3	262°15'15"	35.652	0.534	292°08'15"	13.435	-33.024	3063255.979	626878.532	1332.085	
	574	1.3	294°12'35"	18.608	-0.175	324°05'35"	15.072	-10.913	3063257.616	626900.643	1331.376	
	575	1.3	288°32'08"	15.764	-0.562	318°25'08"	11.792	-10.462	3063254.336	626901.094	1330.989	
	576	1.3	299°04'08"	27.125	-0.108	328°57'08"	23.239	-13.990	3063265.783	626897.566	1331.443	
	577	1.3	256°07'36"	10.722	0.016	286°00'36"	2.957	-10.306	3063245.501	626901.250	1331.567	
	578	1.3	288°30'49"	22.930	0.058	318°23'49"	17.146	-15.225	3063259.690	626896.331	1331.609	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
579	1.3		269°13'42"	22.023	0.745	299°06'42"	10.714	-19.241	3063253.259	626892.315	1332.296	
580	1.3		250°13'45"	21.627	0.464	280°06'45"	3.797	-21.291	3063246.341	626890.265	1332.015	
581	1.3		227°20'20"	22.984	0.623	257°13'20"	-5.083	-22.415	3063237.461	626889.141	1332.174	
582	1.3		224°59'25"	23.212	0.165	254°52'25"	-6.057	-22.408	3063236.487	626889.148	1331.716	
583	1.3		223°25'26"	23.424	0.528	253°18'26"	-6.728	-22.437	3063235.816	626889.119	1332.079	
584	1.5		249°12'08"	11.199	-0.184	279°05'08"	1.768	-11.058	3063244.313	626900.498	1331.167	
585	1.3		207°52'00"	16.632	0.192	237°45'00"	-8.875	-14.066	3063233.669	626897.490	1331.743	
586	1.5		208°08'24"	14.873	-0.338	238°01'24"	-7.876	-12.616	3063234.668	626898.940	1331.013	
587	1.5		208°09'52"	12.741	0.389	238°02'52"	-6.743	-10.811	3063235.801	626900.746	1331.740	
588	1.5		229°27'22"	10.724	0.390	259°20'22"	-1.984	-10.539	3063240.560	626901.017	1331.741	
589	1.5		186°13'11"	19.325	0.388	216°06'11"	-15.614	-11.387	3063226.930	626900.169	1331.739	
590	1.5		222°23'37"	12.421	-0.357	252°16'37"	-3.781	-11.831	3063238.763	626899.725	1330.994	
591	1.5		191°57'13"	20.039	-0.390	221°50'13"	-14.930	-13.366	3063227.614	626898.190	1330.961	
592	1.5		192°13'07"	20.641	0.394	222°06'07"	-15.315	-13.839	3063227.229	626897.717	1331.745	
593	1.5		222°33'25"	33.471	1.430	252°26'25"	-10.098	-31.911	3063232.446	626879.645	1332.781	
594	1.5		234°28'39"	49.494	4.589	264°21'39"	-4.863	-49.254	3063237.681	626862.302	1335.940	
595	1.5		237°42'05"	45.840	2.538	267°35'05"	-1.932	-45.799	3063240.612	626865.757	1333.889	
596	1.5		243°06'48"	4.523	2.824	272°59'48"	0.236	-4.517	3063242.781	626907.039	1334.175	
597	1.5		241°42'14"	36.230	2.421	271°35'14"	1.004	-36.216	3063243.548	626875.340	1333.772	
598	1.5		241°38'53"	28.765	1.368	271°31'53"	0.769	-28.755	3063243.313	626882.801	1332.719	
599	1.5		248°37'00"	37.355	1.812	278°30'00"	5.521	-36.945	3063248.066	626874.611	1333.163	
600	1.5		237°40'36"	44.553	1.910	267°33'36"	-1.897	-44.513	3063240.647	626867.044	1333.261	
601	1.5		258°00'37"	42.912	0.807	287°53'37"	13.185	-40.836	3063255.729	626870.720	1332.158	
602	1.5		251°32'45"	37.196	0.768	281°25'45"	7.371	-36.458	3063249.915	626875.098	1332.119	
603	1.5		259°07'45"	32.092	0.691	289°00'45"	10.455	-30.341	3063252.999	626881.215	1332.042	
604	1.5		224°35'48"	40.604	2.556	254°28'48"	-10.865	-39.123	3063231.680	626872.433	1333.907	
605	1.5		230°48'21"	50.217	3.523	260°41'21"	-8.125	-49.555	3063234.420	626862.001	1334.874	
606	2		129°58'52"	4.681	0.201	159°51'52"	-4.395	1.611	3063238.149	626913.168	1331.052	
607	2		359°58'37"	5.094	0.355	29°51'37"	4.418	2.536	3063246.962	626914.092	1331.206	
608	2.15		37°06'28"	8.381	-0.562	66°59'28"	3.276	7.714	3063245.820	626919.270	1330.139	
609	2.15		78°07'15"	6.604	-0.618	108°00'15"	-2.041	6.281	3063240.503	626917.837	1330.083	
610	2.15		18°46'32"	13.117	-0.343	48°39'32"	8.664	9.848	3063251.208	626921.404	1330.358	
611	2.15		356°01'10"	11.067	0.287	25°54'10"	9.955	4.835	3063252.499	626916.391	1330.988	
612	2.15		356°47'36"	15.018	-0.276	26°40'36"	13.419	6.742	3063255.964	626918.299	1330.425	
613	2.15		350°41'20"	22.182	0.177	20°34'20"	20.767	7.794	3063263.312	626919.351	1330.878	
614	2.15		04°36'59"	29.830	-0.512	34°29'59"	24.584	16.896	3063267.128	626928.452	1330.189	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	615	2.15	355°22'56"	40.226	-0.511	25°15'56"	36.378	17.169	3063278.922	626928.725	1330.190	
	616	2.15	06°05'22"	40.664	-0.514	35°58'22"	32.909	23.886	3063275.453	626935.442	1330.187	
	617	2.15	18°05'50"	46.278	-0.704	47°58'50"	30.978	34.381	3063273.522	626945.937	1329.997	
	618	2.15	11°55'07"	56.840	-0.998	41°48'07"	42.372	37.887	3063284.916	626949.443	1329.703	
	619	2.15	08°37'26"	65.222	-0.820	38°30'26"	51.038	40.608	3063293.582	626952.164	1329.881	
	620	2.15	03°14'31"	68.292	-1.220	33°07'31"	57.193	37.320	3063299.737	626948.876	1329.481	
	621	2.15	17°59'59"	50.837	-1.592	47°52'59"	34.094	37.710	3063276.638	626949.266	1329.109	
	622	2.15	34°15'52"	35.553	-1.709	64°08'52"	15.503	31.995	3063258.047	626943.551	1328.992	
	623	2.15	33°53'24"	31.337	-0.682	63°46'24"	13.849	28.111	3063256.393	626939.667	1330.019	
M16	M15		00°00'00"			88°26'35"			3063342.816	626969.1765	1328.838	
1.413	624	2	56°57'25"	44.848	-0.159	145°24'00"	-36.916	25.467	3063305.900	626994.643	1328.092	
	625	2	67°06'59"	52.134	0.548	155°33'34"	-47.462	21.570	3063295.353	626990.747	1327.386	
	626	2	103°55'32"	37.273	0.850	192°22'07"	-36.408	-7.984	3063306.408	626961.193	1327.688	
	627	2	91°36'52"	27.272	0.984	180°03'27"	-27.272	-0.027	3063315.544	626969.149	1327.822	
	628	2	151°31'06"	23.416	1.129	239°57'41"	-11.722	-20.271	3063331.094	626948.905	1327.967	
	629	2	142°00'42"	38.350	1.826	230°27'17"	-24.417	-29.573	3063318.399	626939.604	1328.664	
	630	2	142°35'19"	16.289	0.927	231°01'54"	-10.244	-12.665	3063332.572	626956.512	1327.765	
	631	2	74°39'50"	1.957	0.364	163°06'25"	-1.873	0.569	3063340.943	626969.745	1327.202	
	632	2	348°43'07"	23.392	-0.795	77°09'42"	5.198	22.807	3063348.014	626991.984	1326.043	
	633	1.3	351°02'45"	41.026	-0.278	79°29'20"	7.484	40.338	3063350.300	627009.514	1327.260	
	634	1.3	354°08'56"	56.212	-3.152	82°35'31"	7.248	55.743	3063350.063	627024.919	1324.386	
	635	1.3	358°56'00"	56.680	-3.289	87°22'35"	2.595	56.621	3063345.410	627025.797	1324.249	
	636	1.3	356°55'15"	41.203	-2.443	85°21'50"	3.330	41.068	3063346.146	627010.245	1325.095	
	637	1.3	01°54'55"	19.763	-1.451	90°21'30"	-0.124	19.763	3063342.692	626988.939	1326.087	
	638	1.3	62°36'42"	6.893	-0.595	151°03'17"	-6.032	3.336	3063336.784	626972.512	1326.943	
	639	1.3	128°37'15"	21.789	0.310	217°03'50"	-17.387	-13.132	3063325.429	626956.044	1327.848	
	640	2	102°33'42"	36.496	0.827	191°00'17"	-35.825	-6.967	3063306.991	626962.210	1327.665	
	641	2	101°41'24"	33.731	0.953	190°07'59"	-33.205	-5.934	3063309.611	626963.242	1327.791	
	642	2	88°50'18"	24.999	0.602	177°16'53"	-24.971	1.186	3063317.845	626970.362	1327.440	
	643	2	96°21'40"	19.914	0.479	184°48'15"	-19.844	-1.668	3063322.972	626967.509	1327.317	
	644	2	104°56'46"	17.254	0.413	193°23'21"	-16.785	-3.995	3063326.031	626965.181	1327.251	
	645	2	84°47'28"	15.985	0.221	173°14'03"	-15.874	1.883	3063326.942	626971.060	1327.059	
	646	2	67°54'34"	14.282	-0.450	156°21'09"	-13.083	5.729	3063329.733	626974.905	1326.388	
	647	2	55°43'10"	17.370	-0.180	144°09'45"	-14.082	10.170	3063328.734	626979.346	1326.658	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
	648	2	65°23'57"	21.022	-0.709	153°50'32"	-18.869	9.267	3063323.947	626978.444	1326.129	
	649	2	73°41'32"	26.221	-0.170	162°08'07"	-24.957	8.044	3063317.859	626977.220	1326.668	
	650	2	81°32'19"	22.831	-0.291	169°58'54"	-22.483	3.972	3063320.333	626973.148	1326.547	
	651	2	81°43'29"	35.050	0.443	170°10'04"	-34.535	5.985	3063308.281	626975.162	1327.281	
	652	2	72°02'42"	36.050	0.215	160°29'17"	-33.980	12.041	3063308.836	626981.217	1327.053	
	653	2	64°47'40"	34.340	-0.081	153°14'15"	-30.662	15.463	3063312.154	626984.640	1326.757	
	654	2	59°35'28"	37.379	-0.638	148°02'03"	-31.711	19.789	3063311.105	626988.965	1326.200	
	655	2	48°14'17"	33.947	-0.802	136°40'52"	-24.698	23.290	3063318.118	626992.466	1326.036	
	656	2	32°35'06"	33.438	-0.817	121°01'41"	-17.236	28.654	3063325.580	626997.830	1326.021	
	657	2	40°56'35"	38.252	-0.583	129°23'10"	-24.273	29.564	3063318.543	626998.741	1326.255	
	658	2	40°07'36"	42.652	-1.059	128°34'11"	-26.592	33.347	3063316.224	627002.524	1325.779	
	659	2	48°06'07"	46.612	-0.112	136°32'42"	-33.836	32.059	3063308.979	627001.235	1326.726	
M15	M14		00°00'00"			106°19'18"			3063345.86	627081.1736	1323.297	
1,410	660	1.3	146°49'24"	33.313	0.921	253°08'42"	-9.659	-31.882	3063336.201	627049.292	1324.328	
	661	1.3	160°05'25"	67.272	3.415	266°24'43"	-4.210	-67.140	3063341.650	627014.033	1326.822	
	662	1.3	149°05'59"	31.601	1.047	255°25'17"	-7.954	-30.584	3063337.906	627050.590	1324.454	
	663	1.3	162°57'26"	21.605	0.538	269°16'44"	-0.272	-21.603	3063345.588	627059.570	1323.945	
	664	1.3	147°00'14"	18.980	0.436	253°19'32"	-5.446	-18.182	3063340.414	627062.992	1323.843	
	665	1.3	32°10'19"	19.536	-0.538	138°29'37"	-14.630	12.947	3063331.230	627094.120	1322.869	
	666	1.3	01°58'20"	49.313	-0.739	108°17'38"	-15.479	46.821	3063330.381	627127.994	1322.668	
	667	1.3	355°57'25"	49.048	-0.885	102°16'43"	-10.431	47.926	3063335.429	627129.100	1322.522	
	668	1.3	95°57'01"	0.000	0.000	202°16'19"	0.000	0.000	3063345.860	627081.174	1323.407	
	669	1.3	18°13'34"	38.860	-0.416	124°32'52"	-22.037	32.007	3063323.823	627113.181	1322.991	
	670	1.3	15°16'57"	43.637	-0.468	121°36'15"	-22.868	37.165	3063322.992	627118.339	1322.939	
	671	1.3	97°11'09"	12.906	0.170	203°30'27"	-11.835	-5.148	3063334.025	627076.026	1323.577	
	672	1.5	115°24'15"	22.841	0.915	221°43'33"	-17.047	-15.202	3063328.813	627065.971	1324.122	
	673	1.3	102°01'53"	22.445	0.720	208°21'11"	-19.752	-10.659	3063326.108	627070.514	1324.127	
	674	1.3	17°16'45"	28.702	-0.309	123°36'03"	-15.884	23.906	3063329.976	627105.080	1323.098	
	675	1.3	16°06'59"	22.615	-0.419	122°26'17"	-12.130	19.086	3063333.730	627100.260	1322.988	
	676	1.3	11°54'17"	26.592	-0.493	118°13'35"	-12.577	23.430	3063333.283	627104.603	1322.914	
	677	1.3	20°56'23"	23.581	-0.215	127°15'41"	-14.277	18.768	3063331.583	627099.941	1323.192	
	678	1.3	59°28'02"	11.791	-0.066	165°47'20"	-11.430	2.895	3063334.430	627084.068	1323.341	
	679	1.3	29°21'03"	20.768	-0.183	135°40'21"	-14.857	14.512	3063331.004	627095.685	1323.224	
	680	1.3	24°22'30"	17.724	-0.359	130°41'48"	-11.557	13.438	3063334.303	627094.611	1323.048	

Traverse Detailing

Ins. St & HI	Sighted to	Signal Ht.	HCR Observation	Hz. Distance	Vert. Distance	Bearing	Consecutive Coordinates		Independent Coordinates		Reduced Level	Remarks
							Latitude	Departure	Northing	Easting		
681	1.3		10°04'41"	14.740	-0.349	116°23'59"	-6.554	13.203	3063339.306	627094.376	1323.058	
682	1.3		357°28'26"	27.253	-0.550	103°47'44"	-6.499	26.467	3063339.361	627107.640	1322.857	
683	1.3		39°43'33"	15.938	-0.193	146°02'51"	-13.221	8.901	3063332.640	627090.075	1323.214	
684	1.3		55°28'24"	11.246	-0.013	161°47'42"	-10.683	3.513	3063335.177	627084.687	1323.394	
685	1.3		70°05'37"	11.612	0.008	176°24'55"	-11.589	0.726	3063334.271	627081.900	1323.415	
686	1.3		72°57'44"	12.913	-0.102	179°17'02"	-12.912	0.161	3063332.948	627081.335	1323.305	
687	1.3		72°34'05"	11.731	0.006	178°53'23"	-11.729	0.227	3063334.131	627081.401	1323.413	
688	1.3		175°22'25"	10.625	0.244	281°41'43"	2.154	-10.404	3063348.014	627070.769	1323.651	
689	1.3		132°41'03"	13.722	0.336	239°00'21"	-7.066	-11.763	3063338.794	627069.411	1323.743	
690	1.3		128°59'54"	15.425	0.378	235°19'12"	-8.777	-12.685	3063337.083	627068.489	1323.785	
691	1.3		102°45'09"	16.153	0.288	209°04'27"	-14.118	-7.849	3063331.743	627073.324	1323.695	
692	1.3		114°47'03"	18.362	0.523	221°06'21"	-13.836	-12.072	3063332.024	627069.101	1323.930	
693	1.3		127°27'19"	24.240	0.794	233°46'37"	-14.324	-19.555	3063331.536	627061.619	1324.201	
694	1.3		132°16'42"	31.528	1.176	238°36'00"	-16.426	-26.911	3063329.434	627054.263	1324.583	
695	1.3		129°18'55"	32.126	1.011	235°38'13"	-18.133	-26.519	3063327.727	627054.654	1324.418	
696	1.3		125°56'52"	38.306	1.606	232°16'10"	-23.441	-30.296	3063322.419	627050.877	1325.013	
697	1.3		165°24'35"	17.866	0.451	271°43'53"	0.540	-17.858	3063346.400	627063.316	1323.858	
698	1.3		163°22'18"	14.877	0.308	269°41'36"	-0.080	-14.877	3063345.780	627066.297	1323.715	
699	1.5		168°22'19"	17.873	0.249	274°41'37"	1.463	-17.813	3063347.323	627063.360	1323.456	
700	1.3		168°57'04"	20.659	0.332	275°16'22"	1.899	-20.572	3063347.759	627060.602	1323.739	

Gale's Table: Major Traverse

Station	Leg/ Line	Distance	Observed Angles	Correction	Corrected angles	Computed WCB	Back Bearing	Conversion to Radians			Consecutive Coordinate		Correction		Corrected Consecutive Coordinate		Independent coordinate		Adjusted length	Adjusted Bearing	
											Latitude	Departure	Latitude	Departure	Latitude	Departure	Northing	Easting			
	CP1																3063184.895	626844.921			
CP1	CP2	126.731	114°54'55"	03"	114°54'58"	164°02'46"	164°02'46"	344°02'46"	6.84	164.05	2.863	-121.850	34.834	0.000	0.000	-121.850	34.834	3063063.045	626879.755	126.731	164°02'46"
CP2	M1	91.688	191°31'37"	02"	191°31'39"	535°34'25"	175°34'25"	355°34'25"	7.32	175.57	3.064	-91.414	7.076	0.006	-0.005	-91.408	7.071	3062971.637	626886.826	91.681	175°34'36"
M1	M2	92.485	148°49'00"	03"	148°49'03"	504°23'28"	144°23'28"	324°23'28"	6.02	144.39	2.520	-75.191	53.849	0.006	-0.005	-75.185	53.844	3062896.453	626940.670	92.476	144°23'29"
M2	M3	105.974	110°33'36"	03"	110°33'39"	434°57'08"	74°57'08"	254°57'08"	3.12	74.95	1.308	27.513	102.340	0.007	-0.006	27.521	102.334	3062923.974	627043.004	105.970	74°56'51"
M3	M4	113.545	201°27'06"	02"	201°27'08"	456°24'15"	96°24'15"	276°24'15"	4.02	96.40	1.683	-12.665	112.836	0.008	-0.006	-12.657	112.830	3062911.316	627155.834	113.538	96°24'02"
M4	M5	121.381	158°07'13"	02"	158°07'15"	434°31'30"	74°31'30"	254°31'30"	3.11	74.53	1.301	32.387	116.981	0.008	-0.007	32.395	116.974	3062943.712	627272.808	121.377	74°31'13"
M5	M6	78.104	137°36'30"	03"	137°36'33"	392°08'03"	32°08'03"	212°08'03"	1.34	32.13	0.561	66.139	41.543	0.005	-0.004	66.144	41.539	3063009.856	627314.347	78.106	32°07'45"
M6	M7	61.790	148°52'36"	02"	148°52'38"	361°00'41"	01°00'41"	181°00'41"	0.04	1.01	0.018	61.780	1.091	0.004	-0.003	61.784	1.087	3063071.640	627315.434	61.794	01°00'29"
M7	M8	102.342	161°35'26"	02"	161°35'28"	342°36'09"	342°36'09"	162°36'09"	14.28	342.60	5.980	97.660	-30.600	0.007	-0.006	97.667	-30.606	3063169.307	627284.828	102.350	342°36'02"
M8	M9	88.997	258°33'09"	02"	258°33'11"	421°09'19"	61°09'19"	241°09'19"	2.55	61.16	1.067	42.935	77.955	0.006	-0.005	42.941	77.950	3063212.248	627362.778	88.995	61°09'02"
M9	M10	64.722	143°49'32"	03"	143°49'35"	384°58'54"	24°58'54"	204°58'54"	1.04	24.98	0.436	58.667	27.334	0.005	-0.004	58.671	27.330	3063270.919	627390.108	64.725	24°58'37"
M10	M11	69.386	127°18'33"	03"	127°18'36"	332°17'30"	332°17'30"	152°17'30"	13.85	332.29	5.800	61.429	-32.262	0.005	-0.004	61.434	-32.266	3063332.353	627357.842	69.392	332°17'27"
M11	M12	96.557	140°37'54"	03"	140°37'57"	292°55'27"	292°55'27"	112°55'27"	12.21	292.92	5.112	37.610	-88.931	0.007	-0.005	37.617	-88.936	3063369.970	627268.906	96.564	292°55'36"
M12	M13	71.872	174°15'10"	02"	174°15'12"	287°10'39"	287°10'39"	107°10'39"	11.97	287.18	5.012	21.226	-68.666	0.005	-0.004	21.231	-68.670	3063391.201	627200.236	71.877	287°10'49"
M13	M14	78.021	98°31'20"	03"	98°31'23"	205°42'02"	205°42'02"	25°42'02"	8.57	205.70	3.590	-70.302	-33.835	0.005	-0.004	-70.297	-33.839	3063320.904	627166.397	78.017	205°42'17"
M14	M15	88.796	260°37'03"	02"	260°37'05"	286°19'07"	286°19'07"	106°19'07"	11.93	286.32	4.997	24.950	-85.218	0.006	-0.005	24.956	-85.223	3063345.860	627081.174	88.802	286°19'18"
M15	M16	112.033	162°07'11"	02"	162°07'13"	268°26'20"	268°26'20"	88°26'20"	11.18	268.44	4.685	-3.052	-111.991	0.008	-0.006	-3.044	-111.997	3063342.816	626969.176	112.038	268°26'35"
M16	M17	115.652	121°26'21"	03"	121°26'24"	209°52'44"	209°52'44"	29°52'44"	8.74	209.88	3.663	-100.280	-57.614	0.008	-0.006	-100.272	-57.620	3063242.544	626911.556	115.648	209°53'00"
M17	CP1	88.112	199°15'03"	02"	199°15'05"	229°07'48"	229°07'48"	49°07'48"	9.55	229.13	3.999	-57.656	-66.630	0.006	-0.005	-57.649	-66.635	3063184.895	626844.921	88.112	229°08'07"
Σ		1641.452	3059°59'13"	47"	3060°00'00"							-0.114	0.091	0.114	-0.091	0.000			1641.462		

$$e = \sqrt{\Delta L^2 + \Delta D^2} = 0.1460$$

Relative Precision = e/P = 8.9E-05

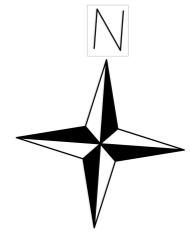
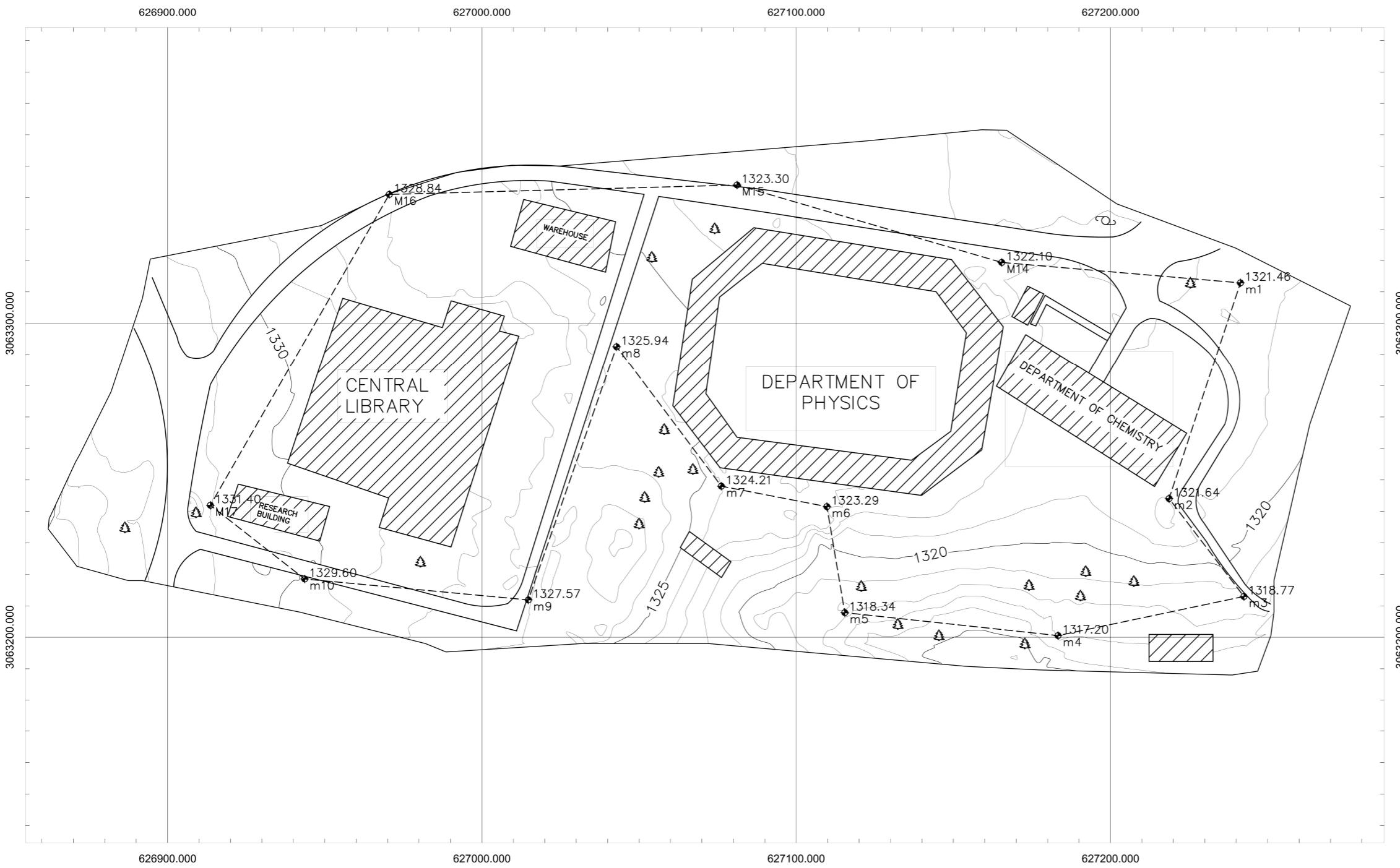
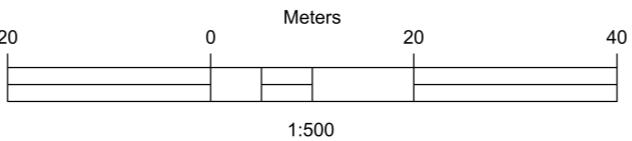
Gale's Table: Minor Traverse

Station	Leg	Distance	Observed Angles	WCB	Computed WCB	Correction	Corrected WCB	Consecutive		Independent Coordinate		Correction		Corrected Independent		Adjusted length	Adjusted Bearing
								Latitude	Departure	Northing	Easting	Northing	Easting	Northing	Easting		
M16	M17			209°53'00"						3063242.544	626911.556			3063242.544	626911.556		
M17	m10	38.516	98°04'53"		127°57'53"	00'10"	127°57'43"	-23.693	30.367	3063218.851	626941.923	-0.008	-0.004	3063218.843	626941.919	38.518	127°58'31"
m10	m9	72.356	147°21'56"		95°19'49"	00'19"	95°19'30"	-6.715	72.044	3063212.136	627013.967	-0.024	-0.011	3063212.113	627013.956	72.350	95°20'14"
m9	m8	86.435	103°52'23"		19°12'12"	00'29"	19°11'43"	81.629	28.419	3063293.765	627042.385	-0.042	-0.019	3063293.724	627042.366	86.414	19°11'38"
m8	m7	56.267	303°57'27"		143°09'39"	00'38"	143°09'01"	-45.025	33.744	3063248.740	627076.130	-0.054	-0.024	3063248.686	627076.105	56.273	143°09'44"
m7	m6	34.634	137°47'37"		100°57'16"	00'48"	100°56'28"	-6.574	34.004	3063242.167	627110.134	-0.061	-0.028	3063242.105	627110.106	34.632	100°57'16"
m6	m5	34.567	249°28'01"		170°25'17"	00'58"	170°24'19"	-34.083	5.761	3063208.084	627115.896	-0.069	-0.031	3063208.015	627115.864	34.573	170°24'46"
m5	m4	69.065	105°43'17"		96°08'34"	01'07"	96°07'27"	-7.368	68.671	3063200.715	627184.567	-0.083	-0.038	3063200.632	627184.529	69.060	96°08'13"
m4	m3	61.177	161°59'33"		78°08'07"	01'17"	78°06'50"	12.600	59.865	3063213.316	627244.431	-0.096	-0.044	3063213.219	627244.388	61.168	78°07'30"
m3	m2	39.651	64°28'07"		322°36'14"	01'26"	322°34'48"	31.490	-24.094	3063244.806	627220.338	-0.105	-0.048	3063244.701	627220.290	39.646	322°34'03"
m2	m1	73.331	235°41'21"		18°17'35"	01'36"	18°15'59"	69.636	22.985	3063314.442	627243.322	-0.120	-0.055	3063314.322	627243.267	73.314	18°15'52"
m1	M14	77.146	76°38'36"		274°56'11"	01'45"	274°54'26"	6.599	-76.863	3063321.041	627166.459	-0.137	-0.062	3063320.904	627166.397	77.152	274°53'38"
M14	M15		191°25'02"	286°19'18"	286°21'13"	01'55"			Original M14	3063320.904	627166.397						
Σ		643.143			00°01'55"			78.497	254.903	0.137	0.062					643.102	

$$e = \sqrt{\Delta L^2 + \Delta D^2} = 36'16"$$

Relative Precision = e/P = 2.3E-04

Topographic Map



Legend	
Traverse Line	-----
Traverse Station	●○●○
Building	/\ / \ / \ /
Road	=====
Electric Pole	○○
Tree	●

Station	Northing	Easting	Elevation
m1	3063314.320	627243.270	1321.460
m2	3063244.700	627220.290	1321.640
m3	3063213.220	627244.390	1318.770
m4	3063200.630	627184.530	1317.200
m5	3063208.020	627115.860	1318.340
m6	3063242.110	627110.110	1323.290
m7	3063248.690	627076.110	1324.210
m8	3063293.720	627042.370	1325.940
m9	3063212.110	627013.960	1327.570
m10	3063218.840	626941.920	1329.600
M14	3063320.900	627166.400	1322.100
M15	3063345.860	627081.170	1323.300
M16	3063342.820	626969.180	1328.840
M17	3063242.540	626911.560	1331.400

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS
Department of Civil Engineering
Survey Instruction Committee
Pulchowk, Lalitpur

Title: Topographic Map

Scale: 1: 500

Prepared By: Group 29

Kushal Khatiwada 074BCE072

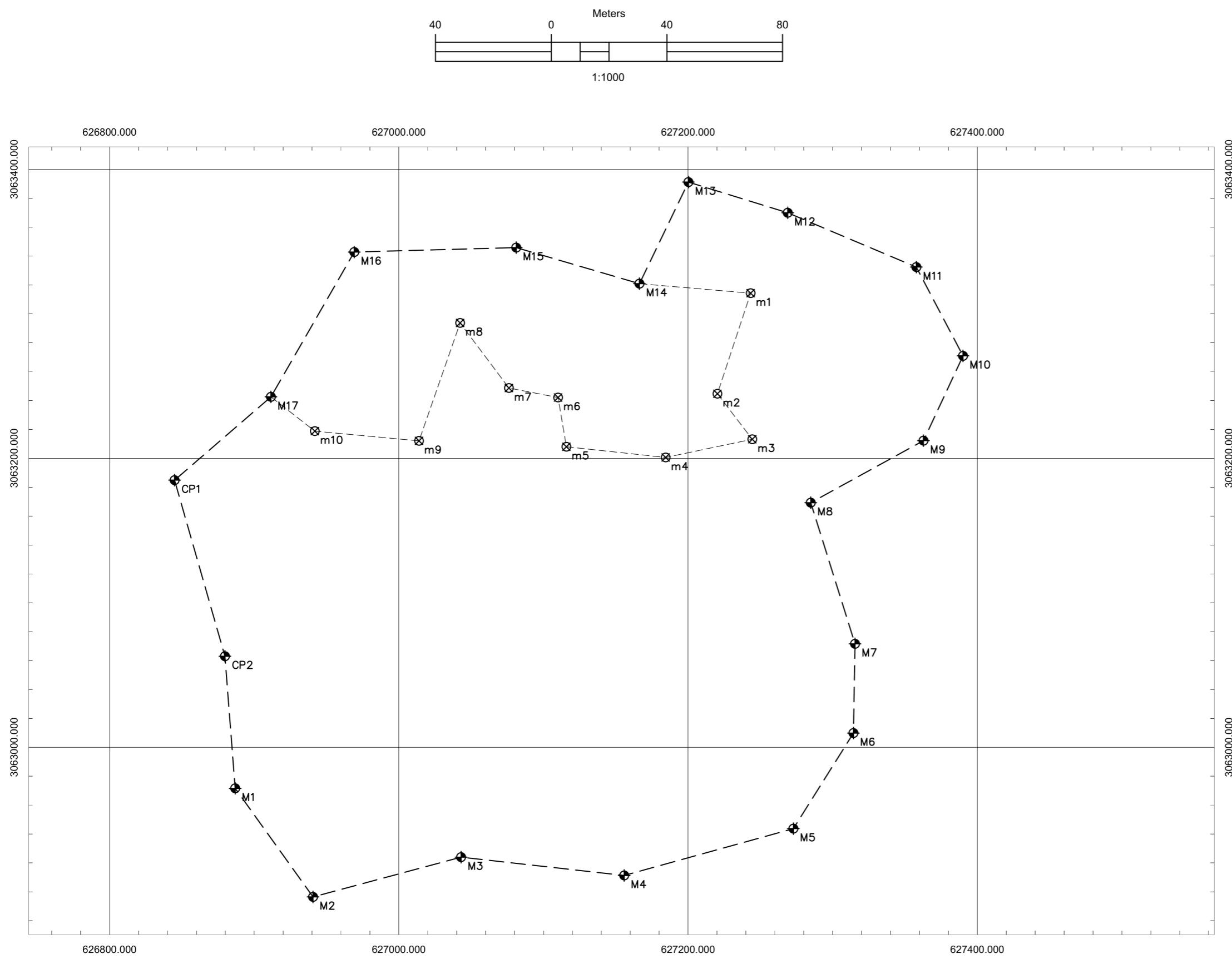
Pragyan Shrestha 074BCE104

Sanjeev Bashyal 074BCE143

Umesh Koirala 074BCE187

Yubin Baniya 074BCE192

Traverse Plot



Legend

Major Traverse	
Minor Traverse	

Station	Northing	Easting
CP1	3063184.895	626844.921
CP2	3063063.045	626879.755
M1	3062971.637	626886.826
M2	3062896.453	626940.670
M3	3062923.974	627043.004
M4	3062911.316	627155.834
M5	3062943.712	627272.808
M6	3063009.856	627314.347
M7	3063071.640	627315.434
M8	3063169.307	627284.828
M9	3063212.248	627362.778
M10	3063270.919	627390.108
M11	3063332.353	627357.842
M12	3063369.970	627268.906
M13	3063391.201	627200.236
M14	3063320.904	627166.397
M15	3063345.860	627081.174
M16	3063342.816	626969.177
M17	3063242.544	626911.556
m1	3063314.320	627243.270
m2	3063244.700	627220.290
m3	3063213.220	627244.390
m4	3063200.630	627184.530
m5	3063208.020	627115.860
m6	3063242.110	627110.110
m7	3063248.690	627076.110
m8	3063293.720	627042.370
m9	3063212.110	627013.960
m10	3063218.840	626941.920

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS
Department of Civil Engineering

Survey Instruction Committee
Pulchowk, Lalitpur

Title: Traverse Plot

Scale: 1:1000

Prepared By: Group 29

Kushal Khatiwada 074BCE072

Pragyan Shrestha 074BCE104

Sanjeev Bashyal 074BCE143

Umesh Koirala 074BCE187

Yubin Baniya 074BCE192

Observation of Angle at Bridge Site by Total Station

St.	To.	Face	Set-I			Set-II			Mean Hz. Angle of two sets	Corrected Mean Hz. Angle of two sets	
			HCR Observation			Horizontal Angle	HCR Observation				
			d	m	s		d	m	s		
A	C	L	0	0	0	87°31'41"	90	0	0		
		R	180	0	4		269	59	54		
	B	L	87	31	40		177	31	42		
		R	267	31	46		357	31	38	87°31'43"	
	D	L	174	59	2		264	59	8	87°31'42"	
		R	354	59	14		84	59	10	87°31'45"	
	D	L	0	0	0		90	0	0		
		R	180	0	12		269	59	52		
B	A	L	35	13	37	35°13'39"	125	13	43		
		R	215	13	53		305	13	31	35°13'41"	
	C	L	74	19	26		164	19	34	35°13'40"	
		R	254	19	44		344	19	28	35°13'42"	
C	B	L	0	0	0	39°5'50"	90	0	0		
		R	180	0	8		270	0	6		
	A	L	53	22	20		143	22	13		
		R	233	22	26		323	22	23	39°5'52"	
D	A	L	0	0	0	57°18'49"	90	0	0		
		R	180	0	4		270	0	18		
	B	L	57	18	52		147	18	48		
		R	237	18	51		327	19	0	57°18'45"	
Triangle ABC			Triangle ABD			Triangle ABD					
Sum of internal angles			Sum of internal angles			Sum of internal angles					
Theoretical sum of internal angles			179°59'51"			179°59'54"					
Error (-ve)			180°			180°					
Permissible error ($30'' \sqrt{N}$)			0°0'9"			0°0'06"					
Correction (+ve)			0°0'52"			0°0'52"					
			0°0'3"			0°0'2"					

Triangle ABC	
Sum of internal angles	179°59'51"
Theoretical sum of internal angles	180°
Error (-ve)	0°0'9"
Permissible error ($30'' \sqrt{N}$)	0°0'52"
Correction (+ve)	0°0'3"

Triangle ABD	
Sum of internal angles	179°59'54"
Theoretical sum of internal angles	180°
Error (-ve)	0°0'06"
Permissible error ($30'' \sqrt{N}$)	0°0'52"
Correction (+ve)	0°0'2"

Observation of Angle at Bridge Site by Total Station
(Minor Triangles)

St.	To.	Face	HCR Observation			Horizontal Angle	Corrected Mean Hz. Angle of two sets
			d	m	s		
C	F	L	0	0	0	66°11'11"	66°11'14"
		R	180	0	24		
	E	L	66	11	15		
		R	246	11	31		
C	E	L	66	11	15	53°22'5"	53°22'9"
		R	246	11	31		
	B	L	119	33	19		
		R	299	33	37		
F	G	L	0	0	0	80°9'45"	80°9'50"
		R	179	59	57		
	E	L	80	9	46		
		R	260	9	41		
F	E	L	80	9	46	68°31'56"	68°31'59"
		R	260	9	41		
	C	L	148	41	45		
		R	328	41	34		
G	E	L	0	0	0	73°2'23"	73°2'28"
		R	180	0	6		
	F	L	73	2	20		
		R	253	2	32		
B	C	L	73	44	12	50°20'46"	50°20'50"
		R	253	45	0		
	E	L	124	5	1		
		R	304	5	43		
E	B	L	0	0	0	76°16'57"	76°17'1"
		R	180	0	0		
	C	L	76	16	56		
		R	256	16	58		
E	C	L	76	16	56	45°16'45"	45°16'48"
		R	256	16	58		
	F	L	121	33	39		
		R	301	33	45		
E	F	L	121	33	39	26°47'37"	26°47'42"
		R	301	33	45		
	G	L	148	21	14		
		R	328	21	24		

Triangle CBE	
Sum of internal angles	179°59'48"
Theoretical sum of internal angles	180°
Error(-ve)	0°0'12"
Permissible error (1' \sqrt{N})	0°1'44"
Correction (+ve)	0°0'4"

Triangle CEF	
Sum of internal angles	179°59'52"
Theoretical sum of internal angles	180°
Error(-ve)	0°0'8"
Permissible error (1' \sqrt{N})	0°1'44"
Correction (+ve)	0°0'3"

Triangle EFG	
Sum of internal angles	179°59'45"
Theoretical sum of internal angles	180°
Error(-ve)	0°0'15"
Permissible error (1' \sqrt{N})	0°1'44"
Correction (+ve)	0°0'5"

Triangulation

Triangle ABC										
Angle	Value			Correction	Corrected Angle			Side	Length	Length (After Avg AB)
	D	M	S		D	M	S			
A	87	31	42	3"	87	31	45	BC	77.794	77.808
B	39	5	52	3"	39	5	55	AC	49.107	49.116
C	53	22	17	3"	53	22	20	AB	62.49	62.501
Sum	179	59	51							
Error	0	0	9							

Triangle ABD										
Angle	Value			Correction	Corrected Angle			Side	Length	Length (After Avg AB)
	D	M	S		D	M	S			
A	87	27	27	2"	87	27	29	BD	74.201	74.188
B	35	13	40	2"	35	13	42	AD	42.844	42.844
D	57	18	47	2"	57	18	49	AB	62.512	62.501
Sum	179	59	54							
Error	0	0	6							

Triangle BCE										
Angle	Value			Correction	Corrected Angle			Side	Length	Length (After Avg)
	D	M	S		D	M	S			
B	50	20	46	4"	50	20	50	CE	61.665	
C	53	22	51	4"	53	22	9	BE	64.273	
E	76	16	57	4"	76	17	1	BC	77.808	
Sum	179	59	48							
Error	0	0	12							

Triangle FEC										
Angle	Value			Correction	Corrected Angle			Side	Length	Length (After Avg)
	D	M	S		D	M	S			
F	68	31	56	3"	68	31	59	EC	61.665	
E	45	16	45	3"	45	16	48	FC	47.082	
C	66	11	11	3"	66	11	14	FE	60.621	
Sum	179	59	51							
Error	0	0	9							

Triangle FEG										
Angle	Value			Correction	Corrected Angle			Side	Length	Length (After Avg)
	D	M	S		D	M	S			
F	80	9	45	5"	80	9	50	EG	62.445	
E	26	47	37	5"	26	47	42	GF	28.57	
G	73	2	23	5"	73	2	28	FE	60.621	
Sum	179	59	45							
Error	0	0	15							

RL TRANSFER TO BRIGDE STATION A

Stations Chainage	Bridge Station to TBM2 [Forward]													
	BS			Mean BS	S1	FS			Mean FS	S2	Rise	Fall	Stadia Interval	Horizontal Distance
	Top	Mid	Bottom			Top	Mid	Bottom						
BS A	1.245	1.215	1.185	1.215	0.060								0.060	6.000
TP1	1.195	1.156	1.118	1.156	0.077	0.665	0.637	0.605	0.636	0.060	0.579		0.137	13.700
TP2	1.916	1.903	1.888	1.902	0.028	0.982	0.947	0.912	0.947	0.070	0.209		0.098	9.800
TP3	1.752	1.729	1.701	1.727	0.051	0.654	0.641	0.627	0.641	0.027	1.262		0.078	7.800
TP4	1.865	1.835	1.805	1.835	0.060	0.743	0.721	0.695	0.720	0.048	1.008		0.108	10.800
TP5	1.530	1.507	1.485	1.507	0.045	0.981	0.963	0.945	0.963	0.036	0.872		0.081	8.100
TP6	1.500	1.430	1.360	1.430	0.140	1.081	1.059	1.038	1.059	0.043	0.448		0.183	18.300
TP7	1.397	1.328	1.260	1.328	0.137	1.260	1.190	1.121	1.190	0.139	0.240		0.276	27.600
TP8	1.355	1.285	1.215	1.285	0.140	1.005	0.935	0.864	0.935	0.141	0.394		0.281	28.100
TP9	1.443	1.407	1.375	1.408	0.068	1.633	1.558	1.485	1.559	0.148		0.274	0.216	21.600
TP10	1.389	1.233	1.279	1.300	0.110	0.686	0.650	0.617	0.651	0.069	0.757		0.179	17.900
TBM2						1.956	1.898	1.845	1.900	0.111		0.599	0.111	11.100
Σ				16.095					11.200		5.769	0.873		180.800

Arithmetic Check:	
Σ BS - Σ FS	4.896
Σ Rise - Σ Fall	4.896

RL TRANSFER TO BRIGDE STATION A

Bridge Station to TBM2 [Backward]														
Stations Chainage	BS			Mean BS	S1	FS			Mean FS	S2	Rise	Fall	Stadia Interval	Horizontal Distance
	Top	Mid	Bottom			Top	Mid	Bottom						
TBM 2	1.990	1.941	1.890	1.940	0.100								0.100	10.000
TP1	0.714	0.678	0.643	0.678	0.071	1.484	1.434	1.380	1.433	0.104	0.508		0.175	17.500
TP2	1.345	1.300	1.256	1.300	0.089	1.447	1.408	1.368	1.408	0.079		0.729	0.168	16.800
TP3	1.279	1.250	1.181	1.237	0.098	1.077	1.031	0.985	1.031	0.092	0.269		0.190	19.000
TP4	0.946	0.905	0.869	0.907	0.077	1.275	1.226	1.175	1.225	0.100	0.011		0.177	17.700
TP5	1.109	1.035	0.967	1.037	0.142	1.255	1.218	1.180	1.218	0.075		0.311	0.217	21.700
TP6	0.839	0.787	0.736	0.787	0.103	1.235	1.166	1.098	1.166	0.137		0.129	0.240	24.000
TP7	0.731	0.713	0.695	0.713	0.036	1.804	1.752	1.702	1.753	0.102		0.965	0.138	13.800
TP8	0.743	0.723	0.703	0.723	0.040	1.544	1.524	1.505	1.524	0.039		0.811	0.079	7.900
TP9	0.877	0.864	0.850	0.864	0.027	1.825	1.802	1.787	1.805	0.038		1.082	0.065	6.500
TP10	1.005	0.974	0.940	0.973	0.065	1.838	1.821	1.807	1.822	0.031		0.958	0.096	9.600
TP11	1.129	1.091	1.054	1.091	0.075	1.572	1.538	1.505	1.538	0.067		0.565	0.142	14.200
TP12	0.868	0.857	0.840	0.855	0.028	0.981	0.947	0.914	0.947	0.067	0.144		0.095	9.500
BS A						1.154	1.144	1.134	1.144	0.020		0.289	0.020	2.000
Σ				13.106					18.014		0.932	5.841		190.200

Arithmetic Check:	
Σ BS - Σ FS	-4.908
Σ Rise - Σ Fall	-4.908

Mean Height Difference	4.902
Discrepancy	0.013
Required Precision	0.010

RL of TBM2	1309.768
\therefore RL of station A	1304.866

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RECIPROCAL LEVELING

Instrument Very Near to A					
Sighted to	Staff Reading			Mean	Apparent Difference
	Top	Mid	Bottom		
A	1.665	1.643	1.622	1.643	
B	1.484	1.146	0.808	1.146	-0.497

Instrument Very Near to B					
Sighted to	Staff Reading			Mean	Apparent Difference
	Top	Mid	Bottom		
A	1.392	1.087	0.781	1.087	
B	0.606	0.594	0.581	0.594	-0.493

Average Height Difference between A and B	-0.495
Error (mm)	4
loop length ($2 * AB$) (km)	0.125002
Permissible error ($25\sqrt{k}$) (mm)	8.839
RL of station A	1304.866
\therefore RL of station B	1304.371

RI Transfer To Triangulation Stations

Turning Point	Station/Chainage	BS	FS	Rise	Fall	Elevation	Correction	Corrected Elevation
	A	0.864				1304.866	0.000	1304.866
TP1		0.968	1.688		0.824	1304.042	0.000	1304.042
TP2		1.150	1.650		0.682	1303.360	0.000	1303.360
TP3		0.851	1.763		0.613	1302.747	-0.001	1302.746
TP4		1.124	1.855		1.004	1301.743	-0.001	1301.742
	D	1.607	1.627		0.503	1301.240	-0.001	1301.239
TP5		1.804	1.032	0.575		1301.815	-0.001	1301.814
TP6		1.720	1.005	0.799		1302.614	-0.001	1302.613
TP7		1.518	0.972	0.748		1303.362	-0.002	1303.360
TP8		1.901	1.019	0.499		1303.861	-0.002	1303.859
	A		0.894	1.007		1304.868	-0.002	1304.866
Σ		13.507	13.505	3.628	3.626			

Arithmetic Check:	
Σ BS - Σ FS	0.002
Σ Rise - Σ Fall	0.002

Discrepancy	0.002
Loop Perimeter (m)	85.688
Required Precision	0.007

RI Transfer To Triangulation Stations

Turning Point	Station/Chainage	BS	FS	Rise	Fall	Elevation	Correction	Corrected Elevation
	A	1.184				1304.866	0.000	1304.866
TP1		1.187	1.724		0.540	1304.326	0.000	1304.326
TP2		0.992	1.672		0.485	1303.841	0.001	1303.842
TP3		1.742	1.498		0.506	1303.335	0.001	1303.336
TP4		1.596	1.393	0.349		1303.684	0.002	1303.686
TP5		1.676	1.377	0.219		1303.903	0.002	1303.905
	C	1.174	1.089	0.587		1304.490	0.002	1304.492
TP6		0.976	1.695		0.521	1303.969	0.003	1303.972
TP7		1.426	1.602		0.626	1303.343	0.003	1303.346
TP8		1.939	1.335	0.091		1303.434	0.004	1303.438
TP9		1.263	1.744	0.195		1303.629	0.004	1303.633
	F	1.143	1.420		0.157	1303.472	0.004	1303.476
TP10		1.118	1.855		0.712	1302.760	0.005	1302.765
TP11		1.188	1.631		0.513	1302.247	0.005	1302.252
TP12		1.181	1.806		0.618	1301.629	0.006	1301.635
	G	1.262	1.283		0.102	1301.527	0.006	1301.533
TP13		1.751	1.084	0.178		1301.705	0.006	1301.711
TP14		1.481	1.217	0.534		1302.239	0.007	1302.246
TP15		1.643	0.721	0.760		1302.999	0.007	1303.006
TP16		1.434	1.183	0.460		1303.459	0.008	1303.467
TP17		1.212	1.100	0.334		1303.793	0.008	1303.801
TP18		1.642	1.735		0.523	1303.270	0.008	1303.278
TP19		1.697	0.975	0.667		1303.937	0.009	1303.946
TP20		0.918	1.154	0.543		1304.480	0.009	1304.489
TP21		1.181	1.721		0.803	1303.677	0.010	1303.686
TP22		1.122	1.319		0.138	1303.539	0.010	1303.549
TP23		1.866	1.542		0.420	1303.119	0.010	1303.129
TP24		1.756	1.081	0.785		1303.904	0.011	1303.915
	A		0.805	0.951		1304.855	0.011	1304.866
Σ		38.750	38.761	6.653	6.664			

Arithmetic Check:		Discrepancy	-0.0111
$\sum \text{BS} - \sum \text{FS}$	-0.0111	Loop Perimeter (m)	249.492
$\sum \text{Rise} - \sum \text{Fall}$	-0.0111	Required Precision	0.012

RI Transfer To Triangulation Stations

Turning Point	Station/Chainage	BS	FS	Rise	Fall	Elevation	Correction	Corrected Elevation
	B	1.630				1304.371	0.000	1304.371
TP1		1.525	0.779	0.851		1305.222	-0.001	1305.221
TP2		0.997	1.208	0.317		1305.539	-0.002	1305.537
TP3		0.850	1.930		0.933	1304.606	-0.003	1304.603
	E	0.927	0.783	0.067		1304.673	-0.004	1304.669
TP4		1.717	0.949		0.022	1304.651	-0.004	1304.646
TP5		0.610	0.626	1.091		1305.742	-0.005	1305.737
TP6		0.895	1.579		0.969	1304.773	-0.006	1304.767
TP7		0.872	1.503		0.608	1304.165	-0.007	1304.158
	B		0.658	0.214		1304.379	-0.008	1304.371
Σ		10.023	10.015	2.540	2.532			

Arithmetic Check:	
$\sum \text{BS} - \sum \text{FS}$	0.008
$\sum \text{Rise} - \sum \text{Fall}$	0.008

Discrepancy	0.008
Loop Perimeter (m)	128.524
Required Precision	0.009

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Independent Co-ordinates And RL Of Stations

Stations	Easting (X)	Northing (Y)	RL (Z)
A	1000.000	1000.000	1304.866
B	987.844	1061.307	1304.371
C	951.455	992.533	1304.492
D	1041.607	1010.187	1301.239
E	924.921	1048.197	1304.669
F	904.393	991.158	1303.476
G	879.559	1005.283	1301.533

Detailing of Bridge

		X	Y	Z
station	D	1041.607	1010.187	1301.239

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
D	B	1.3	0	0	0	0°0'0"	313°33'22"	60.610	4.016	-53.764	51.120			
1.348	1	1.9	186	55	6	186°55'6"	140°28'28"	7.480	1.014	4.760	-5.770	1046.368	1004.417	1299.673
	2	1.3	148	9	19	148°9'19"	101°42'41"	3.852	-0.324	3.772	-0.782	1045.379	1009.405	1301.611
	3	1.3	112	49	16	112°49'16"	66°22'38"	3.523	-0.552	3.228	1.412	1044.835	1011.599	1301.839
	4	1.3	95	24	13	95°24'13"	48°57'35"	4.548	-0.859	3.430	2.986	1045.038	1013.173	1302.146
	5	1.3	86	28	11	86°28'11"	40°1'33"	5.311	-1.472	3.416	4.067	1045.023	1014.254	1302.759
	6	1.3	81	45	56	81°45'56"	35°19'18"	6.391	-1.984	3.695	5.215	1045.303	1015.402	1303.271
	7	2.15	73	41	8	73°41'8"	27°14'30"	8.242	-1.393	3.773	7.328	1045.380	1017.515	1301.830
	8	2.15	69	5	3	69°5'3"	22°38'25"	10.841	-1.954	4.173	10.006	1045.781	1020.193	1302.391
	9	2.15	63	45	2	63°45'2"	17°18'24"	12.967	-2.515	3.858	12.380	1045.465	1022.567	1302.952
	10	2.15	59	45	43	59°45'43"	13°19'5"	15.244	-3.207	3.512	14.834	1045.119	1025.021	1303.644
	11	2.15	59	51	14	59°51'14"	13°24'36"	17.374	-3.484	4.029	16.900	1045.637	1027.087	1303.921
	12	2.15	61	36	16	61°36'16"	15°9'38"	18.834	-3.703	4.926	18.179	1046.533	1028.366	1304.140
	13	2.15	62	2	28	62°2'28"	15°35'50"	21.100	-4.002	5.673	20.323	1047.281	1030.510	1304.439
	14	2.15	61	50	17	61°50'17"	15°23'39"	21.622	-4.724	5.740	20.846	1047.347	1031.033	1305.161
	15	2.15	62	37	33	62°37'33"	16°10'55"	22.424	-5.187	6.249	21.536	1047.857	1031.723	1305.624
	16	2.15	63	3	19	63°3'19"	16°36'41"	23.357	-4.079	6.677	22.382	1048.285	1032.569	1304.516
	17	1.3	237	20	31	237°20'31"	190°53'53"	4.395	0.766	-0.831	-4.316	1040.777	1005.871	1300.521
	18	1.3	60	37	49	60°37'49"	14°11'11"	32.934	-4.639	8.071	31.930	1049.679	1042.117	1305.926
	19	1.3	242	51	5	242°51'5"	196°24'27"	1.161	0.065	-0.328	-1.114	1041.280	1009.073	1301.222
	20	2.15	50	36	50	50°36'50"	4°10'12"	37.085	-3.258	2.697	36.987	1044.304	1047.174	1303.695
	21	2.15	27	59	29	27°59'29"	341°32'51"	2.466	-0.360	-0.781	2.339	1040.827	1012.526	1300.797
	22	1.3	51	32	41	51°32'41"	5°6'3"	42.381	-2.924	3.768	42.213	1045.376	1052.400	1304.211
	23	1.3	50	45	1	50°45'1"	4°18'23"	46.055	-1.634	3.458	45.925	1045.066	1056.112	1302.921
	24	1.3	50	29	9	50°29'9"	4°2'31"	49.666	-0.403	3.501	49.542	1045.108	1059.730	1301.690
	25	2.15	40	54	6	40°54'6"	354°27'28"	4.234	-0.524	-0.409	4.214	1041.199	1014.401	1300.961
	26	1.3	50	0	5	50°0'5"	3°33'27"	51.591	0.015	3.201	51.492	1044.809	1061.679	1301.272
	27	2.15	38	19	46	38°19'46"	351°53'8"	6.602	-0.742	-0.932	6.536	1040.676	1016.723	1301.179
	28	1.3	50	16	15	50°16'15"	3°49'37"	53.900	0.918	3.597	53.780	1045.205	1063.967	1300.369
	29	2.15	39	49	54	39°49'54"	353°23'16"	9.766	-1.444	-1.125	9.701	1040.483	1019.888	1301.881
	30	2.15	47	42	50	47°42'50"	1°16'12"	62.248	3.305	1.380	62.233	1042.987	1072.420	1297.132

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	31	2.15	42	47	50	42°47'50"	356°21'12"	14.599	-2.758	-0.929	14.569	1040.679	1024.757	1303.195
	32	2.15	39	5	29	39°5'29"	352°38'51"	68.761	4.725	-8.800	68.196	1032.808	1078.383	1295.712
	33	2.15	44	16	33	44°16'33"	357°49'55"	16.588	-3.388	-0.628	16.576	1040.980	1026.763	1303.825
	34	2.15	32	24	6	32°24'6"	345°57'28"	76.497	6.471	-18.561	74.211	1023.047	1084.398	1293.966
	35	2.15	44	52	4	44°52'4"	358°25'26"	28.739	-3.607	-0.790	28.728	1040.817	1038.915	1304.044
	36	2.15	46	2	28	46°2'28"	359°35'50"	36.898	-3.241	-0.259	36.897	1041.348	1047.084	1303.678
	37	2.15	49	41	7	49°41'7"	3°14'29"	40.320	-2.538	2.280	40.255	1043.887	1050.443	1302.975
	38	2.15	36	9	34	36°9'34"	349°42'56"	36.220	-2.843	-6.467	35.638	1035.141	1045.825	1303.280
	39	2.15	37	21	10	37°21'10"	350°54'32"	42.881	-2.025	-6.775	42.342	1034.832	1052.529	1302.462
	40	2.15	33	18	52	33°18'52"	346°52'14"	44.266	-1.629	-10.055	43.109	1031.552	1053.296	1302.066
	41	2.15	34	35	8	34°35'8"	348°8'30"	49.399	-0.258	-10.151	48.345	1031.456	1058.532	1300.695
	42	2.15	34	0	46	34°0'46"	347°34'8"	54.538	0.381	-11.740	53.259	1029.867	1063.446	1300.056
	43	2.15	24	31	13	24°31'13"	338°43'5"	52.703	1.321	-19.678	48.892	1021.930	1059.079	1299.116
	44	2.15	270	51	12	270°51'12"	224°24'34"	7.584	2.315	-5.307	-5.418	1036.300	1004.769	1298.122
	45	1.3	256	52	52	256°52'52"	210°26'14"	13.975	3.357	-7.080	-12.049	1034.528	998.138	1297.930
	46	2.15	256	41	41	256°41'41"	210°15'3"	18.243	4.562	-9.191	-15.759	1032.417	994.428	1295.875
	A	2.15	302	53	53	302°53'53"	256°14'33"	62.434	3.537	-41.607	-10.187			

Detailing of Bridge

station	A	X 1000.000	Y 1000.000	Z 1304.866
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Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
A	D	1.3	0	0	0	0°0'0"	76°14'33"	62.434	-3.534	41.607	10.187			
1.32	47	1.3	83	37	45	83°37'45"	159°52'18"	11.527	1.730	3.967	-10.823	1003.967	989.177	1303.156
	48	1.3	81	47	31	81°47'31"	158°2'4"	9.320	0.843	3.486	-8.643	1003.486	991.357	1304.043
	49	1.3	80	9	35	80°9'35"	156°24'8"	8.580	0.366	3.435	-7.863	1003.435	992.137	1304.520
	50	1.3	351	59	58	351°59'58"	68°14'31"	2.361	-0.323	2.193	0.875	1002.193	1000.875	1305.209
	51	1.3	0	9	48	0°9'48"	76°24'21"	26.005	-1.820	25.276	6.112	1025.276	1006.112	1306.706
	52	1.3	309	19	20	309°19'20"	25°33'53"	4.495	-0.979	1.940	4.055	1001.940	1004.055	1305.865
	53	1.3	17	45	52	17°45'52"	94°0'25"	23.149	-0.237	23.092	-1.618	1023.092	998.382	1305.123
	54	2.15	297	43	7	297°43'7"	13°57'40"	6.997	-1.763	1.688	6.790	1001.688	1006.790	1305.799
	55	2.15	288	19	47	288°19'47"	4°34'20"	10.421	-1.957	0.831	10.388	1000.831	1010.388	1305.993
	56	1.3	26	3	15	26°3'15"	102°17'48"	24.059	0.318	23.507	-5.124	1023.507	994.876	1304.568
	57	2.15	287	50	32	287°50'32"	4°5'5"	21.801	-5.566	1.553	21.746	1001.553	1021.746	1309.602
	58	2.15	287	34	16	287°34'16"	3°48'49"	25.150	-5.801	1.673	25.094	1001.673	1025.094	1309.837
	59	2.15	290	52	21	290°52'21"	7°6'54"	27.225	-6.325	3.372	27.015	1003.372	1027.015	1310.361
	60	2.15	289	21	54	289°21'54"	5°36'27"	27.876	-7.458	2.724	27.743	1002.724	1027.743	1311.494
	61	2.15	284	57	56	284°57'56"	1°12'29"	28.370	-6.301	0.598	28.364	1000.598	1028.364	1310.337
	62	2.15	283	26	33	283°26'33"	359°41'6"	39.383	-6.146	-0.217	39.382	999.783	1039.382	1310.182
	63	2.15	283	4	54	283°4'54"	359°19'27"	43.918	-5.031	-0.518	43.915	999.482	1043.915	1309.067
	64	2.15	271	25	35	271°25'35"	347°40'8"	42.319	-4.812	-9.038	41.343	990.962	1041.343	1308.848
	65	2.15	264	17	41	264°17'41"	340°32'14"	36.414	-5.807	-12.133	34.333	987.867	1034.333	1309.843
	66	1.55	269	58	57	269°58'57"	346°13'30"	21.291	-6.145	-5.070	20.679	994.930	1020.679	1310.781
	67	1.3	357	59	20	357°59'20"	74°13'53"	19.768	-1.796	19.024	5.372	1019.024	1005.372	1306.682
	68	1.58	267	53	44	267°53'44"	344°8'17"	18.760	-5.360	-5.127	18.046	994.873	1018.046	1309.966
	69	2.15	262	27	50	262°27'50"	338°42'23"	25.073	-7.071	-9.105	23.361	990.895	1023.361	1311.107
	70	1.3	349	11	48	349°11'48"	65°26'21"	20.080	-3.089	18.263	8.346	1018.263	1008.346	1307.975
	71	1.3	330	48	0	330°48'0"	47°2'33"	20.725	-3.985	15.168	14.123	1015.168	1014.123	1308.871
	72	1.3	258	55	43	258°55'43"	335°10'16"	17.411	-4.183	-7.311	15.802	992.689	1015.802	1309.069
	73	2.15	318	12	2	318°12'2"	34°26'35"	19.739	-3.768	11.164	16.279	1011.164	1016.279	1307.804
	74	1.3	279	29	1	279°29'1"	355°43'34"	16.222	-4.694	-1.209	16.177	998.791	1016.177	1309.580
	75	2.15	260	29	35	260°29'35"	336°44'8"	14.725	-3.369	-5.816	13.528	994.184	1013.528	1307.405
	76	2.15	310	20	4	310°20'4"	26°34'37"	22.009	-4.805	9.847	19.683	1009.847	1019.683	1308.841
	77	1.3	277	43	20	277°43'20"	353°57'53"	12.893	-3.729	-1.356	12.822	998.644	1012.822	1308.615
	78	1.3	261	3	11	261°3'11"	337°17'44"	11.566	-3.091	-4.464	10.670	995.536	1010.670	1307.977

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	79	1.3	283	0	21	283°0'21"	359°14'54"	10.203	-2.863	-0.134	10.202	999.866	1010.202	1307.749
	80	2.15	605	56	10	605°56'10"	322°10'43"	26.521	-5.906	-16.263	20.950	983.737	1020.950	1309.942
	81	1.3	293	16	51	293°16'51"	9°31'24"	7.310	-2.765	1.209	7.209	1001.209	1007.209	1307.651
	82	1.5	261	23	26	261°23'26"	337°37'59"	6.330	-2.143	-2.409	5.854	997.591	1005.854	1306.829
	83	1.3	159	18	42	159°18'42"	235°33'15"	16.746	0.366	-13.810	-9.472	986.190	990.528	1304.520
	84	1.3	254	23	18	254°23'18"	330°37'51"	1.292	-0.227	-0.634	1.126	999.366	1001.126	1305.113
	85	1.3	151	3	52	151°3'52"	227°18'25"	17.005	1.499	-12.499	-11.531	987.501	988.469	1303.387
	86	2.15	294	32	36	294°32'36"	10°47'9"	46.200	-5.988	8.646	45.384	1008.646	1045.384	1310.024
	87	1.3	291	11	23	291°11'23"	7°25'56"	52.979	-3.192	6.853	52.534	1006.853	1052.534	1308.078
	88	1.3	179	56	24	179°56'24"	256°10'57"	14.775	-1.140	-14.347	-3.529	985.653	996.471	1306.026
	89	2.15	290	19	37	290°19'37"	6°34'10"	57.825	-1.521	6.616	57.445	1006.616	1057.445	1305.557
	90	1.3	212	8	40	212°8'40"	288°23'13"	18.757	-3.936	-17.799	5.917	982.201	1005.917	1308.822
	91	1.3	286	9	43	286°9'43"	2°24'16"	61.690	-0.898	2.588	61.636	1002.588	1061.636	1305.784
	92	1.3	223	18	13	223°18'13"	299°32'46"	23.625	-5.023	-20.553	11.650	979.447	1011.650	1309.909
	93	1.3	229	6	29	229°6'29"	305°21'2"	29.636	-6.089	-24.172	17.147	975.828	1017.147	1310.975
	94	2.15	230	3	32	230°3'32"	306°18'5"	34.868	-5.964	-28.101	20.643	971.899	1020.643	1310.000
	95	1.3	209	6	38	209°6'38"	285°21'11"	24.700	-5.114	-23.819	6.540	976.181	1006.540	1310.000
	96	1.3	206	35	1	206°35'1"	282°49'34"	27.107	-4.265	-26.431	6.018	973.569	1006.018	1309.151
	97	1.3	203	40	7	203°40'7"	279°54'40"	26.927	-4.471	-26.525	4.635	973.475	1004.635	1309.357
	98	1.3	192	38	16	192°38'16"	268°52'49"	24.727	-3.167	-24.722	-0.483	975.278	999.517	1308.053
	99	2.15	192	16	11	192°16'11"	268°30'44"	22.290	-3.687	-22.282	-0.579	977.718	999.421	1307.723
	100	1.3	192	6	12	192°6'12"	268°20'45"	19.445	-2.841	-19.437	-0.561	980.563	999.439	1307.727
	B	1.3	272	30	31	272°30'31"	348°47'4"	28.565	0.470	-12.156	61.307			
	C(101)	1.3	184	58	53	184°58'53"	261°15'19"	0.000	-0.399	-48.545	-7.467			

Detailing of Bridge

		X	Y	Z
station	C	951.455	992.533	1304.492379

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
C	A	1.3	0	0	0	0°0'0"	81°15'19"	0.000	0.214	48.545	7.467			
1.431	102	1.3	296	21	45	296°21'45"	17°37'4"	2.011	-0.410	0.609	1.917	952.064	994.450	1305.033
	103	1.3	84	43	7	84°43'7"	165°58'26"	5.480	1.497	1.328	-5.317	952.783	987.216	1303.126
	104	1.3	269	25	42	269°25'42"	350°41'1"	4.477	-1.086	-0.725	4.418	950.731	996.951	1305.709
	105	1.3	334	46	37	334°46'37"	56°1'56"	7.648	-1.539	6.343	4.273	957.798	996.806	1306.162
	106	1.3	258	24	13	258°24'13"	339°39'32"	6.404	-1.526	-2.226	6.005	949.229	998.537	1306.149
	107	1.3	317	54	20	317°54'20"	39°9'39"	11.269	-2.466	7.116	8.738	958.572	1001.271	1307.089
	108	1.3	250	19	22	250°19'22"	331°34'41"	7.690	-1.719	-3.660	6.763	947.795	999.296	1306.342
	109	1.3	308	0	5	308°0'5"	29°15'24"	15.495	-3.529	7.573	13.518	959.028	1006.051	1308.152
	110	1.3	238	31	42	238°31'42"	319°47'1"	6.349	-1.217	-4.099	4.848	947.356	997.381	1305.840
	111	1.3	291	2	46	291°2'46"	12°18'5"	16.866	-3.891	3.593	16.479	955.049	1009.012	1308.514
	112	1.3	239	55	3	239°55'3"	321°10'22"	8.048	-1.691	-5.046	6.270	946.409	998.803	1306.314
	113	1.3	286	41	47	286°41'47"	7°57'6"	18.130	-4.399	2.508	17.956	953.963	1010.489	1309.022
	114	1.3	238	45	28	238°45'28"	320°0'47"	10.494	-2.327	-6.744	8.040	944.712	1000.573	1306.950
	115	1.3	284	2	58	284°2'58"	5°18'17"	20.314	-5.196	1.878	20.227	953.333	1012.760	1309.819
	116	1.3	239	52	38	239°52'38"	321°7'57"	12.907	-2.978	-8.099	10.049	943.356	1002.582	1307.601
	117	1.3	239	4	55	239°4'55"	320°20'14"	16.216	-3.620	-10.350	12.483	941.105	1005.016	1308.243
	118	1.3	291	28	7	291°28'7"	12°43'26"	22.936	-5.339	5.052	22.373	956.507	1014.906	1309.962
	119	1.3	289	13	27	289°13'27"	10°28'46"	25.846	-5.344	4.701	25.415	956.156	1017.948	1309.967
	120	2.15	239	12	14	239°12'14"	320°27'33"	20.552	-3.721	-13.084	15.849	938.371	1008.382	1307.494
	121	1.3	289	22	46	289°22'46"	10°38'5"	28.647	-5.496	5.287	28.155	956.742	1020.688	1310.119
	122	1.9	242	15	29	242°15'29"	323°30'48"	23.510	-3.979	-13.980	18.902	937.475	1011.435	1308.002
	123	1.3	285	10	38	285°10'38"	6°25'57"	29.792	-5.452	3.338	29.604	954.793	1022.137	1310.075
	124	1.75	241	41	5	241°41'5"	322°56'24"	25.741	-4.078	-15.513	20.541	935.942	1013.074	1308.251
	125	1.75	242	43	54	242°43'54"	323°59'13"	28.764	-4.148	-16.912	23.267	934.543	1015.800	1308.321
	126	1.3	283	1	13	283°1'13"	4°16'32"	30.732	-5.534	2.291	30.646	953.746	1023.179	1310.157
	127	1.75	252	20	47	252°20'47"	333°36'6"	8.442	-1.487	-3.753	7.562	947.702	1000.095	1305.660
	128	1.3	280	37	2	280°37'2"	1°52'21"	35.307	-5.326	1.154	35.288	952.609	1027.821	1309.949
	129	1.3	281	53	37	281°53'37"	3°8'56"	35.491	-5.041	1.950	35.437	953.405	1027.970	1309.664
	130	2.15	280	54	47	280°54'47"	2°10'6"	36.830	-5.503	1.393	36.804	952.849	1029.336	1309.276
	131	1.3	199	17	19	199°17'19"	280°32'38"	6.647	-0.509	-6.535	1.216	944.921	993.749	1305.132
	132	1.3	199	19	31	199°19'31"	280°34'50"	8.957	-0.910	-8.805	1.645	942.651	994.177	1305.533
	133	1.3	206	22	42	206°22'42"	287°38'1"	10.709	-1.546	-10.206	3.244	941.249	995.777	1306.169

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	134	1.3	203	28	7	203°28'7"	284°43'26"	12.671	-1.658	-12.255	3.220	939.200	995.753	1306.281
	135	1.3	206	42	24	206°42'24"	287°57'43"	14.850	-2.080	-14.126	4.580	937.329	997.112	1306.703
	136	1.3	313	36	20	313°36'20"	34°51'39"	18.834	-3.979	10.765	15.454	962.221	1007.987	1308.602
	137	1.3	212	10	27	212°10'27"	293°25'46"	15.730	-2.482	-14.433	6.255	937.022	998.787	1307.105
	138	1.3	213	13	2	213°13'2"	294°28'21"	18.142	-2.758	-16.512	7.515	934.943	1000.048	1307.381
	139	1.3	215	18	1	215°18'1"	296°33'20"	20.448	-2.900	-18.291	9.142	933.165	1001.674	1307.523
	140	2.15	30	29	9	30°29'9"	111°44'28"	11.528	0.731	10.708	-4.270	962.163	988.263	1303.042
	141	1.3	37	41	35	37°41'35"	118°56'54"	12.762	0.823	11.167	-6.177	962.623	986.356	1303.800
	142	2	218	33	45	218°33'45"	299°49'4"	22.458	-2.590	-19.485	11.167	931.970	1003.700	1306.513
	143	1.3	4	18	30	4°18'30"	85°33'49"	8.959	-0.990	8.932	0.693	960.387	993.226	1305.613
	144	1.3	3	7	44	3°7'44"	84°23'3"	12.772	-1.267	12.711	1.250	964.166	993.783	1305.890
	145	1.3	5	31	57	5°31'57"	86°47'16"	19.149	-1.002	19.119	1.073	970.574	993.606	1305.625
	146	1.3	359	27	43	359°27'43"	80°43'2"	19.732	-1.622	19.474	3.183	970.929	995.716	1306.245
	147	1.3	19	14	6	19°14'6"	100°29'25"	20.796	-0.507	20.448	-3.786	971.904	988.747	1305.130
	148	1.3	24	55	17	24°55'17"	106°10'36"	22.292	0.702	21.409	-6.211	972.865	986.322	1303.921
	149	1.3	31	39	4	31°39'4"	112°54'23"	22.998	1.531	21.184	-8.951	972.640	983.581	1303.092
	150	1.442	36	49	3	36°49'3"	118°42'22"	23.886	2.474	21.076	-11.241	972.531	981.292	1302.007
	151	1.3	45	26	22	45°26'22"	126°41'41"	19.501	2.381	15.637	-11.653	967.092	980.880	1302.242
	152	1.3	41	30	0	41°30'0"	122°45'19"	16.890	1.385	14.204	-9.138	965.660	983.394	1303.238
	153	1.3	39	23	53	39°23'53"	120°39'12"	12.084	0.795	10.395	-6.161	961.851	986.372	1303.828
	154	1.3	223	37	8	223°37'8"	304°52'27"	14.155	-2.873	-11.613	8.093	939.842	1000.626	1307.496
	155	1.3	223	34	12	223°34'12"	304°49'31"	19.768	-3.498	-16.227	11.289	935.228	1003.822	1308.121
	156	1.3	221	24	18	221°24'18"	302°39'37"	22.026	-3.443	-18.543	11.886	932.912	1004.419	1308.066
	157	1.3	222	57	4	222°57'4"	304°12'23"	23.441	-3.566	-19.386	13.178	932.069	1005.711	1308.189
	158	2.15	217	8	46	217°8'46"	298°24'5"	51.594	-2.809	-45.384	24.540	906.071	1017.073	1306.582
	159	2.15	208	37	5	208°37'5"	289°52'24"	52.740	-2.812	-49.599	17.929	901.856	1010.461	1306.585
	160	2.15	206	9	59	206°9'59"	287°25'18"	55.318	-2.613	-52.780	16.562	898.675	1009.095	1306.386
	161	1.3	121	22	26	121°22'26"	202°37'45"	5.701	1.666	-2.194	-5.262	949.262	987.271	1302.957
	162	1.3	171	4	28	171°4'28"	252°19'47"	10.582	-0.216	-10.083	-3.212	941.373	989.321	1304.839
	163	1.3	164	4	32	164°4'32"	245°19'51"	10.677	0.520	-9.703	-4.456	941.753	988.076	1304.103
	164	1.3	167	53	33	167°53'33"	249°8'52"	13.336	0.141	-12.463	-4.747	938.993	987.786	1304.482
	165	1.3	173	46	26	173°46'26"	255°14'5"	15.403	0.162	-14.880	-3.979	936.575	988.554	1304.461
	166	1.3	168	0	22	168°0'22"	249°15'41"	15.571	0.892	-14.562	-5.514	936.893	987.019	1303.731
	167	2.15	162	24	46	162°24'46"	243°40'5"	15.882	1.929	-14.234	-7.045	937.221	985.488	1301.844
	168	1.3	237	57	11	237°57'11"	319°12'30"	26.870	-4.542	-17.554	20.343	933.901	1012.876	1309.165
	169	2	155	13	29	155°13'29"	236°28'48"	14.534	2.511	-12.117	-8.026	939.338	984.507	1301.412

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
170	2	161	20	33	161°20'33"	242°35'52"	12.048	1.770	-10.696	-5.545	940.759	986.988	1302.153	
	1.3	140	38	43	140°38'43"	221°54'2"	4.102	0.726	-2.739	-3.053	948.716	989.480	1303.897	
	1.3	128	55	11	128°55'11"	210°10'30"	3.910	1.158	-1.965	-3.380	949.490	989.153	1303.465	
	1.3	90	20	53	90°20'53"	171°36'12"	5.369	1.531	0.784	-5.311	952.239	987.221	1303.092	
	1.3	103	58	0	103°58'0"	185°13'19"	5.786	1.689	-0.527	-5.762	950.929	986.771	1302.934	
	1.3	287	49	28	287°49'28"	9°4'47"	66.643	1.689	10.517	65.808	961.972	1058.341	1302.934	
	12.15	312	46	2	312°46'2"	34°1'21"	50.497	-5.254	28.254	41.853	979.709	1034.386	1299.027	
	2.15	287	29	7	287°29'7"	8°44'26"	60.637	0.950	9.214	59.933	960.670	1052.466	1302.823	
	2.15	287	15	13	287°15'13"	8°30'32"	57.300	0.445	8.478	56.669	959.934	1049.202	1303.328	
	1.3	284	57	19	284°57'19"	6°12'38"	55.475	0.010	6.001	55.149	957.457	1047.682	1304.613	
F	2.08	186	59	58	186°59'58"	268°19'36"	0.000	-0.259	-47.062	-1.375				

Detailing of Bridge

		X	Y	Z
station	F	904.393	991.158	1303.476361

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
F	C	1.3	0	0	0	0°0'0"	88°19'36"	0.000	0.756	47.062	1.375			
1.503	180	1.3	116	23	45	116°23'45"	204°43'21"	4.006	0.616	-1.675	-3.639	902.718	987.519	1303.063
	181	1.3	357	41	11	357°41'11"	86°0'47"	21.214	0.278	21.163	1.475	925.556	992.633	1303.401
	182	1.3	358	54	46	358°54'46"	87°14'22"	21.354	-0.156	21.329	1.028	925.722	992.186	1303.835
	183	1.3	1	15	51	1°15'51"	89°35'27"	21.067	0.998	21.066	0.150	925.460	991.308	1302.681
	184	1.3	2	40	52	2°40'52"	91°0'28"	19.550	1.357	19.547	-0.344	923.940	990.814	1302.322
	185	1.55	6	46	8	6°46'8"	95°5'44"	22.676	2.319	22.586	-2.014	926.980	989.144	1301.110
	186	1.7	11	48	38	11°48'38"	100°8'14"	20.744	2.643	20.420	-3.651	924.813	987.507	1300.636
	187	1.3	22	46	57	22°46'57"	111°6'33"	14.068	1.318	13.124	-5.067	917.517	986.092	1302.361
	188	1.3	6	25	48	6°25'48"	94°45'24"	13.177	0.727	13.132	-1.093	917.525	990.065	1302.952
	189	1.3	357	24	56	357°24'56"	85°44'32"	12.597	0.143	12.562	0.935	916.955	992.093	1303.536
	190	1.3	1	44	5	1°44'5"	90°3'41"	11.042	-0.300	11.042	-0.012	915.435	991.146	1303.979
	191	1.3	10	21	59	10°21'59"	98°41'35"	10.818	0.024	10.694	-1.635	915.087	989.523	1303.655
	192	1.3	8	0	4	8°0'4"	96°19'40"	8.914	-0.921	8.860	-0.982	913.253	990.176	1304.600
	193	1.3	26	4	18	26°4'18"	114°23'54"	5.757	-0.096	5.243	-2.378	909.636	988.780	1303.775
	194	1.3	47	18	49	47°18'49"	135°38'25"	7.667	0.684	5.360	-5.482	909.754	985.676	1302.995
	195	1.3	48	27	25	48°27'25"	136°47'1"	13.390	1.825	9.169	-9.758	913.562	981.400	1301.854
	196	1.3	119	45	28	119°45'28"	208°5'4"	2.436	0.246	-1.147	-2.149	903.246	989.009	1303.433
	197	1.3	292	36	0	292°36'0"	20°55'36"	57.840	1.000	20.659	54.025	925.052	1045.183	1302.679
	198	1.3	295	55	12	295°55'12"	24°14'48"	2.707	-0.768	1.112	2.468	905.505	993.626	1304.447
	199	1.3	208	52	26	208°52'26"	297°12'2"	10.854	-1.125	-9.654	4.961	894.739	996.120	1304.804
	200	1.3	298	10	11	298°10'11"	26°29'47"	6.284	-1.454	2.804	5.624	907.197	996.782	1305.133
	201	1.3	218	46	32	218°46'32"	307°6'8"	11.028	-1.561	-8.795	6.653	895.598	997.811	1305.240
	202	1.3	314	1	9	314°1'9"	42°20'45"	6.407	-1.401	4.316	4.735	908.709	995.893	1305.080
	203	1.3	226	22	13	226°22'13"	314°41'49"	12.691	-1.804	-9.021	8.926	895.372	1000.084	1305.483
	204	1.7	296	9	16	296°9'16"	24°28'52"	8.360	-1.360	3.464	7.608	907.857	998.766	1304.639
	205	1.3	233	9	12	233°9'12"	321°28'48"	13.916	-2.209	-8.667	10.888	895.726	1002.046	1305.888
	206	1.3	318	43	14	318°43'14"	47°2'50"	9.376	-1.894	6.862	6.389	911.256	997.547	1305.573
	207	1.3	235	10	17	235°10'17"	323°29'53"	15.063	-2.369	-8.960	12.108	895.433	1003.266	1306.048
	208	2	294	12	32	294°12'32"	22°32'8"	10.058	-1.248	3.855	9.290	908.248	1000.448	1304.227
	209	2.15	245	49	17	245°49'17"	334°8'53"	18.460	-1.736	-8.049	16.613	896.344	1007.771	1304.565
	210	2.15	310	59	53	310°59'53"	39°19'29"	12.702	-1.704	8.049	9.826	912.443	1000.984	1304.533
	211	2.15	246	59	17	246°59'17"	335°18'53"	23.888	-1.719	-9.976	21.705	894.417	1012.863	1304.548

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	212	2.15	311	27	42	311°27'42"	39°47'18"	14.087	-1.970	9.015	10.825	913.408	1001.983	1304.799
	213	2.15	314	53	57	314°53'57"	43°13'33"	14.577	-1.887	9.983	10.622	914.377	1001.780	1304.716
	214	2.15	305	28	53	305°28'53"	33°48'29"	27.885	-1.657	15.516	23.170	919.909	1014.328	1304.486
	215	2.15	302	46	44	302°46'44"	31°6'20"	15.593	-2.173	8.056	13.351	912.449	1004.509	1305.002
	216	2.15	291	34	17	291°34'17"	19°53'53"	16.169	-2.172	5.503	15.204	909.896	1006.362	1305.001
	217	2.15	245	54	37	245°54'37"	334°14'13"	29.676	-1.626	-12.899	26.726	891.494	1017.884	1304.455
	218	2.15	307	28	32	307°28'32"	35°48'8"	16.931	-2.265	9.904	13.732	914.298	1004.890	1305.094
	219	2.15	243	46	6	243°46'6"	332°5'42"	31.935	-1.717	-14.946	28.222	889.447	1019.380	1304.546
	220	2.15	297	45	56	297°45'56"	26°5'32"	19.365	-2.186	8.517	17.391	912.910	1008.550	1305.015
	221	2.15	251	31	48	251°31'48"	339°51'24"	30.033	-1.848	-10.342	28.196	894.051	1019.354	1304.677
	222	2.15	311	10	0	311°10'0"	39°29'36"	26.968	-2.387	17.151	20.811	921.545	1011.969	1305.216
	223	2.15	315	40	35	315°40'35"	44°0'11"	26.633	-2.398	18.502	19.157	922.895	1010.315	1305.227
	224	2.15	254	27	43	254°27'43"	342°47'19"	31.944	-1.656	-9.452	30.514	894.941	1021.672	1304.485
	225	2.15	298	57	6	298°57'6"	27°16'42"	27.927	-2.515	12.799	24.821	917.192	1015.979	1305.344
	226	2.15	291	20	16	291°20'16"	19°39'52"	29.430	-2.367	9.904	27.714	914.297	1018.872	1305.196
	227	2.15	287	14	49	287°14'49"	15°34'25"	25.899	-2.137	6.953	24.948	911.346	1016.106	1304.966
	228	2.15	263	37	13	263°37'13"	351°56'49"	31.768	-1.778	-4.450	31.455	899.943	1022.613	1304.607
	229	2.15	276	37	23	276°37'23"	4°56'59"	20.440	-1.937	1.764	20.364	906.157	1011.522	1304.766
	230	2.15	263	42	2	263°42'2"	352°1'38"	33.883	-1.914	-4.700	33.555	899.694	1024.714	1304.743
	231	2.15	311	7	2	311°7'2"	39°26'38"	25.546	-1.853	16.230	19.728	920.623	1010.886	1304.682
	232	2.15	298	13	24	298°13'24"	26°33'0"	40.336	-1.851	18.029	36.082	922.423	1027.240	1304.680
	233	2.15	306	27	30	306°27'30"	34°47'6"	25.578	-1.847	14.592	21.007	918.985	1012.165	1304.676
	234	2.15	298	12	20	298°12'20"	26°31'56"	40.338	-1.863	18.019	36.090	922.412	1027.248	1304.692
	235	1.3	262	36	47	262°36'47"	350°56'23"	34.558	-2.473	-5.442	34.127	898.951	1025.285	1306.152
	236	1.3	261	31	52	261°31'52"	349°51'28"	35.888	-2.044	-6.320	35.327	898.074	1026.485	1305.723
	237	1.3	294	28	55	294°28'55"	22°48'31"	40.160	-2.516	15.568	37.020	919.961	1028.178	1306.195
	238	1.3	259	50	49	259°50'49"	348°10'25"	37.288	-1.532	-7.642	36.497	896.751	1027.655	1305.211
	239	2.15	298	55	32	298°55'32"	27°15'8"	42.987	-2.034	19.684	38.215	924.077	1029.373	1304.863
	240	2.15	255	33	54	255°33'54"	343°53'30"	39.377	0.018	-10.925	37.831	893.468	1028.989	1302.811
	241	2.15	296	33	7	296°33'7"	24°52'43"	42.387	-2.605	17.832	38.454	922.225	1029.612	1305.434
	242	2.15	255	16	25	255°16'25"	343°36'1"	42.567	0.502	-12.018	40.835	892.375	1031.993	1302.327
	243	2.15	294	17	53	294°17'53"	22°37'29"	44.264	-1.411	17.028	40.858	921.421	1032.016	1304.240
	244	2.15	297	33	40	297°33'40"	25°53'16"	46.035	-1.189	20.099	41.415	924.493	1032.573	1304.018
	245	2.15	296	6	7	296°6'7"	24°25'43"	46.653	-1.107	19.294	42.476	923.687	1033.635	1303.936
	246	1.3	256	7	50	256°7'50"	344°27'26"	43.842	-0.016	-11.748	42.239	892.645	1033.397	1303.695
	247	2.15	294	17	3	294°17'3"	22°36'39"	47.892	-0.610	18.413	44.211	922.806	1035.369	1303.439

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	248	1.3	255	46	11	255°46'11"	344°5'47"	45.025	0.187	-12.338	43.302	892.055	1034.460	1303.492
	249	2.15	296	15	23	296°15'23"	24°34'59"	51.782	0.202	21.542	47.088	925.935	1038.246	1302.627
	250	2.15	293	41	59	293°41'59"	22°1'35"	50.863	0.063	19.075	47.151	923.469	1038.309	1302.766
	251	2.15	294	51	18	294°51'18"	23°10'54"	52.951	0.362	20.844	48.676	925.237	1039.834	1302.467
	252	2.15	292	7	32	292°7'32"	20°27'8"	53.818	0.927	18.806	50.425	923.199	1041.584	1301.902
	253	2.17	308	5	22	308°5'22"	36°24'58"	52.917	-0.950	31.414	42.584	935.807	1033.742	1303.759
	254	2.17	309	27	25	309°27'25"	37°47'1"	54.663	-1.003	33.491	43.202	937.884	1034.360	1303.812
	255	2.15	299	12	9	299°12'9"	27°31'45"	55.049	1.687	25.444	48.816	929.837	1039.974	1301.142
	256	2.17	309	26	40	309°26'40"	37°46'16"	55.254	-2.024	33.844	43.676	938.237	1034.834	1304.833
	257	2.17	312	59	7	312°59'7"	41°18'43"	49.074	-2.977	32.397	36.861	936.790	1028.019	1305.786
	258	2.15	299	23	21	299°23'21"	27°42'57"	53.710	1.137	24.980	47.548	929.373	1038.706	1301.692
	259	2.17	306	47	11	306°47'11"	35°6'47"	47.120	-2.023	27.103	38.545	931.496	1029.703	1304.832
	260	2.15	299	21	41	299°21'41"	27°41'17"	36.529	-2.655	16.974	32.346	921.367	1023.504	1305.484
	261	2.15	306	5	25	306°5'25"	34°25'1"	32.991	-3.036	18.647	27.216	923.040	1018.374	1305.865
	262	2.15	308	0	14	308°0'14"	36°19'50"	30.215	-2.615	17.901	24.342	922.294	1015.500	1305.444
G		1.3	211	20	46	211°20'46"	299°37'48"	0.000	-2.245	-24.834	14.125			

Detailed of Bridge

station	G	X 879.559	Y 1005.283	Z 1301.532946
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Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
G	F	1.3	0	0	0	0°0'0"	119°37'48"	0.000	1.938	24.834	-14.125			
1.368	263	1.3	147	34	37	147°34'37"	267°12'25"	14.145	0.284	-14.128	-0.689	865.431	1004.594	1301.317
	264	1.3	213	20	22	213°20'22"	332°58'10"	5.325	-0.058	-2.420	4.743	877.139	1010.026	1301.659
	265	1.3	208	44	37	208°44'37"	328°22'25"	7.483	0.057	-3.924	6.372	875.635	1011.655	1301.544
	266	1.3	140	45	36	140°45'36"	260°23'24"	15.830	0.378	-15.608	-2.643	863.951	1002.640	1301.223
	267	1.3	221	37	28	221°37'28"	341°15'16"	9.867	-0.016	-3.171	9.344	876.388	1014.627	1301.617
	268	1.3	135	49	13	135°49'13"	255°27'1"	16.666	0.492	-16.132	-4.187	863.427	1001.096	1301.109
	269	1.3	223	8	13	223°8'13"	342°46'1"	12.022	0.409	-3.562	11.482	875.997	1016.765	1301.192
	270	1.3	213	0	8	8213°0'8"	332°37'56"	16.782	0.153	-7.715	14.904	871.844	1020.187	1301.448
	271	1.3	132	33	14	132°33'14"	252°11'2"	18.318	0.684	-17.440	-5.605	862.119	999.678	1300.917
	272	1.3	131	17	55	131°17'55"	250°55'43"	18.856	0.551	-17.821	-6.161	861.738	999.122	1301.050
	273	2.15	280	32	3	280°8'32"	40°9'51"	40.408	20.792	26.062	30.880	905.621	1036.163	1279.959
	274	2.15	280	8	33	280°8'33"	39°46'21"	36.746	2.431	23.508	28.243	903.067	1033.526	1298.320
	275	2.15	123	18	40	123°18'40"	242°56'28"	20.477	1.299	-18.236	-9.315	861.323	995.968	1299.452
	276	1.3	113	19	55	113°19'55"	232°57'43"	18.746	1.457	-14.964	-11.292	864.595	993.991	1300.144
	277	1.3	112	6	31	112°6'31"	231°44'19"	20.123	2.359	-15.800	-12.461	863.759	992.822	1299.242
	278	1.3	104	33	5	104°33'5"	224°10'53"	17.755	1.945	-12.374	-12.733	867.185	992.550	1299.656
	279	2.15	255	13	23	255°13'23"	14°51'11"	23.897	2.826	6.126	23.099	885.685	1028.382	1297.925
	280	1.3	92	2	35	92°2'35"	211°40'23"	19.135	3.675	-10.047	-16.285	869.512	988.998	1297.926
	281	1.8	234	15	17	234°15'17"	353°53'5"	21.556	3.619	-2.296	21.433	877.263	1026.716	1297.482
	282	1.3	87	2	28	87°2'28"	206°40'16"	21.226	5.225	-9.528	-18.968	870.031	986.315	1296.376
	283	2.15	76	42	41	76°42'41"	196°20'29"	20.653	6.958	-5.811	-19.819	873.748	985.464	1293.793
	284	2.15	88	51	42	88°51'42"	208°29'30"	25.574	7.304	-12.200	-22.477	867.359	982.806	1293.447
	285	2.15	257	35	32	257°35'32"	17°13'20"	23.229	2.615	6.878	22.188	886.437	1027.471	1298.136
	286	2.15	80	5	36	80°5'36"	199°43'24"	25.321	7.692	-8.545	-23.836	871.014	981.447	1293.059
	287	2.15	285	18	21	285°18'21"	44°56'9"	27.640	6.414	19.522	19.566	899.081	1024.849	1294.337
	288	1.3	168	31	44	168°31'44"	288°9'32"	15.563	0.627	-14.788	4.850	864.771	1010.133	1300.974
	289	1.3	281	1	24	281°1'24"	40°39'12"	2.485	-0.297	1.619	1.885	881.178	1007.168	1301.898
	290	1.3	15	28	25	15°28'25"	135°6'13"	10.647	0.805	7.515	-7.542	887.074	997.741	1300.796
	291	1.3	356	7	0	356°7'0"	115°44'48"	9.909	0.446	8.925	-4.304	888.484	1000.979	1301.155
	292	1.3	172	4	54	172°4'54"	291°42'42"	16.379	1.225	-15.217	6.059	864.342	1011.342	1300.376
E		1.3	286	46	54	286°46'54"	46°35'20"	0.000	3.846	45.362	42.914			

Detailing of Bridge

station	B	X 987.844	Y 1061.307	Z 1304.370833
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Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
B	A	1.3	0	0	0	0°0'0"	168°47'4"	28.565		12.156	-61.307			
1.3	293	1.5	193	17	9	193°17'9"	2°4'13"	31.522	5.996	1.139	31.501	988.982	1092.809	1298.175
	294	1.5	189	35	37	189°35'37"	358°22'41"	31.824	6.310	-0.901	31.811	986.943	1093.119	1297.861
	295	1.5	224	26	2	224°26'2"	33°13'6"	32.922	4.291	18.036	27.542	1005.879	1088.850	1299.880
	296	1.5	186	27	36	186°27'36"	355°14'40"	32.979	6.458	-2.734	32.865	985.109	1094.173	1297.713
	297	1.5	242	34	30	242°34'30"	51°21'34"	27.136	2.227	21.195	16.945	1009.039	1078.252	1301.944
	298	1.5	186	10	9	186°10'9"	354°57'13"	29.865	5.925	-2.627	29.749	985.217	1091.057	1298.246
	299	1.5	257	59	43	257°59'43"	66°46'47"	24.075	0.824	22.125	9.492	1009.968	1070.799	1303.347
	300	1.5	191	37	5	191°37'5"	0°24'9"	29.554	5.549	0.208	29.553	988.051	1090.861	1298.622
	301	1.5	269	1	22	269°1'22"	77°48'26"	23.867	-0.468	23.329	5.041	1011.172	1066.348	1304.639
	302	1.5	188	4	13	188°4'13"	356°51'17"	27.270	5.331	-1.496	27.229	986.347	1088.536	1298.840
	303	1.5	285	50	40	285°50'40"	94°37'44"	22.574	-2.431	22.500	-1.822	1010.344	1059.486	1306.602
	304	1.5	297	7	4	297°7'4"	105°54'8"	24.349	-3.757	23.417	-6.672	1011.261	1054.636	1307.928
	305	2.15	303	48	4	303°48'4"	112°35'8"	27.557	-4.756	25.444	-10.584	1013.287	1050.724	1308.277
	306	2.15	312	37	59	312°37'59"	121°25'3"	30.951	-6.507	26.413	-16.134	1014.257	1045.174	1310.028
	307	1.5	194	26	18	194°26'18"	3°13'22"	26.006	5.036	1.462	25.965	989.306	1087.272	1299.135
	308	1.5	186	28	37	186°28'37"	355°15'41"	23.786	4.961	-1.965	23.705	985.879	1085.012	1299.210
	309	1.5	182	43	22	182°43'22"	351°30'26"	23.299	4.993	-3.441	23.044	984.403	1084.351	1299.178
	310	1.5	176	25	23	176°25'23"	345°12'27"	23.878	5.100	-6.097	23.087	981.747	1084.394	1299.071
	311	1.5	175	42	34	175°42'34"	344°29'38"	21.068	4.644	-5.632	20.301	982.211	1081.609	1299.527
	312	1.5	184	1	43	184°1'43"	352°48'47"	20.221	4.462	-2.530	20.062	985.314	1081.370	1299.709
	313	1.5	194	55	25	194°55'25"	3°42'29"	21.005	4.339	1.358	20.961	989.202	1082.268	1299.832
	314	1.5	204	0	11	204°0'11"	12°47'15"	20.949	4.037	4.637	20.429	992.480	1081.737	1300.134
	315	1.5	219	35	19	219°35'19"	28°22'23"	22.491	3.486	10.688	19.789	998.531	1081.097	1300.685
	316	1.5	206	47	45	206°47'45"	15°34'49"	17.419	3.461	4.679	16.779	992.522	1078.086	1300.710
	317	1.5	195	5	10	195°5'10"	3°52'14"	15.545	3.530	1.049	15.510	988.893	1076.817	1300.641
	318	1.5	229	14	15	229°14'15"	38°1'19"	17.035	2.391	10.493	13.420	998.336	1074.727	1301.780
	319	1.5	177	57	47	177°57'47"	346°44'51"	15.308	3.594	-3.509	14.900	984.334	1076.208	1300.577
	320	1.5	251	27	40	251°27'40"	60°14'44"	12.829	0.750	11.138	6.367	998.981	1067.674	1303.421
	321	1.5	164	23	0	164°22'60"	333°10'4"	14.460	3.334	-6.527	12.903	981.317	1074.211	1300.837
	322	1.5	147	57	39	147°57'39"	316°44'43"	12.738	2.803	-8.729	9.277	979.115	1070.585	1301.368
	323	1.5	291	19	53	291°19'53"	100°6'57"	12.529	-1.912	12.334	-2.201	1000.178	1059.107	1306.083
	324	2.15	307	25	41	307°25'41"	116°12'45"	14.185	-2.210	12.726	-6.266	1000.570	1055.042	1305.731

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	325	1.5	156	40	36	156°40'36"	325°27'40"	27.095	5.284	-15.362	22.319	972.482	1083.627	1298.887
	326	1.5	165	13	55	165°13'55"	334°0'59"	25.526	5.319	-11.183	22.946	976.660	1084.253	1298.852
	327	2.8	321	50	40	321°50'40"	130°37'44"	15.154	-2.217	11.501	-9.868	999.345	1051.440	1305.088
	328	1.5	180	38	0	180°37'60"	349°25'4"	11.293	2.829	-2.074	11.101	985.770	1072.408	1301.342
	329	1.5	199	22	57	199°22'57"	8°10'1"	8.885	2.207	1.262	8.795	989.106	1070.102	1301.964
	330	1.5	156	21	17	156°21'17"	325°8'21"	26.637	5.257	-15.225	21.857	972.618	1083.164	1298.914
	331	1.5	186	20	39	186°20'39"	355°7'43"	6.613	1.882	-0.562	6.589	987.282	1067.896	1302.289
	332	1.5	206	53	36	206°53'36"	15°40'40"	6.069	1.526	1.640	5.843	989.484	1067.151	1302.645
	333	2	162	16	1	162°16'1"	331°3'5"	30.531	6.493	-14.778	26.716	973.066	1088.024	1297.178
	334	1.5	233	27	8	233°27'8"	42°14'12"	5.410	0.790	3.637	4.005	991.480	1065.313	1303.381
	335	1.5	128	54	34	128°54'34"	297°41'38"	15.264	2.634	-13.515	7.094	974.328	1068.401	1301.537
	336	1.5	261	28	56	261°28'56"	70°15'60"	5.318	0.170	5.006	1.796	992.849	1063.103	1304.001
	337	1.5	181	27	12	181°27'12"	350°14'16"	6.275	1.657	-1.064	6.184	986.780	1067.492	1302.514
	338	1.5	204	27	37	204°27'37"	13°14'41"	4.252	0.876	0.974	4.139	988.818	1065.446	1303.295
	339	1.5	248	11	57	248°11'57"	56°59'1"	3.977	0.243	3.335	2.167	991.178	1063.474	1303.928
	340	1.5	97	31	18	97°31'18"	266°18'22"	13.379	1.162	-13.351	-0.862	974.492	1060.445	1303.009
	341	1.5	78	59	33	78°59'33"	247°46'37"	14.208	-0.176	-13.153	-5.374	974.691	1055.934	1304.347
	342	1.5	67	22	1	67°22'1"	236°9'5"	16.200	-0.856	-13.454	-9.023	974.389	1052.284	1305.027
	343	1.3	59	28	35	59°28'35"	228°15'39"	15.003	-1.389	-11.195	-9.988	976.649	1051.319	1305.760
	344	2.15	53	21	0	53°21'0"	222°8'4"	16.363	-1.588	-10.977	-12.134	976.866	1049.173	1305.109
	345	2.15	37	45	23	37°45'23"	206°32'27"	20.189	-3.640	-9.021	-18.061	978.822	1043.246	1307.161
	346	2.15	28	12	47	28°12'47"	196°59'51"	24.766	-5.379	-7.240	-23.684	980.604	1037.623	1308.900
	347	1.5	174	14	21	174°14'21"	343°1'25"	6.006	1.820	-1.754	5.744	986.090	1067.052	1302.351
	348	1.5	181	35	55	181°35'55"	350°22'59"	4.059	1.237	-0.678	4.002	987.165	1065.309	1302.934
	349	1.5	216	14	22	216°14'22"	25°1'26"	2.831	0.693	1.198	2.565	989.041	1063.873	1303.478
	350	2.15	27	49	13	27°49'13"	196°36'17"	28.007	-5.986	-8.003	-26.839	979.840	1034.468	1309.507
	351	2.15	25	34	12	25°34'12"	194°21'16"	33.280	-5.985	-8.251	-32.241	979.593	1029.066	1309.506
	352	1.5	282	37	50	282°37'50"	91°24'54"	4.747	-0.363	4.746	-0.117	992.589	1061.190	1304.534
	353	1.5	294	3	26	294°3'26"	102°50'30"	7.127	-1.431	6.949	-1.584	994.792	1059.723	1305.602
	354	1.5	283	8	50	283°8'50"	91°55'54"	8.653	-0.850	8.648	-0.292	996.492	1061.016	1305.021
	355	1.5	310	29	55	310°29'55"	119°16'59"	5.342	-1.265	4.659	-2.613	992.503	1058.694	1305.436
	356	1.3	346	46	21	346°46'21"	155°33'25"	4.441	-1.560	1.838	-4.043	989.681	1057.264	1305.931
	357	1.3	31	41	30	31°41'30"	200°28'34"	3.072	-0.917	-1.075	-2.878	986.769	1058.429	1305.288
	358	1.3	13	55	20	13°55'20"	182°42'24"	5.782	-1.724	-0.273	-5.776	987.570	1055.532	1306.095
	359	2.15	150	12	4	150°12'4"	318°59'8"	40.815	7.713	-26.785	30.797	961.059	1092.104	1295.808
	360	1.3	48	1	4	48°1'4"	216°48'8"	11.146	-1.473	-6.677	-8.925	981.166	1052.383	1305.844

Detailing of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	361	2.15	134	52	20	134°52'20"	303°39'24"	31.064	5.500	-25.857	17.216	961.987	1078.524	1298.021
	362	1.3	57	52	36	57°52'36"	226°39'40"	14.390	-1.467	-10.466	-9.876	977.378	1051.431	1305.838
	363	2.15	108	44	46	108°44'46"	277°31'50"	23.492	3.070	-23.289	3.079	964.554	1064.386	1300.451
	364	2.15	88	26	54	88°26'54"	257°13'58"	21.883	1.272	-21.342	-4.836	966.502	1056.471	1302.249
	365	2.15	80	22	40	80°22'40"	249°9'44"	21.853	0.193	-20.424	-7.774	967.420	1053.534	1303.328
	366	2.15	73	12	56	73°12'56"	242°0'0"	23.769	-0.091	-20.987	-11.159	966.857	1050.149	1303.612
	367	1.3	69	14	20	69°14'20"	238°1'24"	25.201	-1.586	-21.377	-13.346	966.466	1047.962	1305.957
	D	1.3	324	46	27	324°46'27"	133°33'22"	60.610	-4.135	53.764	-51.120			
	C	1.35	39	5	5	39°5'5"	207°52'59"	0.000	-0.802	-36.388	-68.775			

Detailed of Bridge

station	E	X	Y	Z
		924.921	1048.197	1304.669278

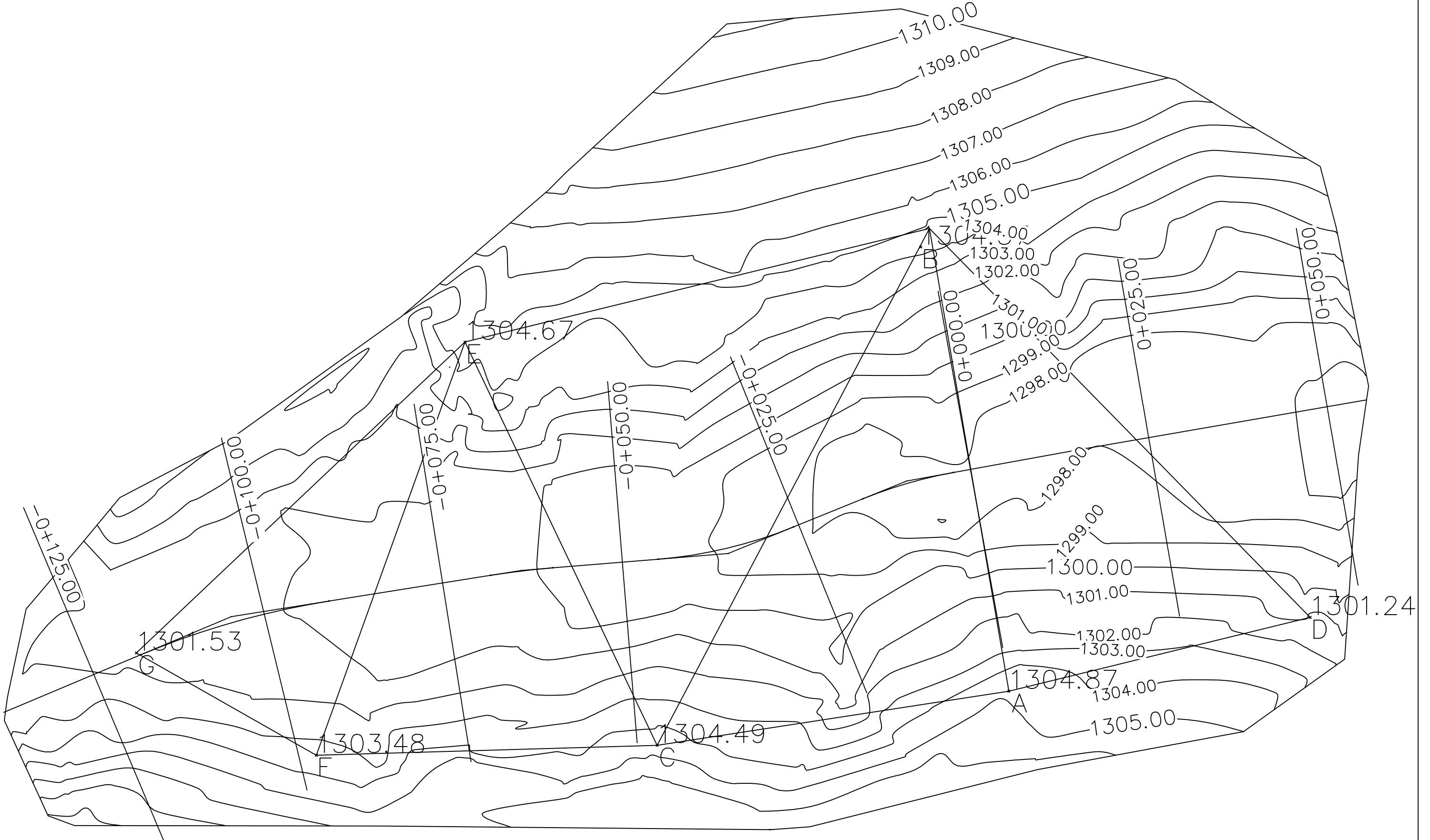
Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
E	B	2.15	0	0	0	0°0'0"	78°13'49"	0.000	0.693	62.922	13.110			
1.317	368	1.3	319	50	15	319°50'15"	38°44"	34.054	4.364	20.997	26.810	945.919	1075.007	1300.322
	369	1.3	324	5	52	324°5'52"	42°19'41"	34.194	3.994	23.025	25.280	947.947	1073.477	1300.692
	370	1.3	322	49	8	322°49'8"	41°25"	31.571	3.805	20.733	23.809	945.654	1072.006	1300.881
	371	1.3	319	30	41	319°30'41"	37°44'30"	29.820	3.789	18.253	23.581	943.174	1071.778	1300.897
	372	1.3	312	29	14	312°29'14"	30°43'3"	27.087	3.852	13.836	23.287	938.758	1071.484	1300.834
	373	1.3	345	5	19	345°5'19"	63°19'8"	29.578	1.611	26.429	13.281	951.350	1061.478	1303.075
	374	1.3	317	18	56	317°18'56"	35°32'45"	26.917	3.447	15.648	21.901	940.570	1070.098	1301.239
	375	1.3	351	17	56	351°17'56"	69°31'45"	28.672	0.841	26.861	10.027	951.783	1058.224	1303.845
	376	1.3	325	46	1	325°46'1"	43°59'50"	28.333	3.124	19.681	20.382	944.602	1068.579	1301.562
	377	1.3	351	11	25	351°11'25"	69°25'14"	32.890	1.265	30.791	11.561	955.713	1059.758	1303.421
	378	1.3	317	52	50	317°52'50"	36°6'39"	25.450	2.988	14.999	20.561	939.920	1068.757	1301.698
	379	1.3	357	47	12	357°47'12"	76°1'1"	31.403	0.220	30.472	7.588	955.394	1055.785	1304.466
	380	1.3	325	6	34	325°6'34"	43°20'23"	24.477	2.619	16.799	17.802	941.721	1065.999	1302.067
	381	1.3	357	42	47	357°42'47"	75°56'36"	31.423	0.224	30.482	7.632	955.404	1055.829	1304.462
	382	1.3	322	16	13	322°16'13"	40°30'2"	23.116	2.509	15.013	17.577	939.934	1065.774	1302.177
	383	1.3	357	59	1	357°59'1"	76°12'50"	28.018	-0.071	27.211	6.677	952.132	1054.874	1304.757
	384	1.3	316	47	48	316°47'48"	35°1'37"	24.084	3.163	13.823	19.722	938.745	1067.919	1301.523
	385	1.3	0	3	27	0°3'27"	78°17'16"	35.413	0.103	34.676	7.189	959.597	1055.386	1304.583
	386	2	310	33	17	310°33'17"	28°47'6"	23.891	4.087	11.504	20.939	936.426	1069.136	1299.899
	387	1.3	1	15	57	1°15'57"	79°29'46"	39.600	0.037	38.936	7.219	963.858	1055.416	1304.649
	388	2	311	40	40	311°40'40"	29°54'29"	20.940	3.476	10.441	18.151	935.362	1066.348	1300.510
	389	2	352	14	50	352°14'50"	70°28'39"	22.857	0.836	21.543	7.638	946.464	1055.835	1303.150
	390	2	311	28	50	311°28'50"	29°42'39"	18.550	3.068	9.194	16.111	934.115	1064.308	1300.918
	391	2	353	54	31	353°54'31"	72°8'20"	22.008	0.380	20.947	6.750	945.869	1054.947	1303.606
	392	2	319	54	52	319°54'52"	38°8'41"	19.080	2.809	11.785	15.006	936.706	1063.202	1301.177
	393	2.15	328	39	59	328°39'59"	46°53'48"	19.436	2.635	14.191	13.281	939.112	1061.478	1301.201
	394	1.3	322	55	48	322°55'48"	41°0'37"	6.488	0.716	4.270	4.885	929.192	1053.082	1303.970
	395	1.3	341	5	23	341°5'23"	59°19'12"	20.417	1.051	17.559	10.418	942.481	1058.615	1303.635
	396	1.3	9	1	7	9°1'7"	87°14'56"	6.788	0.063	6.780	0.326	931.702	1048.523	1304.623
	397	1.3	344	39	45	344°39'45"	62°53'34"	19.709	0.751	17.544	8.981	942.466	1057.178	1303.935
	398	1.3	56	16	16	56°16'16"	134°30'5"	10.409	-0.956	7.424	-7.296	932.345	1040.901	1305.642
	399	1.3	343	47	26	343°47'26"	62°1'15"	15.988	0.912	14.119	7.501	939.041	1055.698	1303.774
	400	2.18	57	31	13	57°31'13"	135°45'2"	13.033	-0.963	9.094	-9.336	934.016	1038.861	1304.769
	401	1.3	355	33	45	355°33'45"	73°47'34"	13.559	-0.107	13.020	3.784	937.942	1051.981	1304.793
	402	2.18	51	36	30	51°36'30"	129°50'19"	14.703	-1.140	11.290	-9.419	936.211	1038.778	1304.946

Detailed of Bridge

Station	Sighted To	Signal Height	HCR observation			Included Clockwise Angle	Bearing	Hz dist	Vt dist	Consecutive Co-ordinate		Independent Coordinate		RL (point)
			d	m	s					departure	latitude	Easting	Northing	
	403	1.3	28	43	2	28°43'2"	106°56'51"	3.260	-0.193	3.118	-0.950	928.040	1047.247	1304.879
	404	1.3	72	23	12	72°23'12"	150°37'1"	8.130	-0.725	3.989	-7.084	928.910	1041.113	1305.411
	405	1.3	94	58	37	94°58'37"	173°12'26"	4.072	-1.257	0.482	-4.043	925.403	1044.154	1305.943
	406	1.3	123	7	15	123°7'15"	201°21'4"	5.000	-1.107	-1.820	-4.657	923.101	1043.540	1305.793
	407	1.3	101	55	37	101°55'37"	180°9'26"	8.348	-2.402	-0.023	-8.348	924.899	1039.849	1307.088
	408	1.3	105	20	17	105°20'17"	183°34'6"	12.452	-3.190	-0.775	-12.428	924.146	1035.769	1307.876
	409	2.15	106	38	48	106°38'48"	184°52'37"	15.428	-3.210	-1.312	-15.372	923.610	1032.825	1307.046
	410	2.15	103	54	26	103°54'26"	182°8'15"	19.124	-3.961	-0.713	-19.111	924.208	1029.086	1307.797
	411	2.15	109	28	5	109°28'5"	187°41'54"	21.378	-4.405	-2.864	-21.185	922.058	1027.012	1308.241
	412	2.15	110	22	31	110°22'31"	188°36'20"	24.888	-4.409	-3.724	-24.608	921.197	1023.589	1308.245
	413	2.15	114	17	59	114°17'59"	192°31'48"	36.153	-4.144	-7.843	-35.292	917.078	1012.905	1307.980
	414	2.15	111	24	11	111°24'11"	189°37'60"	33.000	-4.226	-5.522	-32.535	919.399	1015.662	1308.062
	415	1.3	201	46	20	201°46'20"	280°09"	1.482	-0.061	-1.459	0.257	923.462	1048.454	1304.747
	416	1.3	219	51	51	219°51'51"	298°5'40"	4.780	-0.583	-4.217	2.251	920.705	1050.448	1305.269
	417	1.3	164	48	34	164°48'34"	243°2'23"	24.680	-1.443	-21.998	-11.189	902.924	1037.008	1306.129
	418	2.15	174	3	10	174°3'10"	252°16'59"	19.267	0.274	-18.353	-5.863	906.568	1042.334	1303.562
	419	2.15	215	47	56	215°47'56"	294°1'45"	7.658	-1.447	-6.994	3.118	917.927	1051.315	1305.283
	420	2.15	164	39	45	164°39'45"	242°53'34"	16.966	-0.295	-15.102	-7.731	909.819	1040.466	1304.131
	421	1.3	213	8	32	213°8'32"	291°22'21"	9.486	-0.782	-8.834	3.457	916.088	1051.654	1305.468
	422	2.15	145	53	33	145°53'33"	224°7'22"	14.352	-1.902	-9.992	-10.303	914.930	1037.894	1305.738
	423	2.15	132	37	53	132°37'53"	210°51'42"	4.054	-0.839	-2.080	-3.480	922.842	1044.717	1304.675
	424	1.3	153	57	9	153°57'9"	232°10'58"	5.392	-1.586	-4.260	-3.306	920.662	1044.891	1306.272
	425	2.15	142	28	31	142°28'31"	220°42'20"	18.939	-2.234	-12.351	-14.357	912.570	1033.840	1306.070
	426	1.3	154	20	38	154°20'38"	232°34'27"	6.497	-2.353	-5.160	-3.948	919.762	1044.249	1307.039
	427	1.3	155	55	2	155°55'2"	234°8'51"	10.365	-2.590	-8.401	-6.071	916.520	1042.126	1307.276
	428	1.3	166	42	48	166°42'48"	244°56'37"	13.021	-1.600	-11.796	-5.515	913.126	1042.682	1306.286
	429	1.3	155	36	26	155°36'26"	233°50'15"	19.220	-1.935	-15.517	-11.341	909.404	1036.856	1306.621
	430	2	154	52	25	154°52'25"	233°6'14"	22.738	-1.673	-18.184	-13.651	906.737	1034.546	1305.659
	431	1.3	166	37	34	166°37'34"	244°51'23"	26.490	-1.169	-23.980	-11.255	900.941	1036.942	1305.855
G		1.3	148	31	37	148°31'37"	226°35'20"	0.000	-3.970	-45.362	-42.914			
F		1.3	121	44	44	121°44'44"	199°47'38"	0.000	1.973	-20.528	-57.039			
C		1.3	76	23	31	76°23'31"	154°30'50"	0.000	-0.777	26.534	-55.664			

BEARINGS AND INDEPENDENT CO-ORDINATES CALCULATION OF STATION

Line	Internal Angle	Length	Observed Angle			Forward Bearing			Backward Bearing			Corrected Bearing			Departure	Latitude	Independent Co-ordinates (Forward station)		Independent Co-ordinates (Backward station)	
			d	m	s	d	m	s	d	m	s	d	m	s			Easting	Northing	Easting	Northing
A-B		62.501				348	47	4	166	47	4	11	12	56	-12.156	61.307	1000.000	1000.000	987.844	1061.307
	CAB		87	31	45															
A-C		49.116				261	15	19	81	15	19	81	15	19	-48.545	-7.467	1000.000	1000.000	951.455	992.533
	DAB		87	27	29															
A-D		42.836				76	14	33	256	14	33	76	14	33	41.607	10.187	1000.000	1000.000	1041.607	1010.187
	ABC		39	5	55															
B-C		77.808				207	52	59	27	52	59	27	52	59	-36.388	-68.775	987.844	1061.307	951.455	992.533
	ABD		35	13	42															
B-D		74.188				133	33	22	313	33	22	46	26	38	53.764	-51.120	987.844	1061.307	1041.607	1010.187
	CBE		50	20	50															
B-E		64.273				258	13	49	78	13	49	78	13	49	-62.922	-13.110	987.844	1061.307	924.921	1048.197
	ECB		53	22	9															
C-E		61.665				334	30	50	154	30	50	25	29	10	-26.534	55.664	951.455	992.533	924.921	1048.197
	FCE		66	11	14															
C-F		47.082				268	19	36	88	19	36	88	19	36	-47.062	-1.375	951.455	992.533	904.393	991.158
	CEF		45	16	48															
E-F		60.621				199	47	38	19	47	38	19	47	38	-20.528	-57.039	924.921	1048.197	904.393	991.158
	FEG		26	47	42															
E-G		62.445				226	35	20	46	35	20	46	35	20	-45.362	-42.914	924.921	1048.197	879.559	1005.283
	GFE		80	9	50															
F-G		28.570				299	37	48	119	37	48	60	22	12	-24.834	14.125	904.393	991.158	879.559	1005.283



TRIBHUVAN UNIVERSITY INSTITUTE OF ENGINEERING DEPARTMENT OF CIVIL ENGINEERING SURVEY INSTRUCTION COMMITTEE CENTRAL CAMPUS PULCHOWK	BRIDGE SURVEY	X-SECTION	SCALE	PREPARED BY GROUP 29/30
	SURVEY CAMP 2076	SHEET NO:1	1:500	

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SURVEY INSTRUCTION COMMITTEE
CENTRAL CAMPUS PULCHOWK

BE SURVEY CAMP 2076

TITLE:

**LONGITUDINAL
SECTION OF RIVER**

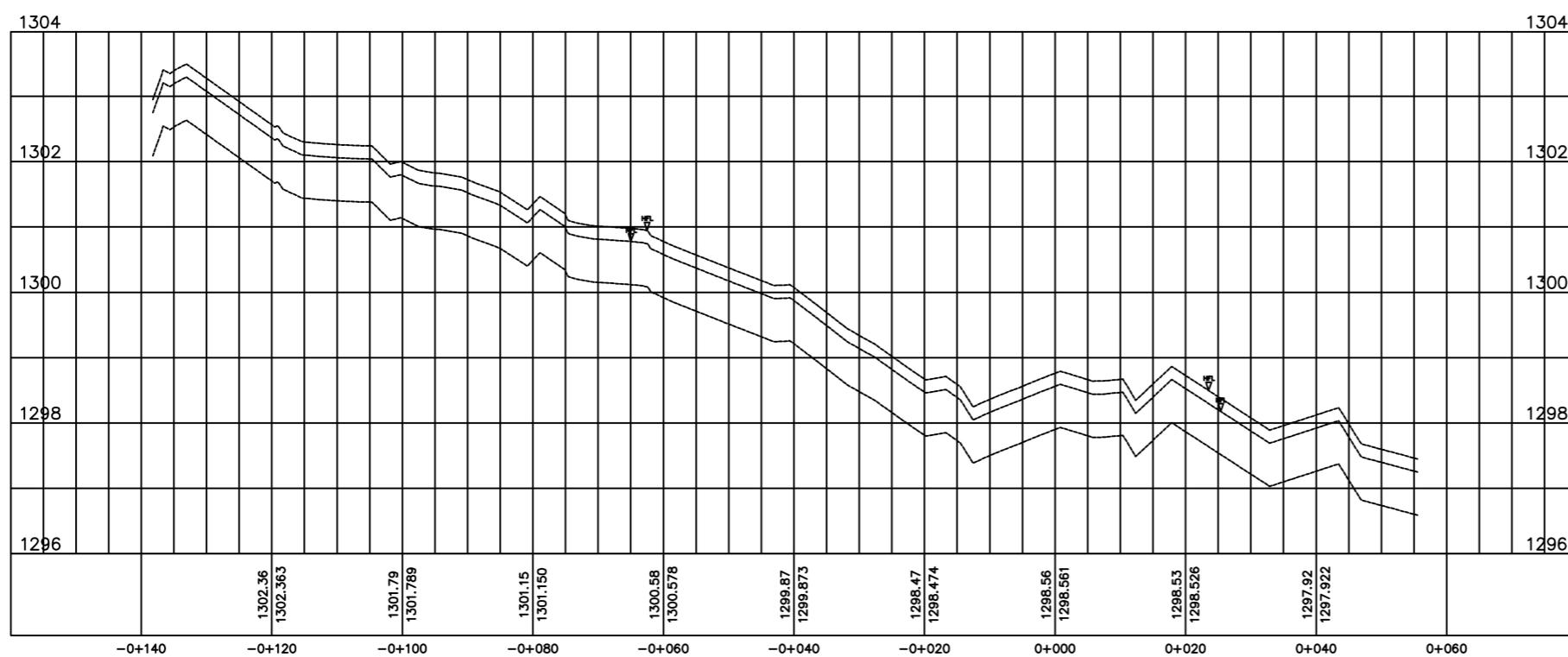
SCALE
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CREATED BY

**SURVEY CAMP
2074 BATCH
GROUP : 29/30**

SHEET NO: 2

CHECKED BY:



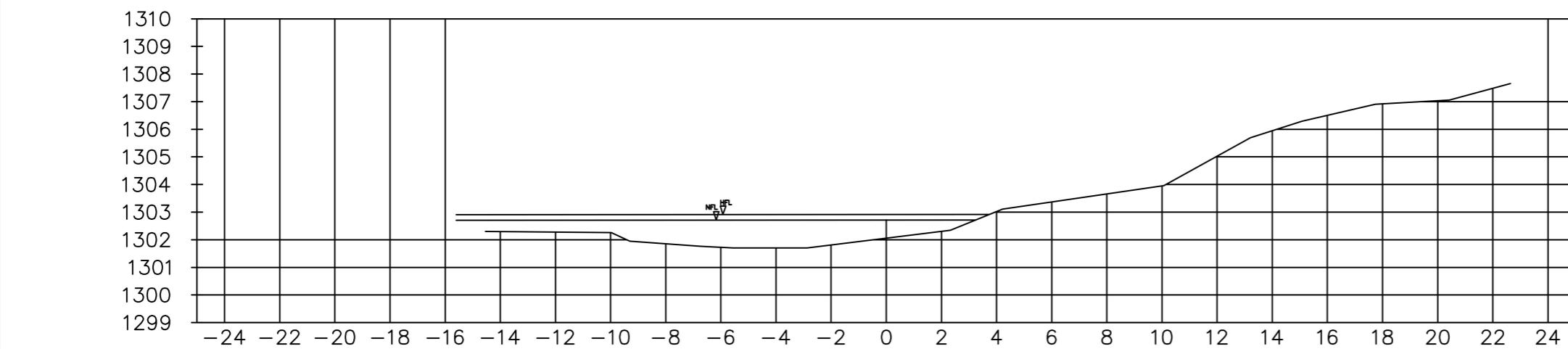
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 CENTRAL CAMPUS PULCHOWK

BRIDGE SURVEY
 SURVEY CAMP
 2076

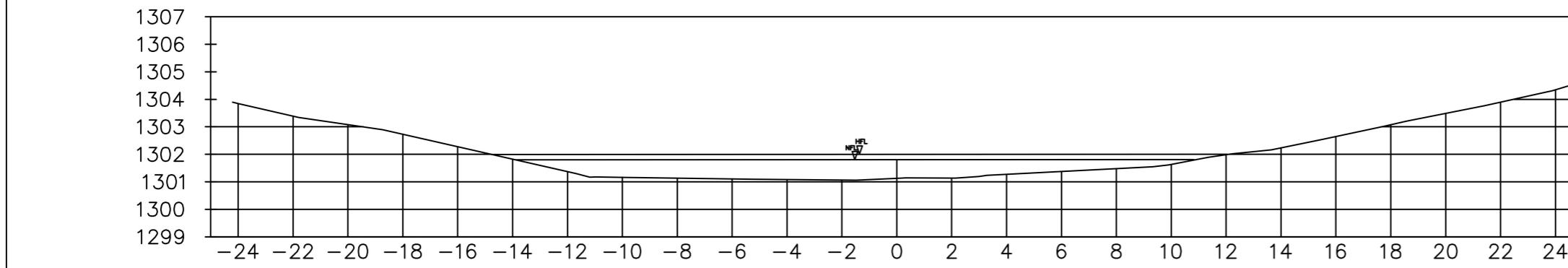
X-SECTION
 SHEET NO: 3

SCALE
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PREPARED BY
 GROUP 29/30



-0+125.00



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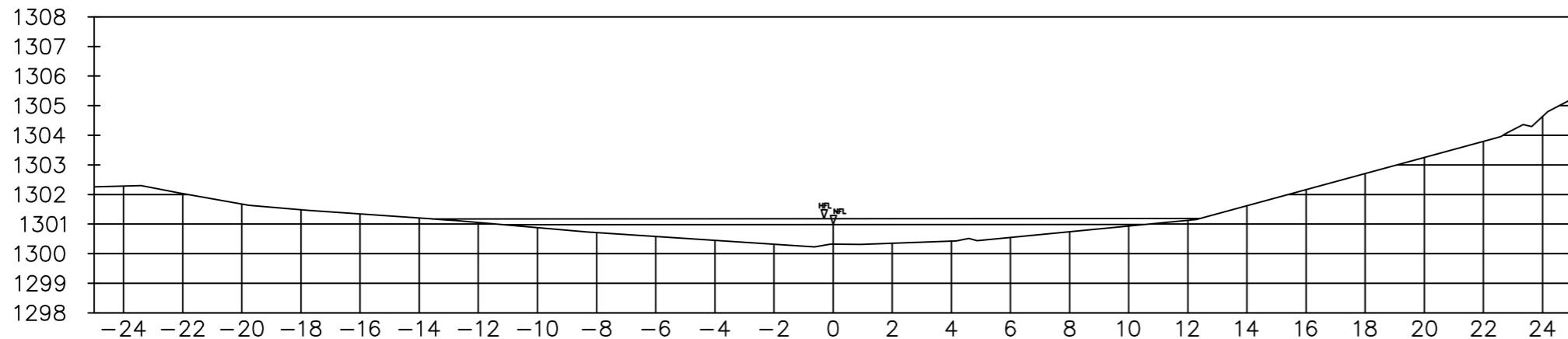
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 CENTRAL CAMPUS PULCHOWK

BRIDGE SURVEY
 SURVEY CAMP
 2076

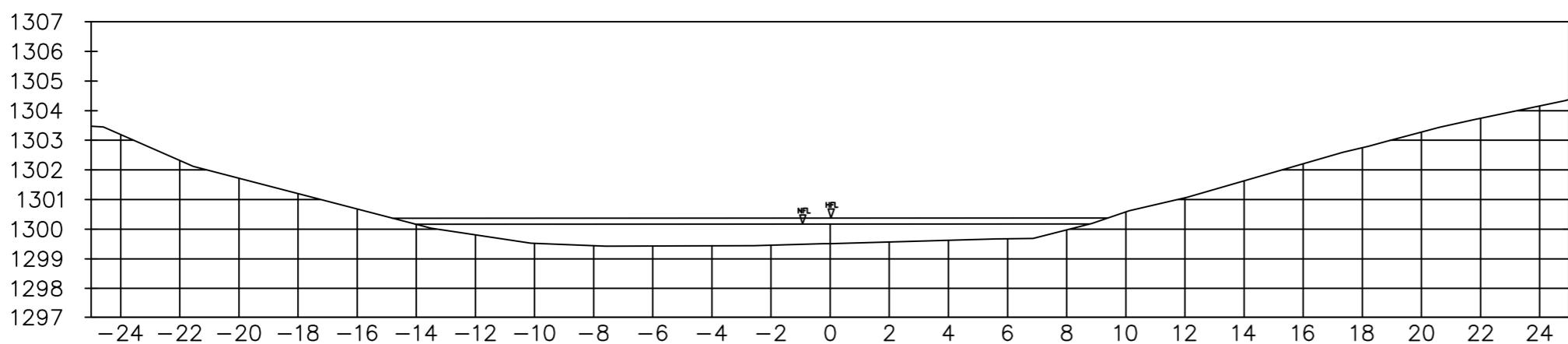
X-SECTION
 SHEET NO: 4

SCALE
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 V: 1:200

PREPARED BY
 GROUP 29/30



-0+075.00



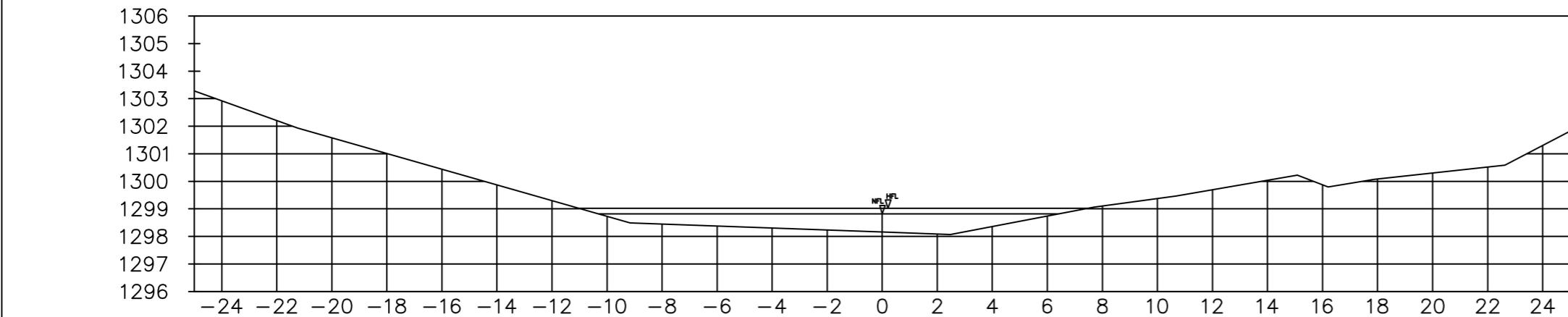
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ELEVATIONS	-24.00	1302.28
OFFSET	-22.00	1302.03
	-20.00	1301.67
	-18.00	1301.49
	-16.00	1301.34
	-14.00	1301.21
	-12.00	1301.05
	-10.00	1300.88
	-8.00	1300.71
	-6.00	1300.58
	-4.00	1300.45
	-2.00	1300.32
	0	1300.32
	2.00	1300.35
	4.00	1300.43
	6.00	1300.55
	8.00	1300.74
	10.00	1300.93
	12.00	1301.12
	14.00	1301.62
	16.00	1302.16
	18.00	1302.70
	20.00	1303.25
	22.00	1303.79
	24.00	1304.64

ELEVATIONS	-24.00	1303.19
OFFSET	-22.00	1302.32
	-20.00	1301.72
	-18.00	1301.20
	-16.00	1300.68
	-14.00	1300.16
	-12.00	1299.80
	-10.00	1299.52
	-8.00	1299.44
	-6.00	1299.43
	-4.00	1299.44
	-2.00	1299.46
	0	1299.51
	2.00	1299.57
	4.00	1299.63
	6.00	1299.67
	8.00	1299.98
	10.00	1300.58
	12.00	1301.05
	14.00	1301.63
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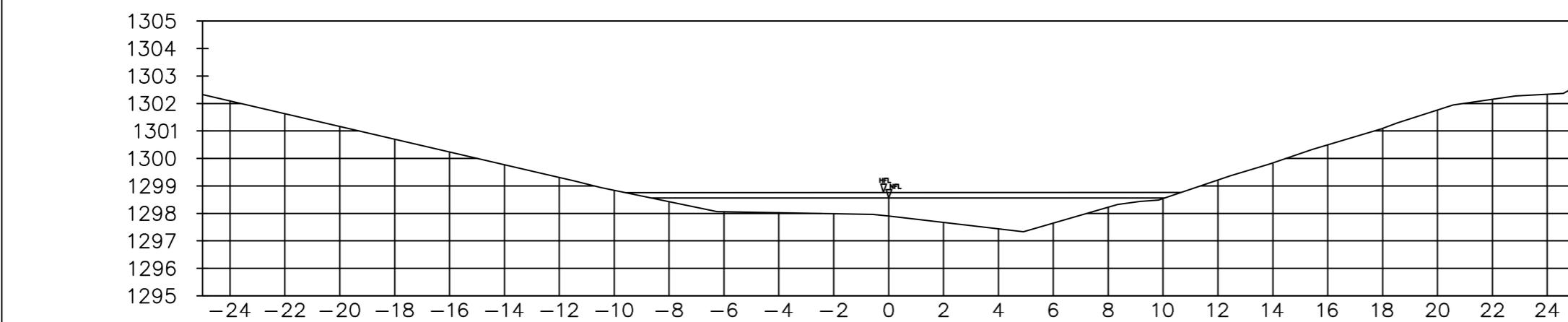
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BRIDGE SURVEY
SURVEY CAMP
2076

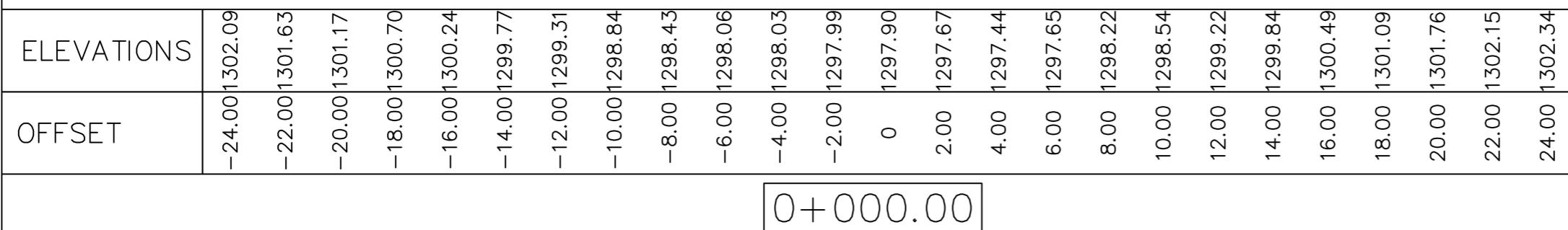


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X-SECTION
SHEET NO:5



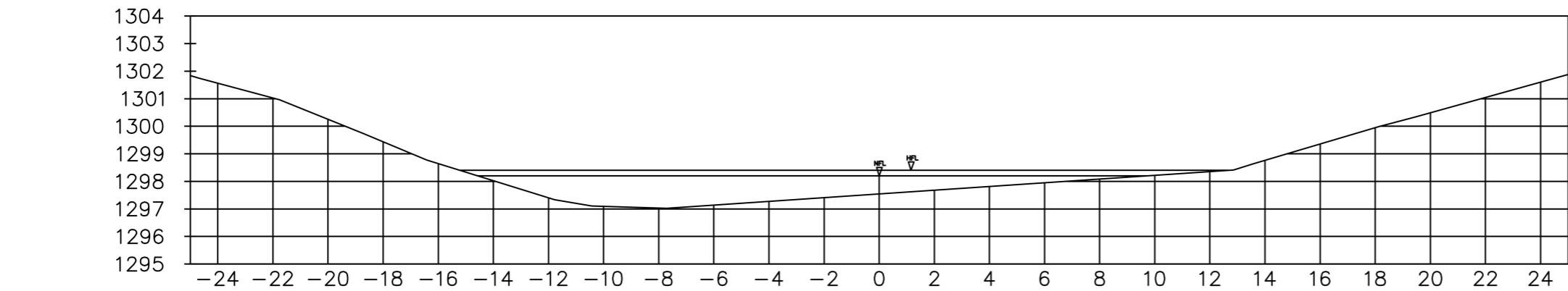
SCALE
H: 1:200
V: 1:200



0+000.00

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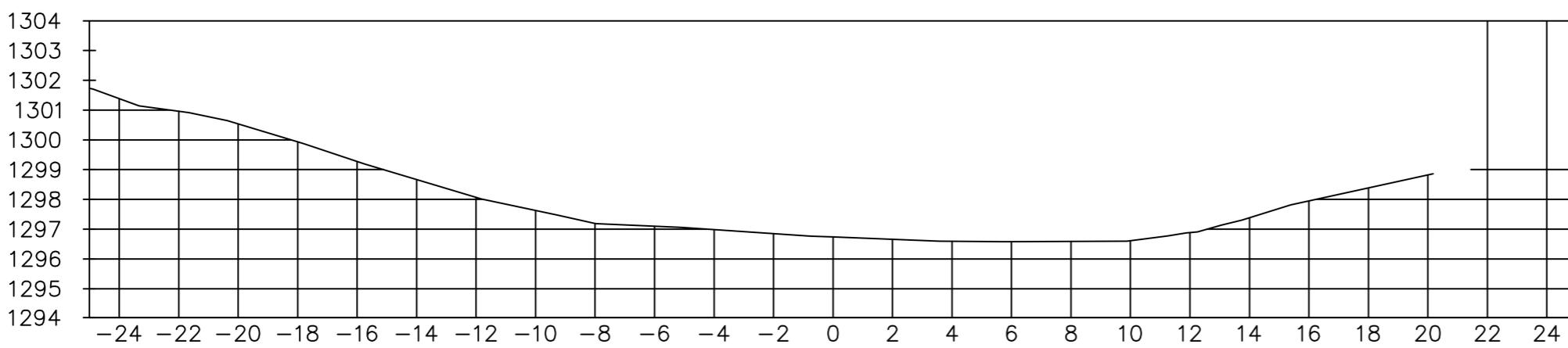


BRIDGE SURVEY
SURVEY CAMP
2076

ELEVATIONS	1301.56
OFFSET	-24.00
	-22.00
	-20.00
	-18.00
	-16.00
	-14.00
	-12.00
	-10.00
	-8.00
	-6.00
	-4.00
	-2.00
	0
	2.00
	4.00
	6.00
	8.00
	10.00
	12.00
	14.00
	16.00
	18.00
	20.00
	22.00
	24.00

0+025.00

X-SECTION
SHEET NO:6



SCALE
H: 1:200
V: 1:200

ELEVATIONS	1301.39
OFFSET	-24.00
	-22.00
	-20.00
	-18.00
	-16.00
	-14.00
	-12.00
	-10.00
	-8.00
	-6.00
	-4.00
	-2.00
	0
	2.00
	4.00
	6.00
	8.00
	10.00
	12.00
	14.00
	16.00
	18.00
	20.00
	22.00
	24.00

0+050.00

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Road Alignment

Cross Section Levelling Correction

Turning Point	Station/Chainage	BS	FS	Rise	Fall	Elevation	Correction	Corrected Elevation
	TBM2	1.852				1309.768	0.000	1309.768
TP1		1.492	1.741	0.111		1309.879	0.008	1309.887
TP2		1.120	0.944	0.548		1310.427	0.016	1310.443
TP3		0.779	2.877		1.757	1308.670	0.025	1308.695
TP4		0.630	2.712		1.933	1306.737	0.033	1306.770
	A		2.542		1.912	1304.825	0.041	1304.866
Σ		5.873	10.816	0.659	5.602			

Arithmetic Check:

$\sum \text{BS} - \sum \text{FS} = -4.943$
$\sum \text{Rise} - \sum \text{Fall} = -4.943$

RL of BS A = 1304.866
Discrepancy = 0.041

Turning Point	Station/Chainage	BS	FS	Rise	Fall	Elevation	Correction	Corrected Elevation
	B	2.048				1304.371	0.000	1304.371
TP5		2.102	0.678	1.370		1305.741	0.000	1305.741
TP6		2.400	0.818	1.284		1307.025	0.001	1307.026
TP7		2.498	1.095	1.305		1308.330	0.001	1308.331
TP8		1.676	1.093	1.405		1309.735	0.002	1309.737
TP9		1.145	1.734		0.058	1309.677	0.002	1309.679
TP10		1.874	1.592		0.447	1309.230	0.002	1309.232
TP11		2.030	0.695	1.179		1310.409	0.003	1310.412
TP12		2.299	0.750	1.280		1311.689	0.003	1311.692
TP13		0.654	1.210	1.089		1312.778	0.004	1312.782
TP14		1.452	2.472		1.818	1310.960	0.004	1310.964
TP15		0.613	2.853		1.401	1309.559	0.004	1309.563
TP16		1.742	2.142		1.529	1308.030	0.005	1308.035
	TBM	0.638	1.179	0.563		1308.593	0.005	1308.598
TP17		1.542	2.775		2.137	1306.456	0.006	1306.462
TP18		0.865	2.145		0.603	1305.853	0.006	1305.859
TP19		0.650	2.175		1.310	1304.543	0.006	1304.549
TP20		0.770	2.786		2.136	1302.407	0.007	1302.414
TP21		0.849	2.419		1.649	1300.758	0.007	1300.765
TP22		0.614	2.691		1.842	1298.916	0.008	1298.924

Cross Section Levelling Correction

Turning Point	Station/Chainage	BS	FS	Rise	Fall	Elevation	Correction	Corrected Elevation
TP23		0.721	2.116		1.502	1297.414	0.008	1297.422
TP24		0.613	2.882		2.161	1295.253	0.008	1295.261
TP25		1.454	2.975		2.362	1292.891	0.009	1292.900
TP26		1.074	0.596	0.858		1293.749	0.009	1293.758
TP27		0.652	2.619		1.545	1292.204	0.010	1292.214
TP28		2.370	2.149		1.497	1290.707	0.010	1290.717
TP29		2.784	0.659	1.711		1292.418	0.011	1292.429
	IP13	1.021	1.313	1.471		1293.889	0.011	1293.900
TP30		0.825	2.587		1.566	1292.323	0.011	1292.334
TP31		1.032	2.482		1.657	1290.666	0.012	1290.678
TP32		0.808	1.671		0.639	1290.027	0.012	1290.039
TP33		2.691	0.874		0.066	1289.961	0.013	1289.974
TP34		2.225	0.694	1.997		1291.958	0.013	1291.971
TP35		2.761	0.754	1.471		1293.429	0.013	1293.442
TP36		2.216	0.640	2.121		1295.550	0.014	1295.564
TP37		2.783	0.718	1.498		1297.048	0.014	1297.062
TP38		2.540	0.672	2.111		1299.159	0.015	1299.174
TP39		2.363	0.762	1.778		1300.937	0.015	1300.952
TP40		2.763	0.623	1.740		1302.677	0.015	1302.692
TP41		1.134	0.639	2.124		1304.801	0.016	1304.817
TP42		0.801	0.619	0.515		1305.316	0.016	1305.332
TP43		0.681	1.385		0.584	1304.732	0.017	1304.749
TP44		1.786	1.145		0.464	1304.268	0.017	1304.285
TP45		1.256	0.981	0.805		1305.073	0.017	1305.090
TP46		1.328	1.110	0.146		1305.219	0.018	1305.237
TP47		1.166	1.047	0.281		1305.500	0.018	1305.518
TP48		0.752	1.498		0.332	1305.168	0.019	1305.187
	B		1.568		0.816	1304.352	0.019	1304.371
Σ		71.061	71.080	30.102	30.121			

Arithmetic Check:

$\sum \text{BS} - \sum \text{FS} = -0.019$
$\sum \text{Rise} - \sum \text{Fall} = -0.019$

Discrepancy = 0.019
Loop Perimeter = 249.492 m
Required Precision = 0.012

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
BM2				1.852			1311.620	1309.768
IP0		0+000			1.527			1310.093
	5				1.135			1310.485
	10				0.941			1310.679
		5			1.692			1309.928
		10			2.100			1309.520
		0+015			1.814			1309.806
	2				1.601			1310.019
	5				0.840			1310.780
	10				0.164			1311.456
		5			1.776			1309.844
		10			2.180			1309.440
		0+030			1.755			1309.865
	5				1.664			1309.956
	10				1.216			1310.404
		5			1.769			1309.851
		10			1.861			1309.759
TP1				1.492		1.741	1311.379	1309.887
BPC1		0+041.2			1.587			1309.792
	5				1.121			1310.258
	10				0.746			1310.633
		5			1.606			1309.773
		10			1.624			1309.755
MPC1		0+062.1			0.906			1310.473
	5				0.567			1310.812
	10				0.242			1311.137
		5			1.125			1310.254
		10			1.161			1310.218
TP2				1.120		0.944	1311.563	1310.443
EBC1		0+083			1.251			1310.312
	5				1.165			1310.398
	10				0.979			1310.584
		5			1.242			1310.321
		10			1.426			1310.137
		0+090			1.125			1310.438
	5				1.100			1310.463
	10				1.027			1310.536

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
			5		1.311			1310.252
			10		1.424			1310.139
BPC2		0+102.3			2.605			1308.958
	5				2.453			1309.110
	10				2.557			1309.006
			5		2.845			1308.718
			10		2.910			1308.653
TP3				0.779		2.877	1309.474	1308.695
MPC2		0+123.2			1.212			1308.262
	5				1.175			1308.299
	10				1.076			1308.398
			5		1.365			1308.109
			10		1.602			1307.872
TP4				0.630		2.712	1307.400	1306.770
EPC2		0+144.2			0.639			1306.761
	5				0.648			1306.752
	7				0.375			1307.025
	10				0.190			1307.210
			5		0.755			1306.645
			10		0.730			1306.670
A		0+161.8			2.542			1304.866
	5				2.916			1304.484
	10				3.435			1303.965
			5		2.593			1304.807
			10		2.547			1304.853
B		0+224		2.048			1306.419	1304.371
	5				1.703			1304.716
	10				1.541			1304.878
			5		2.295			1304.124
			10		2.536			1303.883
BS		0+227.2			1.048			1305.371
			5		1.415			1305.004
			10		1.579			1304.840
	5				1.029			1305.390
	10				0.786			1305.633
TP5				2.102		0.678	1307.843	1305.741

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
BC3		0+236.6			1.102			1306.741
			5		1.306			1306.537
			10		1.754			1306.089
	5				1.005			1306.838
	10				1.032			1306.811
TP6				2.400		0.818	1309.426	1307.026
MC3		0+248			0.995			1308.431
	5				0.509			1308.917
	10				0.101			1309.325
			5		1.713			1307.713
			10		2.321			1307.105
TP7				2.498		1.095	1310.829	1308.331
EC3		0+256.9			1.473			1309.356
	5				0.552			1310.277
	8				0.160			1310.669
			5		2.257			1308.572
			10		2.771			1308.058
		0+270			1.093			1309.736
			5		1.950			1308.879
			10		3.116			1307.713
	3				0.549			1310.280
	5				0.005			1310.824
TP8				1.676		1.093	1311.413	1309.737
		0+285			1.520			1309.893
	5				1.215			1310.198
	7.5				1.150			1310.263
			5		2.502			1308.911
			8		3.063			1308.350
TP9				1.145		1.734	1310.824	1309.679
		0+300			1.477			1309.347
			5		1.225			1309.599
			8		2.765			1308.059
	4				1.020			1309.804
	6				0.711			1310.113
	8				0.255			1310.569
TP10				1.874		1.592	1311.106	1309.232
		0+315			1.357			1309.749

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
			5		2.757			1308.349
			8		3.123			1307.983
	2.5				0.874			1310.232
	3				0.760			1310.346
BC4		0+316.1			1.320			1309.786
			5		2.784			1308.322
			10		3.100			1308.006
TP11				2.030		0.695	1312.442	1310.412
MC4		0+334.5			1.809			1310.633
			4		3.124			1309.318
			8		4.302			1308.140
	3				1.673			1310.769
	6				1.302			1311.140
EC4		0+352.9			0.840			1311.602
	4				0.442			1312.000
			1		0.864			1311.578
			1.2		1.111			1311.331
	1.2				0.846			1311.596
	1.4				0.512			1311.930
			3		1.227			1311.215
			4		2.654			1309.788
			8		3.469			1308.973
		0+360			0.750			1311.692
			1		0.697			1311.745
			1.3		1.060			1311.382
			2.5		1.190			1311.252
	0.7				0.447			1311.995
	1.2				0.282			1312.160
			3.5		2.347			1310.095
			7		2.681			1309.761
TP12				2.299		0.750	1313.991	1311.692
		0+375			1.275			1312.716
	5				0.982			1313.009
	8				0.880			1313.111
	9				0.140			1313.851
			2		1.356			1312.635
			2.8		1.935			1312.056

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
			5.5		1.901			1312.090
			5.7		2.370			1311.621
			9		2.641			1311.350
BC5		0+377.0			1.329			1312.662
	3.5				1.130			1312.861
	7				0.542			1313.449
			1		1.552			1312.439
			2.2		1.878			1312.113
			5		1.883			1312.108
			5.5		2.480			1311.511
			9		2.810			1311.181
TP13				0.654		1.210	1313.436	1312.782
MC5		0+395.1			1.558			1311.878
			1.6		1.423			1312.013
			2.2		1.130			1312.306
			3		1.339			1312.097
			4		2.212			1311.224
	5				1.356			1312.080
			5		1.948			1311.488
	7				1.028			1312.408
	7.4				0.479			1312.957
	8				0.155			1313.281
TP14				1.452		2.472	1312.416	1310.964
EC5		0+413.1			1.987			1310.429
	1				1.651			1310.765
	1.6				0.844			1311.572
	4				0.860			1311.556
	4.4				0.314			1312.102
	5				0.203			1312.213
			5		2.157			1310.259
			8		1.872			1310.544
	10				0.013			1312.403
		0+420			2.267			1310.149
			5		2.422			1309.994
			9		2.189			1310.227
			10		2.901			1309.515
	2.3				2.229			1310.187

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
	3.2				1.407			1311.009
	4				1.230			1311.186
	4.8				0.607			1311.809
	7				0.615			1311.801
	10				0.607			1311.809
		0+435			3.285			1309.131
			0.8		3.119			1309.297
			1.5		3.869			1308.547
			6		4.021			1308.395
			8		3.963			1308.453
	2				3.143			1309.273
	2.7				2.432			1309.984
	5				2.406			1310.010
	10				2.161			1310.255
TP15				0.613		2.853	1310.176	1309.563
BC6		0+448.9			1.530			1308.646
			5		1.742			1308.434
			8		1.693			1308.483
			8.5		2.172			1308.004
			9.5		2.114			1308.062
			10		2.920			1307.256
	5				1.355			1308.821
	7.8				1.277			1308.899
	8.3				0.429			1309.747
MC6		0+459.5			1.783			1308.393
	3				1.604			1308.572
	8				1.335			1308.841
	10				1.185			1308.991
			4.3		1.712			1308.464
			5.5		2.068			1308.108
			7.1		2.052			1308.124
			8.5		2.754			1307.422
EC6		0+470			2.062			1308.114
			1.5		2.118			1308.058
			2		2.495			1307.681
			3		3.172			1307.004
			7		3.135			1307.041

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
			7.5		4.020			1306.156
			9.5		4.022			1306.154
			10		4.692			1305.484
	5				2.018			1308.158
	10				1.473			1308.703
TP16				1.742		2.142	1309.777	1308.035
TBM				0.638		1.179	1309.236	1308.598
		0+480			2.163			1307.073
	5				1.729			1307.507
	10				1.331			1307.905
	1				1.548			1307.688
	0.5				2.048			1307.188
		5			2.692			1306.544
		10			3.683			1305.553
BC7		0+487.4			2.534			1306.702
		5			3.284			1305.952
		10			4.256			1304.980
	5				1.662			1307.574
	10				1.435			1307.801
MC7		0+500.5			2.732			1306.504
		5			3.322			1305.914
		10			4.263			1304.973
	5				2.320			1306.916
	10				1.622			1307.614
TP17				1.542		2.775	1308.004	1306.462
EC7		0+513.7			2.052			1305.952
		5			2.845			1305.159
		10			4.102			1303.902
	5				1.472			1306.532
	10				0.735			1307.269
TP18				0.865		2.145	1306.724	1305.859
BC8		0+525.2			2.150			1304.574
	1				1.476			1305.248
	3				1.103			1305.621
	5				0.253			1306.471
		1			2.340			1304.384
		4			2.474			1304.250

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
			4.6		3.222			1303.502
			8		3.312			1303.412
			8.7		4.114			1302.610
			10		4.184			1302.540
TP19				0.650		2.175	1305.199	1304.549
MC8		0+539.0			2.283			1302.916
			6		2.334			1302.865
			6.6		2.488			1302.711
			7.1		3.229			1301.970
			10		3.210			1301.989
	4				2.171			1303.028
	4.7				1.294			1303.905
	7.6				1.222			1303.977
	8.5				0.799			1304.400
	10				0.192			1305.007
TP20				0.770		2.786	1303.184	1302.414
EC8		0+552.7			1.399			1301.785
			5		1.412			1301.772
			10		1.350			1301.834
	5				1.462			1301.722
	10				1.381			1301.803
		0+555			1.422			1301.762
			5		1.354			1301.830
			10		1.340			1301.844
	5				1.436			1301.748
	5.5				1.364			1301.820
	5.7				1.669			1301.515
	6.2				1.694			1301.490
	10				3.122			1300.062
		0+570			1.801			1301.383
	4				1.719			1301.465
	4.3				2.097			1301.087
	5				2.079			1301.105
	5.6				2.545			1300.639
	9				2.762			1300.422
	10				2.964			1300.220
			3		1.665			1301.519

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
			3.2		1.363			1301.821
			5		1.441			1301.743
			10		1.417			1301.767
TP21				0.849		2.419	1301.614	1300.765
BC9		0+580.1			1.432			1300.182
	5				1.667			1299.948
	9				1.645			1299.969
	10				2.382			1299.232
			5		1.531			1300.083
			10		1.384			1300.230
MC9		0+589.0			2.628			1298.986
			5		2.163			1299.451
			10		2.293			1299.321
	5				2.579			1299.035
	3.3				3.003			1298.611
	5				2.967			1298.647
	5.7				3.912			1297.702
	8				3.856			1297.758
	10				4.351			1297.263
TP22				0.614		2.691	1299.538	1298.924
EC9		0+598.0			1.476			1298.062
	5				2.691			1296.847
	10				4.769			1294.769
			3		0.621			1298.917
			6		0.120			1299.418
		0+600			1.412			1298.126
	1.3				1.407			1298.131
	2.1				2.124			1297.414
	2.6				2.195			1297.343
	3.5				2.702			1296.836
	5				2.703			1296.835
	5.5				3.303			1296.235
	10				4.636			1294.902
			0.4		1.415			1298.123
			0.9		0.735			1298.803
			3		0.711			1298.827
			3.5		0.046			1299.492

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
BC10		0+610.5			2.634			1296.904
	0.5				2.551			1296.987
	1.5				3.542			1295.996
	5				3.529			1296.009
	6				4.337			1295.201
	10				4.423			1295.115
		3.5			2.565			1296.973
		4.5			1.551			1297.987
		7			1.528			1298.010
		9			0.435			1299.103
		10			0.420			1299.118
TP23				0.721		2.116	1298.143	1297.422
MC10		0+615.8			1.574			1296.569
	2.7				1.522			1296.621
	3				2.345			1295.798
	6.6				2.302			1295.841
	7				2.127			1296.016
	10				3.117			1295.026
		1			1.490			1296.653
		1.5			0.683			1297.460
		4.5			0.623			1297.520
EC10		0+621.2			2.929			1295.214
	1.5				2.843			1295.300
	1.7				3.217			1294.926
	4				3.236			1294.907
	4.5				3.826			1294.317
	6.5				3.823			1294.320
	7.5				4.713			1293.430
	10				4.824			1293.319
		1			2.859			1295.284
		1.8			2.517			1295.626
		3.5			2.433			1295.710
		4			2.187			1295.956
		6			2.055			1296.088
		7			1.484			1296.659
		10			1.353			1296.790
TP24				0.613		2.882	1295.874	1295.261

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
		0+630			3.015			1292.859
	0.7				3.017			1292.857
	1.1				3.709			1292.165
	7				3.649			1292.225
	7.4				4.231			1291.643
	10				4.243			1291.631
		4.2			2.997			1292.877
		4.5			2.634			1293.240
		8.5			2.627			1293.247
		8.9			2.206			1293.668
		10			2.197			1293.677
TP25				1.454		2.975	1294.354	1292.900
		0+645			2.226			1292.128
			1.5		2.290			1292.064
			2.1		1.790			1292.564
			4		1.787			1292.567
			4.5		0.722			1293.632
			8		0.698			1293.656
			10		0.321			1294.033
	4.5				2.027			1292.327
	5				3.247			1291.107
	9				3.423			1290.931
	10				4.210			1290.144
		0+660			0.370			1293.984
TP26				1.074		0.596	1294.832	1293.758
BC11		0+671.8			0.866			1293.966
MC11		0+681.8			1.998			1292.834
EC11		0+691.8			3.602			1291.230
TP27				0.652		2.619	1292.866	1292.214
Setback A		0+710.5			1.508			1291.358
	5				1.590			1291.276
	8				1.544			1291.322
	8.1				1.795			1291.071
	10				1.799			1291.067
		5			1.678			1291.188
		10			1.796			1291.070
Culvert A		0+716.8			2.160			1290.706

Levelling for L-Section and X-Section

Points	Left Offset	Centre Line Chainage	Right Offset	BS	IS	FS	HI	Reduced Level
	5				2.093			1290.773
	10				2.136			1290.730
		5			2.278			1290.588
		5.2			2.840			1290.026
		10			2.859			1290.007
TP28				2.370		2.149	1293.087	1290.717
Culvert B		0+722.8			2.159			1290.928
	5				2.063			1291.024
	10				2.154			1290.933
		5			2.201			1290.886
		5.5			3.031			1290.056
		10			3.232			1289.855
Setback B		0+728.8			3.020			1290.067
			5		3.130			1289.957
			10		3.290			1289.797
	5				3.010			1290.077
	10				3.210			1289.877
					1.994			1291.093
BC12		0+729.0			2.120			1290.967
			5		2.201			1290.886
			10		2.201			1290.886
	1.5				1.730			1291.357
	5				1.730			1291.357
	10				1.730			1291.357
MC12		0+733.7			0.762			1292.325
			5		1.760			1291.327
			10		2.102			1290.985
	5				0.793			1292.294
	10				0.812			1292.275
TP29				2.784		0.659	1295.213	1292.429
EC12		0+738.3			2.193			1293.020
IP13		0+767.2			1.313	1.313		1293.900

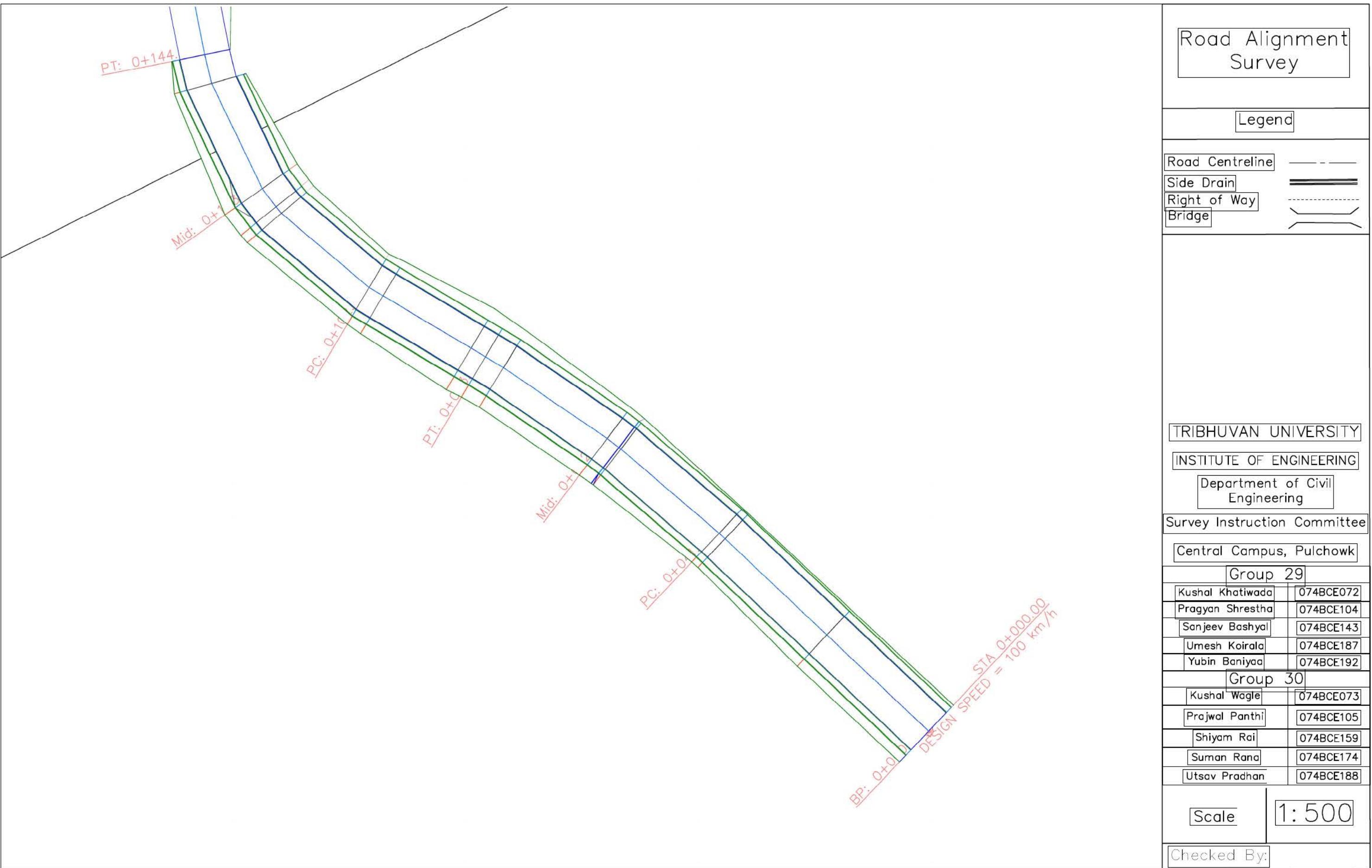
Cross Section by Stepping Method

Chainage	Left		Left Offset	RL	Right		Right Offset	RL
	Horizontal	Vertical			Horizontal	Vertical		
0+660	0.6	-0.460	0.6	1293.52	0.3	0.420	0.3	1294.404
	2.4	-0.001	3	1293.52	4.4	0.001	4.7	1294.405
	0.5	-1.071	3.5	1292.45	0.3	1.450	5	1295.855
	3.5	-0.002	7	1292.45	3	0.001	8	1295.856
	0.4	-1.231	7.4	1291.22	0.9	0.935	8.9	1296.791
1293.984	2.6	-0.002	10	1291.22	1.1	0.002	10	1296.793

Chainage	Left		Left Offset	RL	Right		Right Offset	RL
	Horizontal	Vertical			Horizontal	Vertical		
0+671.8	0.6	-1.130	0.6	1292.84	1.5	0.113	1.5	1294.079
	3	-0.086	3.6	1292.75	0.5	0.785	2	1294.864
	0.5	-0.613	4.1	1292.14	2.5	0.069	4.5	1294.933
	1	-0.064	5.1	1292.07	0.5	0.843	5	1295.776
	0.5	-0.962	5.6	1291.11	2.7	0.063	7.7	1295.839
1293.966	3.5	-0.048	9.1	1291.06	0.7	0.901	8.4	1296.740

Chainage	Left		Left Offset	RL	Right		Right Offset	RL
	Horizontal	Vertical			Horizontal	Vertical		
0+681.8	0.8	-0.456	0.8	1292.38	0.3	0.420	0.3	1293.254
	1.1	-0.034	1.9	1292.34	4.4	0.001	4.7	1293.255
	0.5	-0.321	2.4	1292.02	0.3	1.450	5	1294.705
	1.5	-0.066	3.9	1291.96	3	0.001	8	1294.706
	0.4	-0.679	4.3	1291.28	0.9	0.935	8.9	1295.641
1292.834	4	-0.030	8.3	1291.25	1.1	0.002	10	1295.643

Chainage	Left		Left Offset	RL	Right		Right Offset	RL
	Horizontal	Vertical			Horizontal	Vertical		
0+691.8	0.7	-0.467	0.7	1290.76	0.5	0.430	0.5	1291.660
	1.2	-0.040	1.9	1290.72	4.5	0.010	5	1291.670
	0.5	-0.321	2.4	1290.40	0.5	1.458	5.5	1293.128
	1.5	-0.066	3.9	1290.34	3	0.002	8.5	1293.130
	1	-0.679	4.9	1289.66	1	0.930	9.5	1294.060
1291.23	4.5	-0.372	9.4	1289.29	0.5	0.005	10	1294.065



Road Alignment Survey

Legend

Road Centreline	— — —
Side Drain	=====
Right of Way	-----
Bridge	== ==

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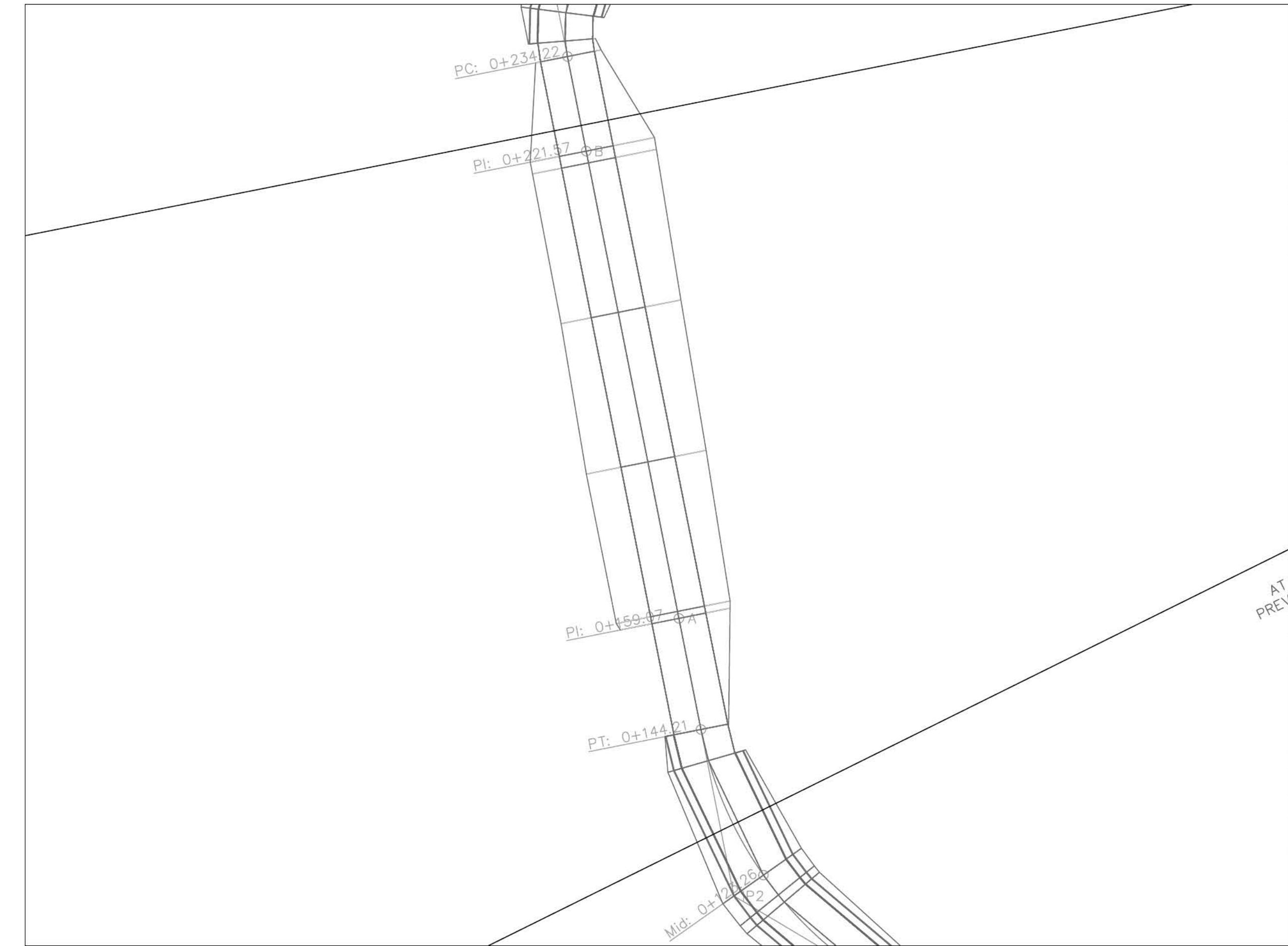
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Pragyan Shrestha	074BCE104
Sanjeev Bashyal	074BCE143
Umesh Koirala	074BCE187
Yubin Baniyaa	074BCE192

Group 30

Kushal Wagle	074BCE073
Prajwal Panti	074BCE105
Shiyam Rai	074BCE159
Suman Rana	074BCE174
Utsav Pradhan	074BCE188

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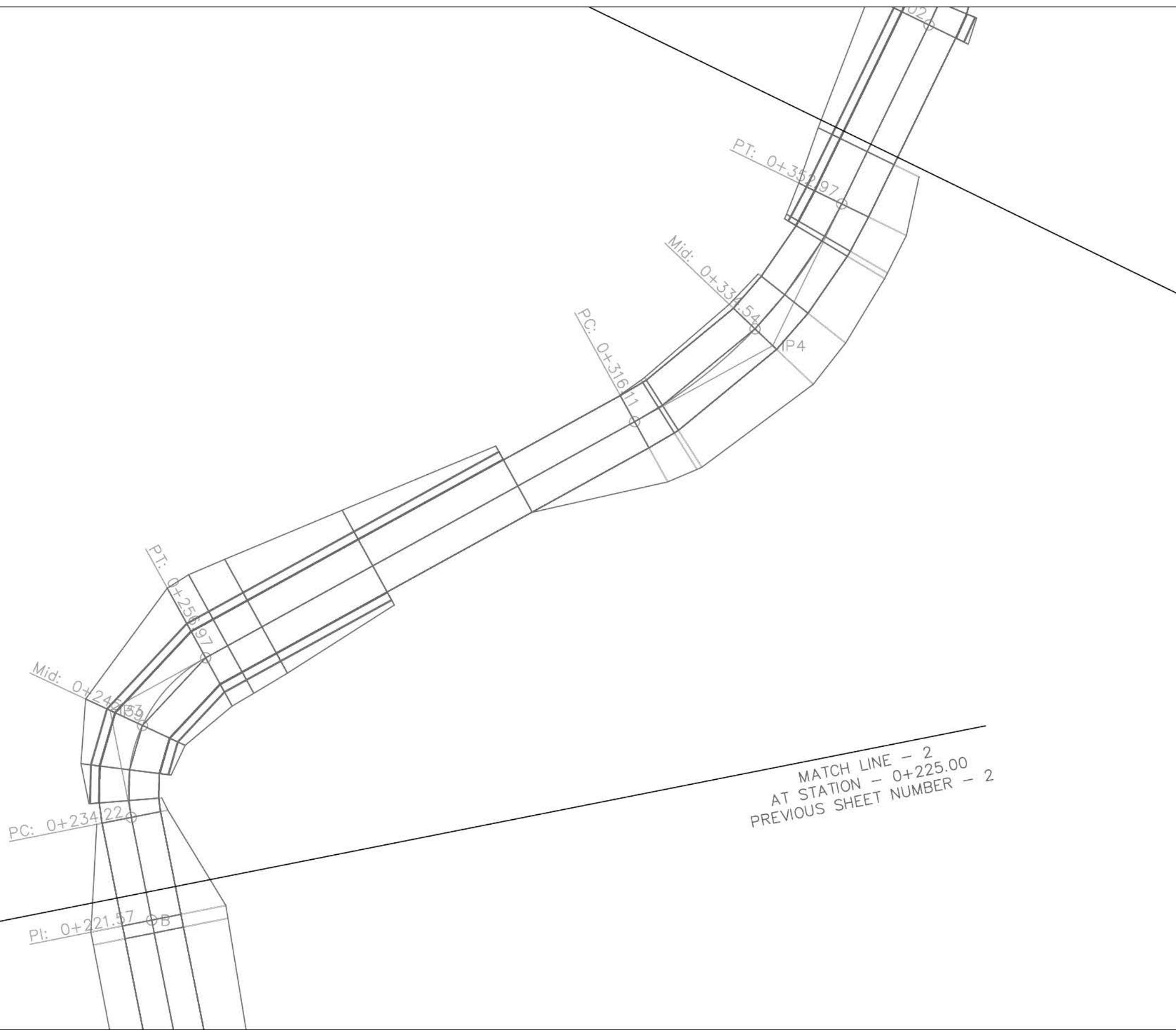
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Road Alignment
Survey

Legend

Road Centreline	— — —
Side Drain	=====
Right of Way	-----
Bridge	====



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Suman Rana	074BCE174
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Road Alignment Survey

Legend

Road Centreline	— — —
Side Drain	=====
Right of Way	-----
Bridge	== ==

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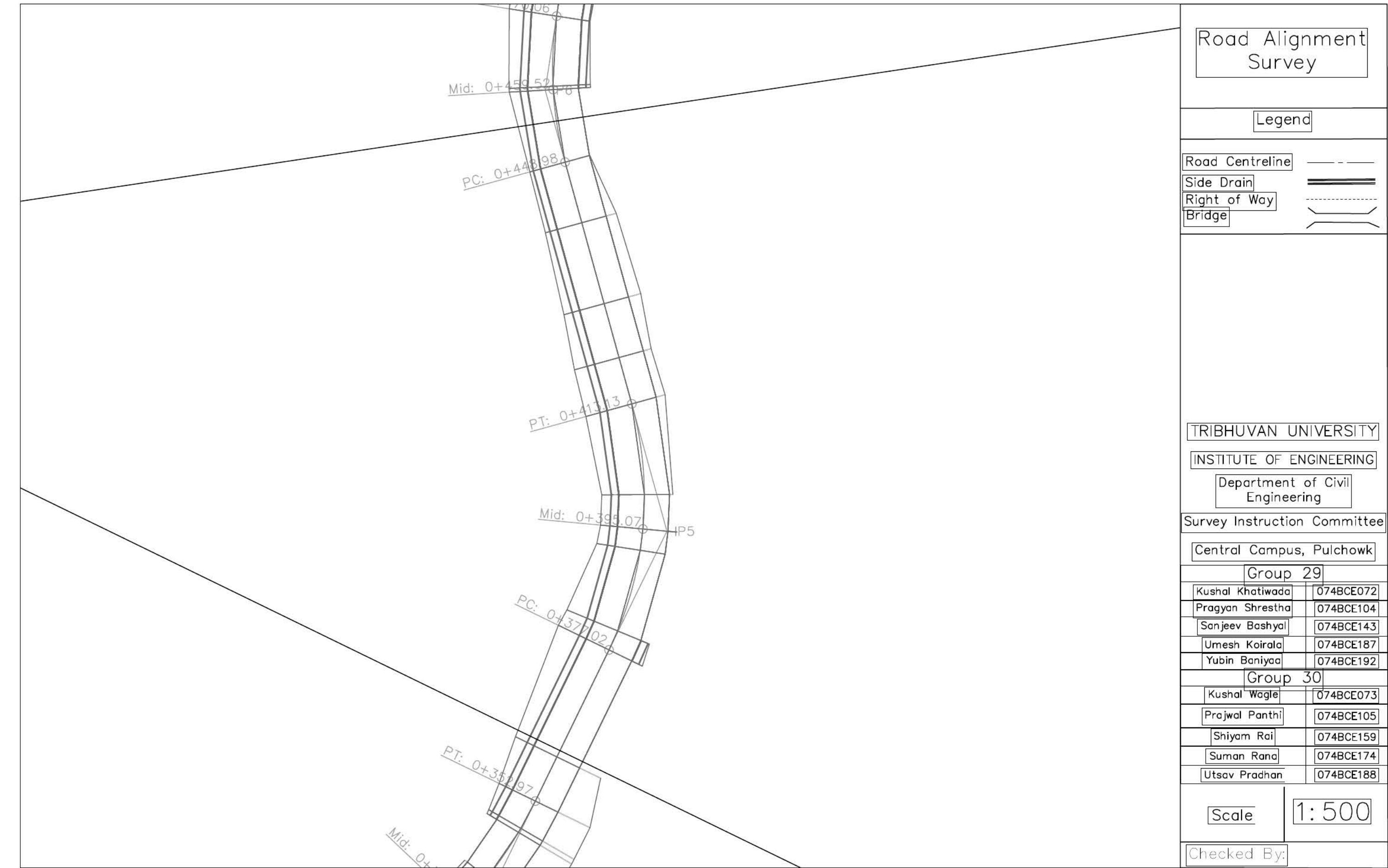
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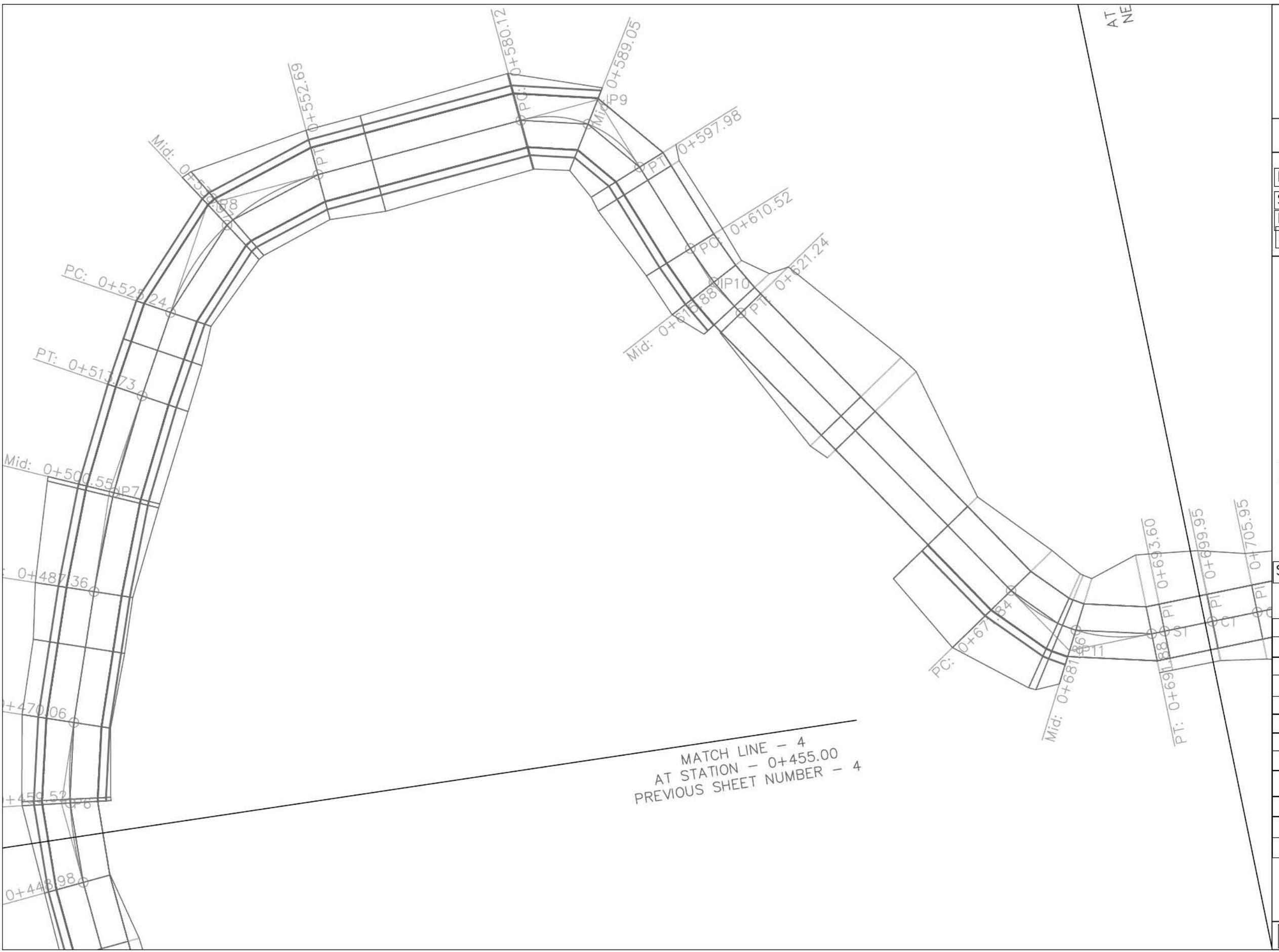
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Road Alignment Survey

Legend

Road Centreline	— — —
Side Drain	— — —
Right of Way	-----
Bridge	— — —



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Suman Rana	074BCE174
Utsav Pradhan	074BCE188

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Road Alignment Survey

Legend

Road Centreline	— — —
Side Drain	=====
Right of Way
Bridge	{} {} {}

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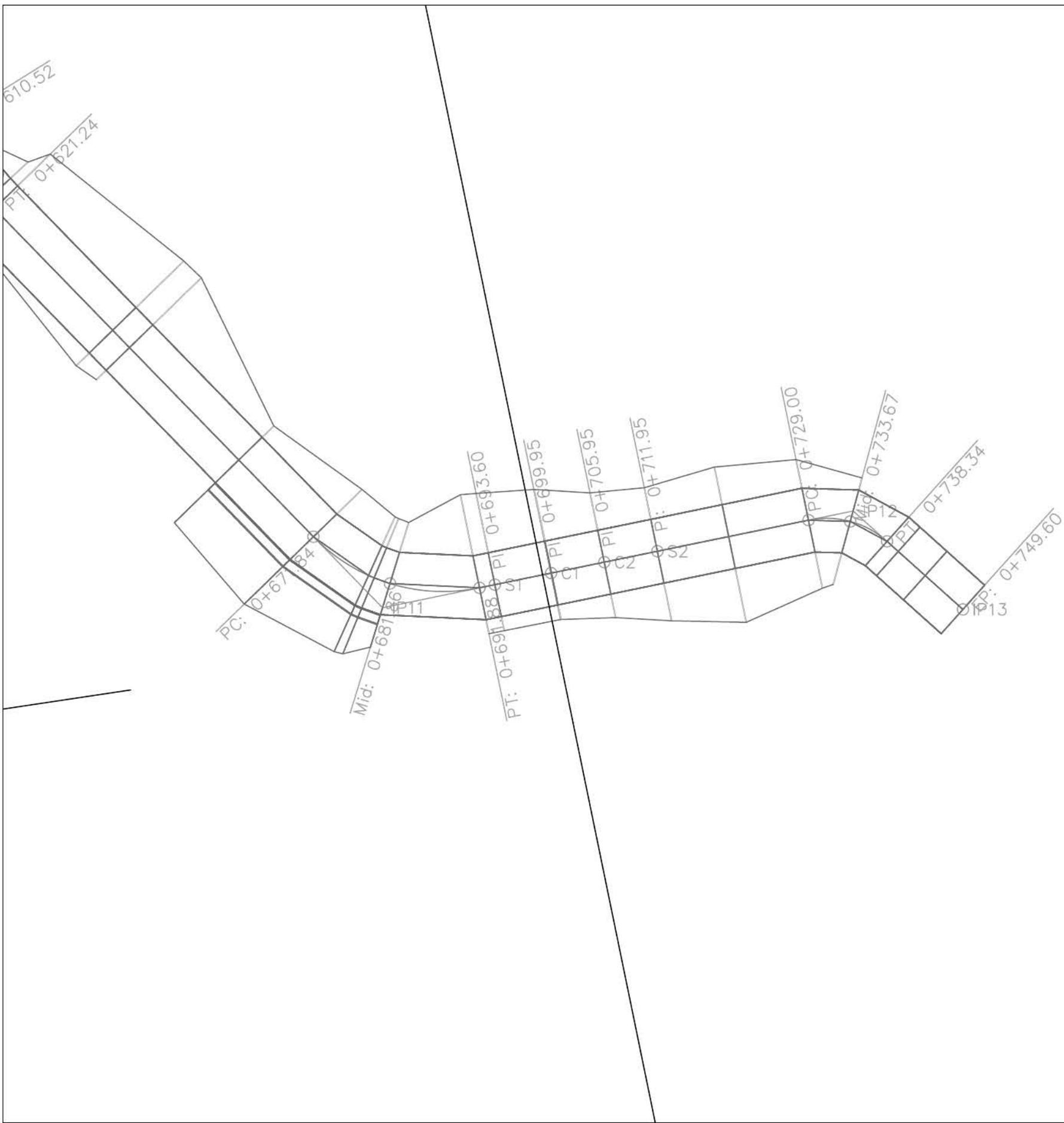
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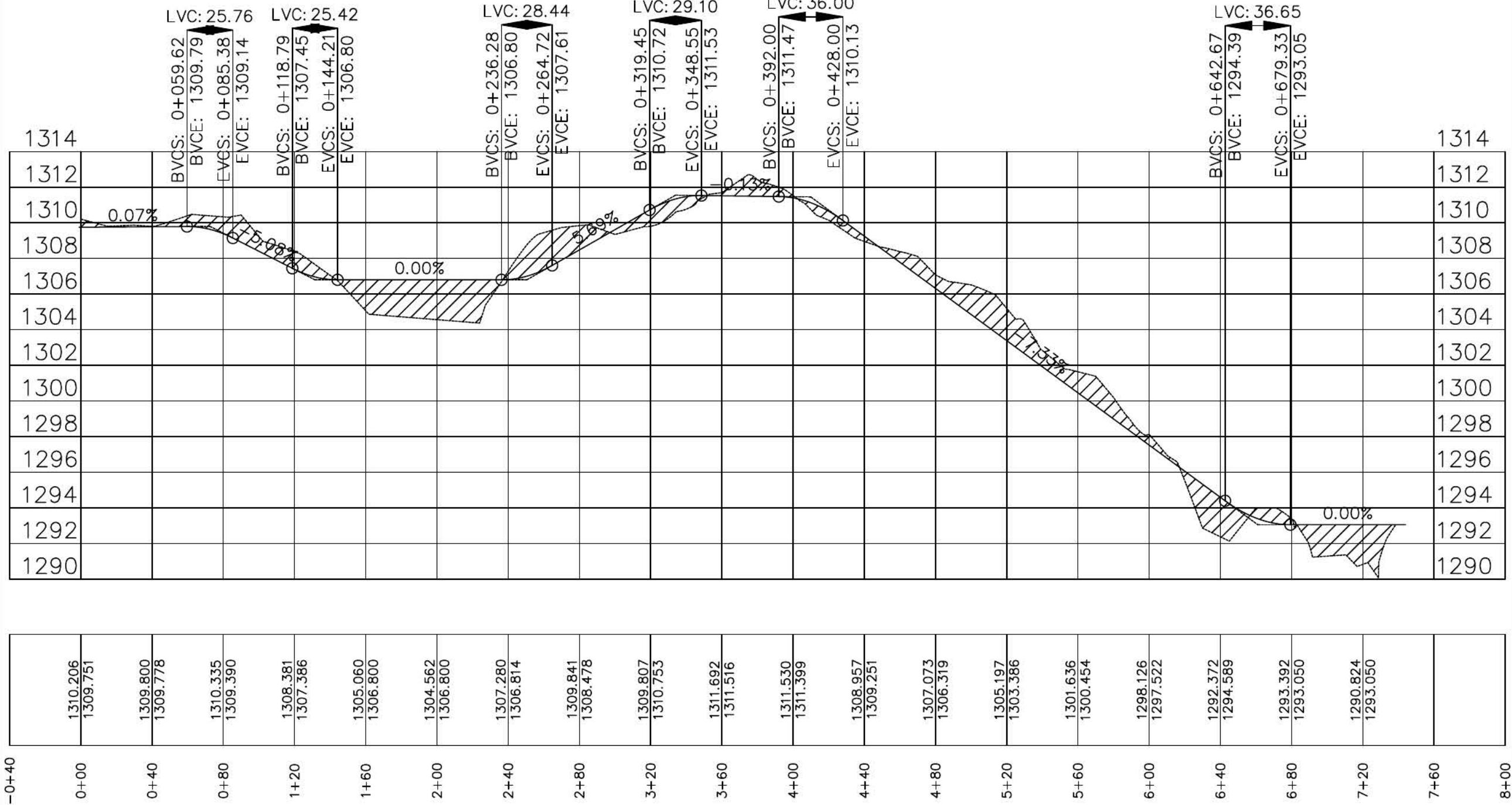
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Road Alignment
Survey

ROAD LONGITUDINAL SECTION



Legend

Road Centreline	— — —
Side Drain	— — —
Right of Way	— — —
Bridge	— — —
Full Forms	
BC	Beginning of Curve
MC	Middle of Curve
EC	End of Curve
AB	Alignment Beginning
AE	Alignment End
PVI	Point of Vertical Intersection
LVC	Length of Vertical Curve
BVC	Beginning of Vertical Curve
EVC	End of Vertical Curve

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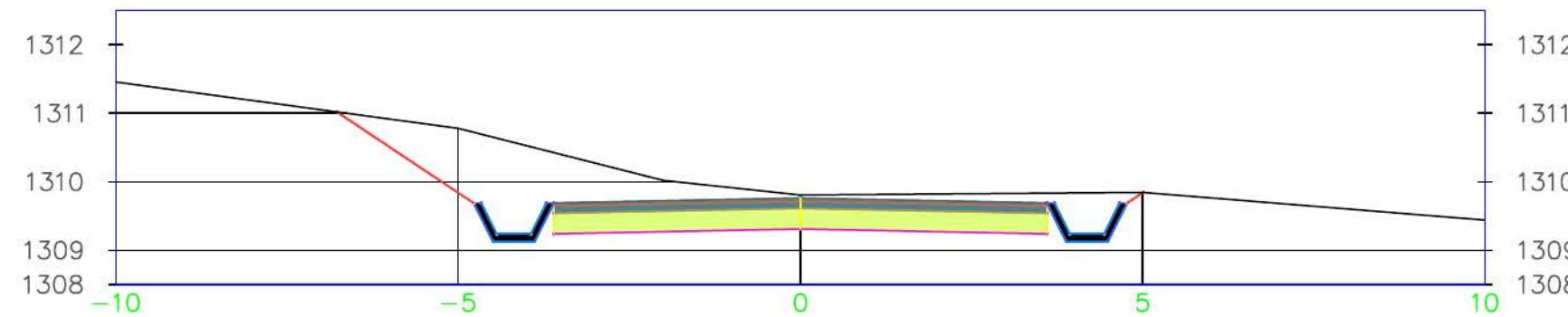
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Prajwal Panthi	074BCE105
Shiyam Rai	074BCE159
Suman Rana	074BCE174
Utsav Pradhan	074BCE188

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Checked By:

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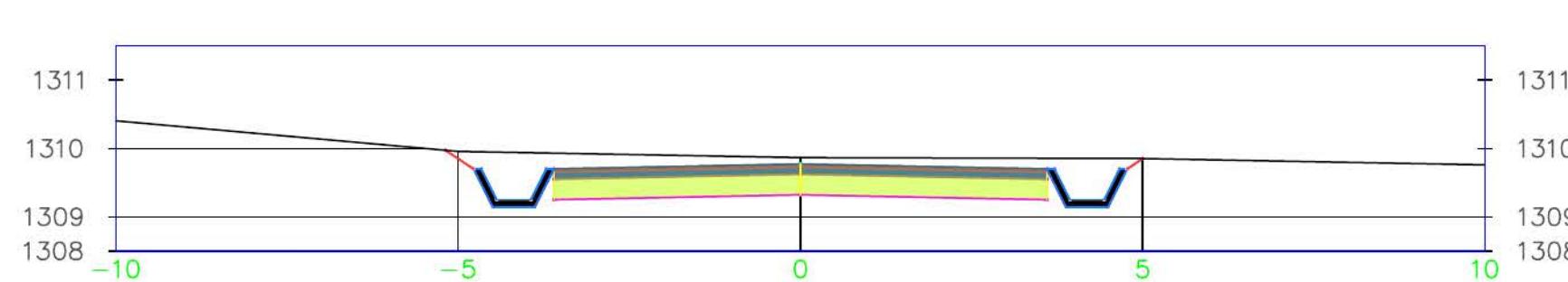
Elevation



Elevation

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Elevation



Elevation

Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

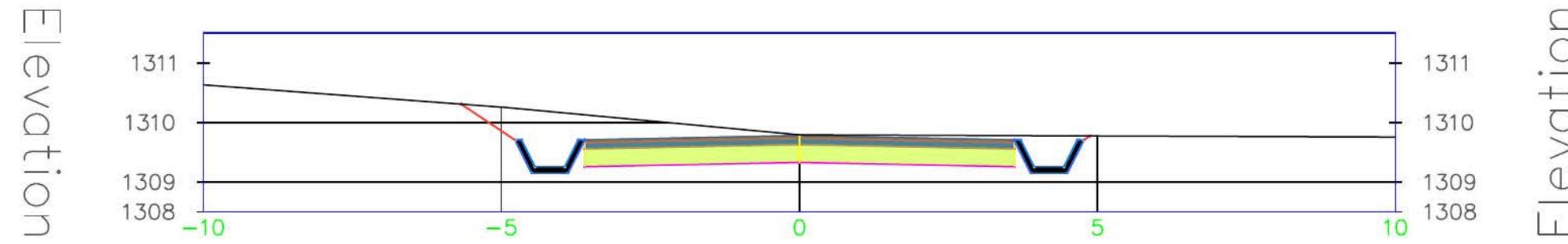
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Pragyan Shrestha	074BCE104	Prajwal Panthi	074BCE105
Sanjeev Bashyal	074BCE143	Shiyam Rai	074BCE159
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Yubin Baniyaa	074BCE192	Utsav Pradhan	074BCE188

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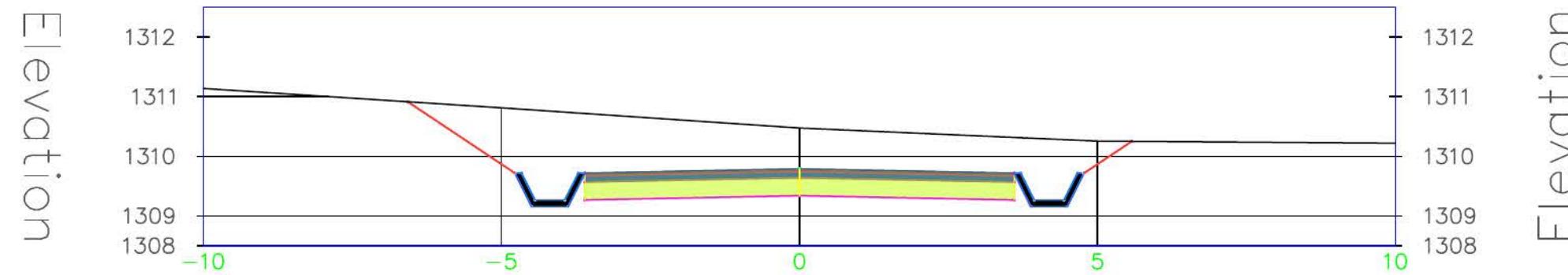
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Sheet Number

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Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

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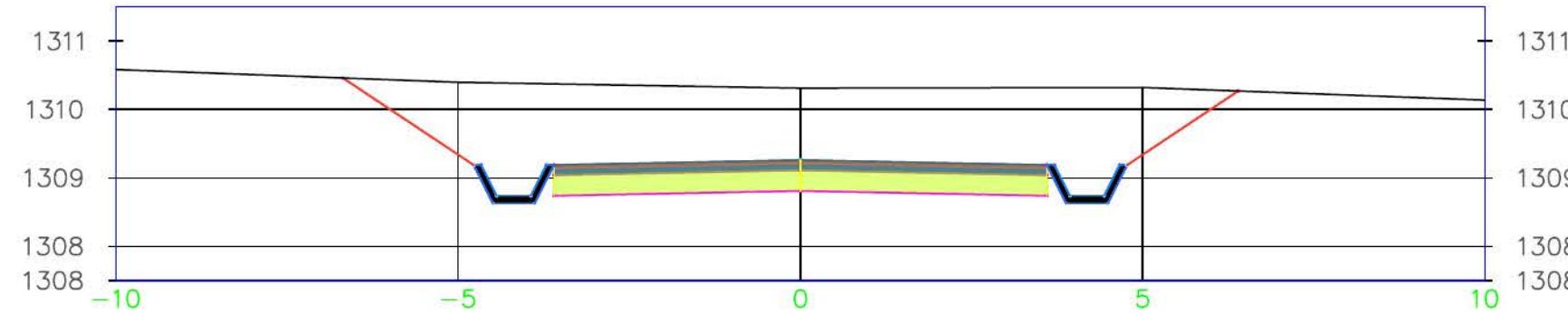
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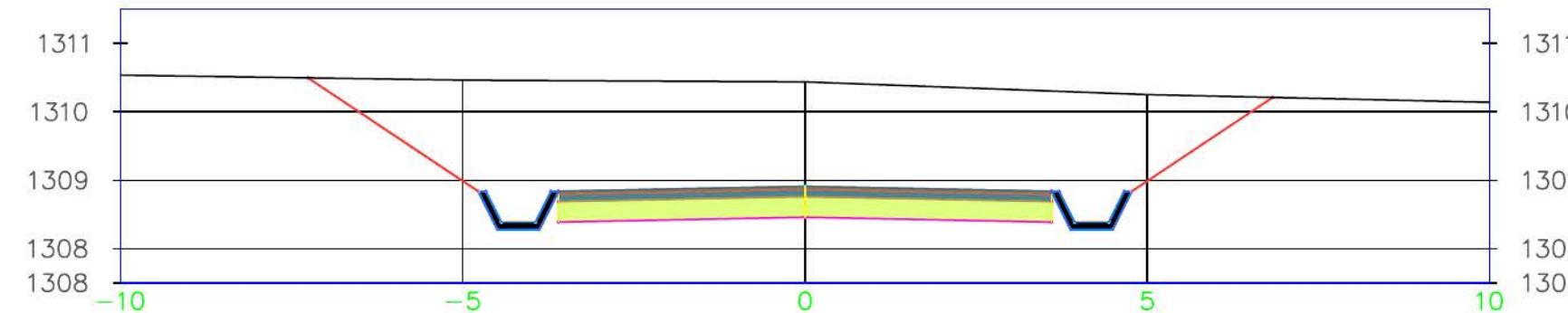
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Elevation



Elevation

Tribhuvan University
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Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

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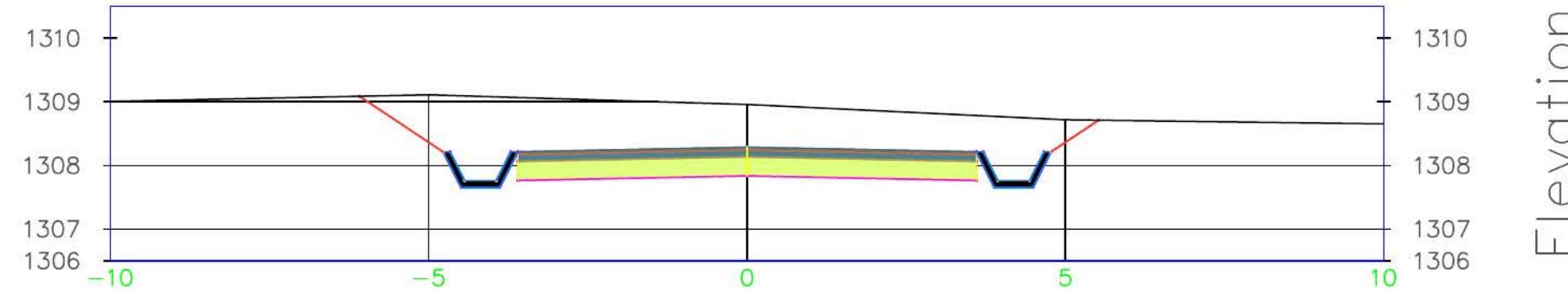
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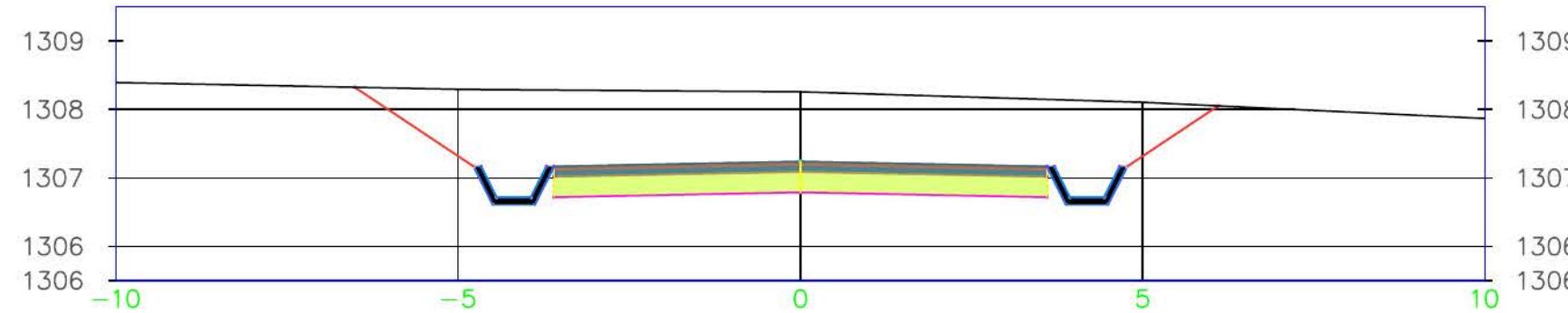


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Tribhuvan University Institute of Engineering Department of Civil Engineering Survey Instruction Committee Central Campus, Pulchowk	Survey Camp - 2076 Road Alignment Survey Cross-Section	Group 29		Group 30		Scale = 1:100 4 Sheet Number
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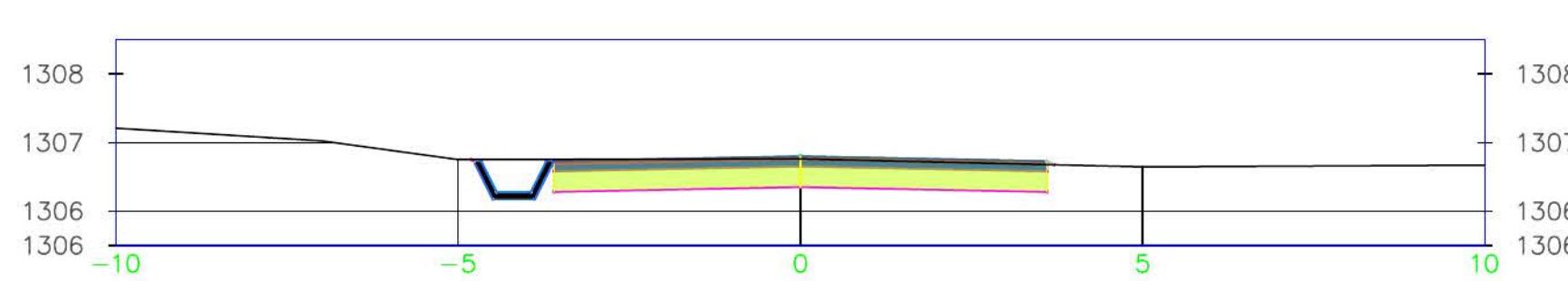
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Elevation

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Elevation

Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

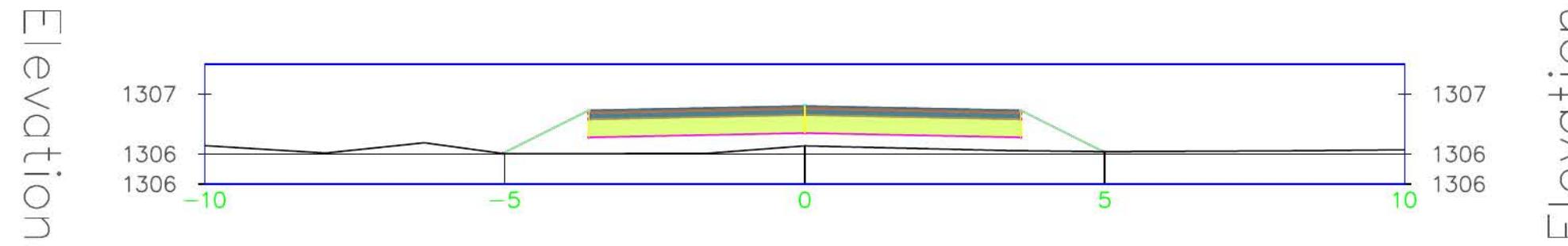
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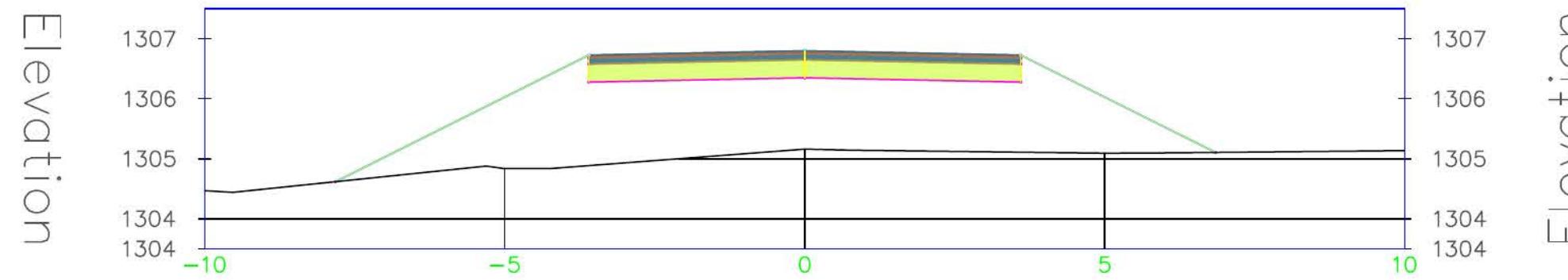
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Tribhuvan University
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Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

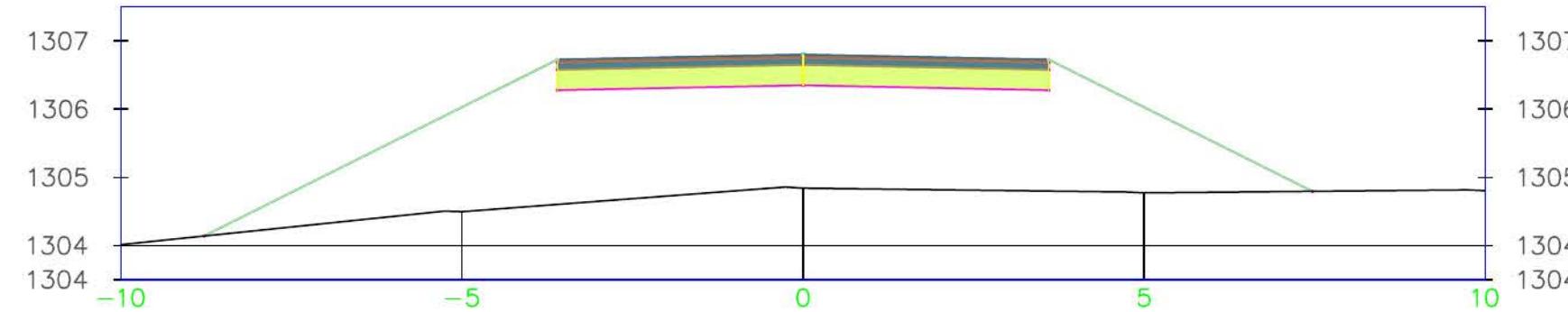
Survey Camp - 2076
Road Alignment Survey
Cross-Section

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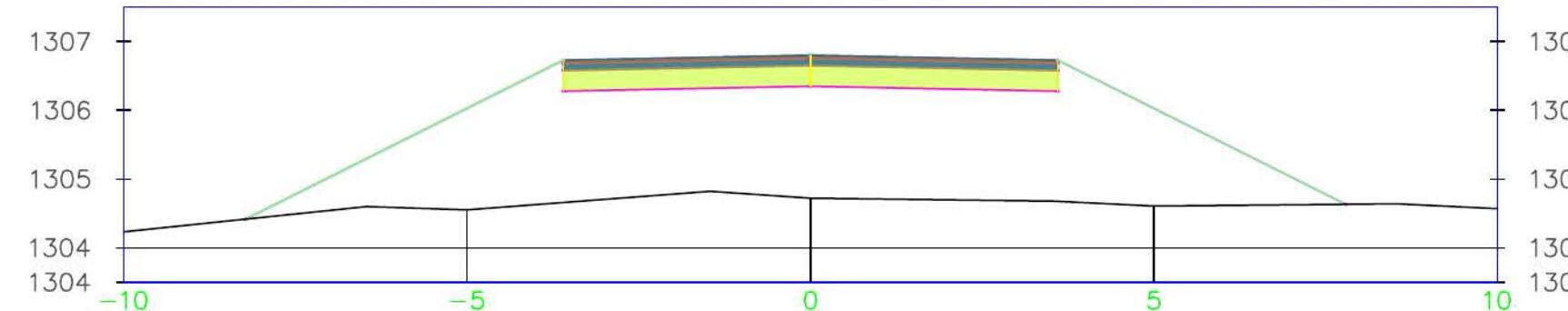
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Elevation

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Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

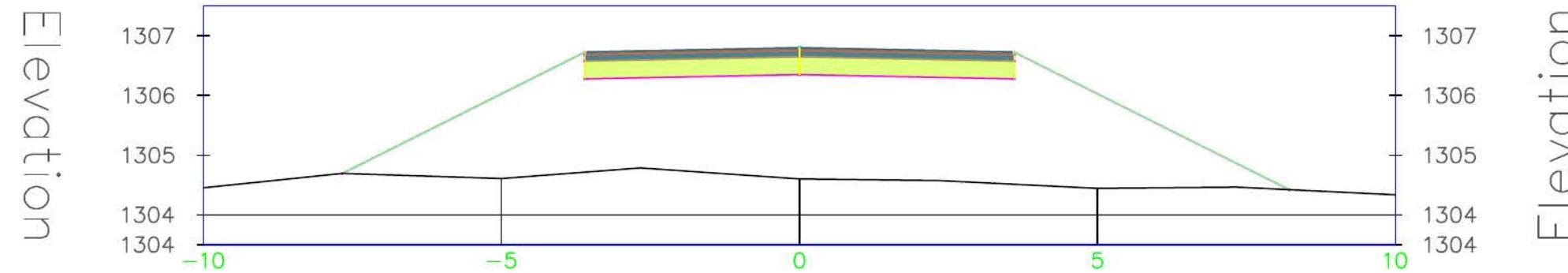
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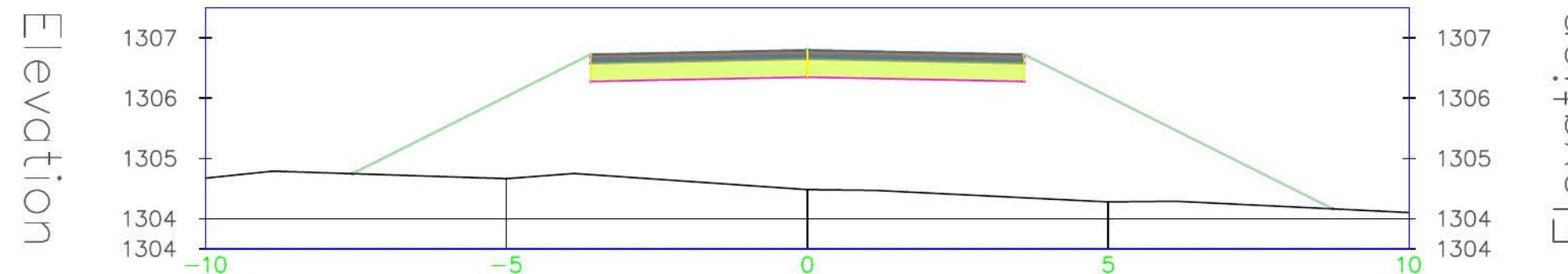
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Tribhuvan University
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Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

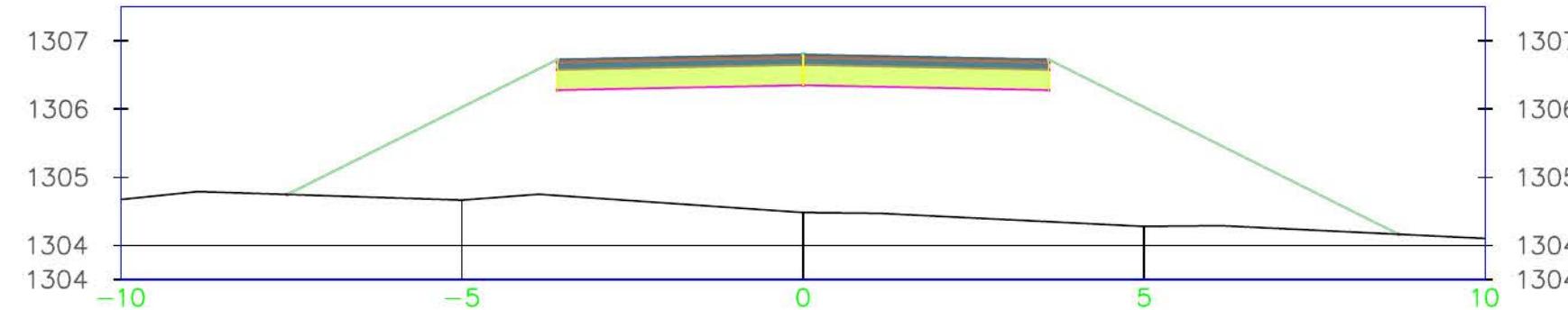
Survey Camp - 2076
Road Alignment Survey
Cross-Section

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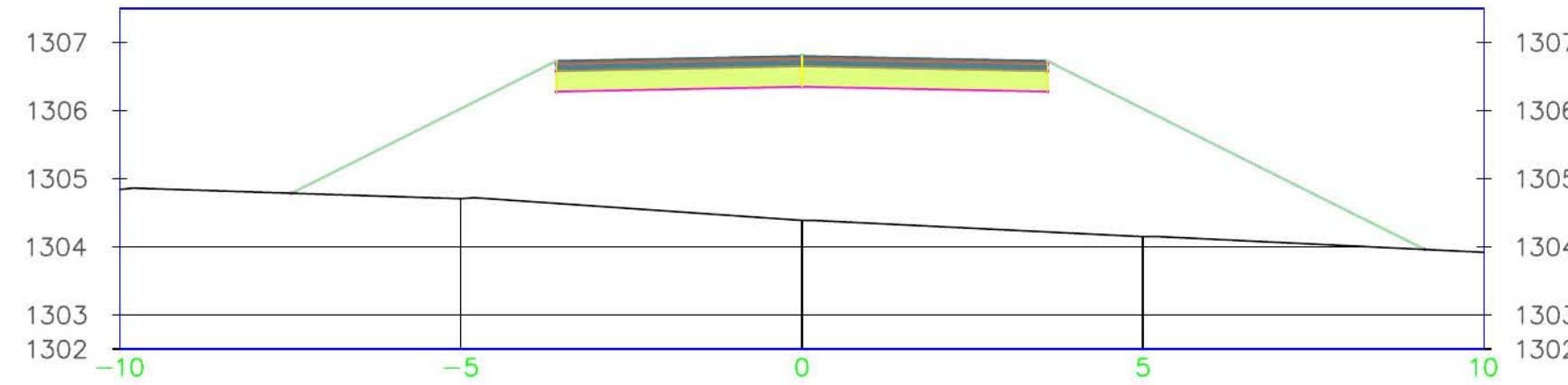
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Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

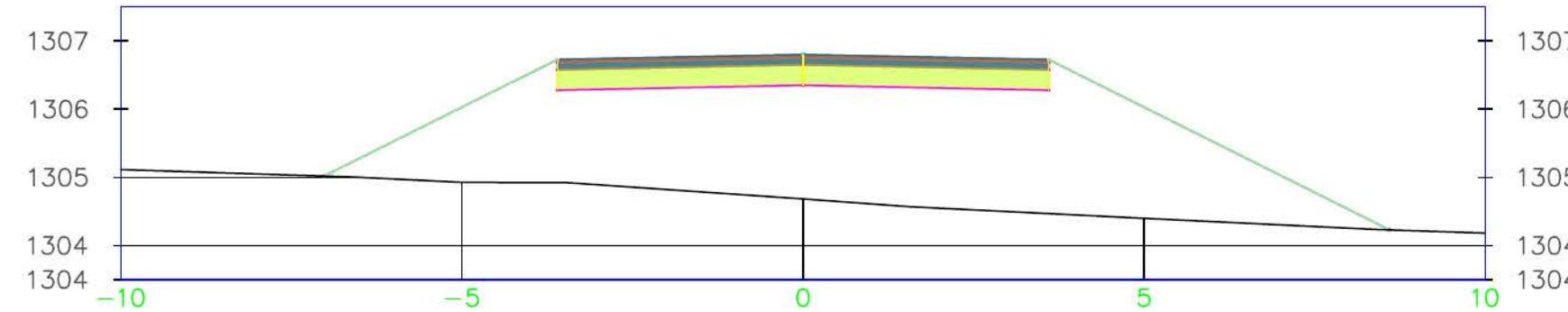
Survey Camp - 2076
Road Alignment Survey
Cross-Section

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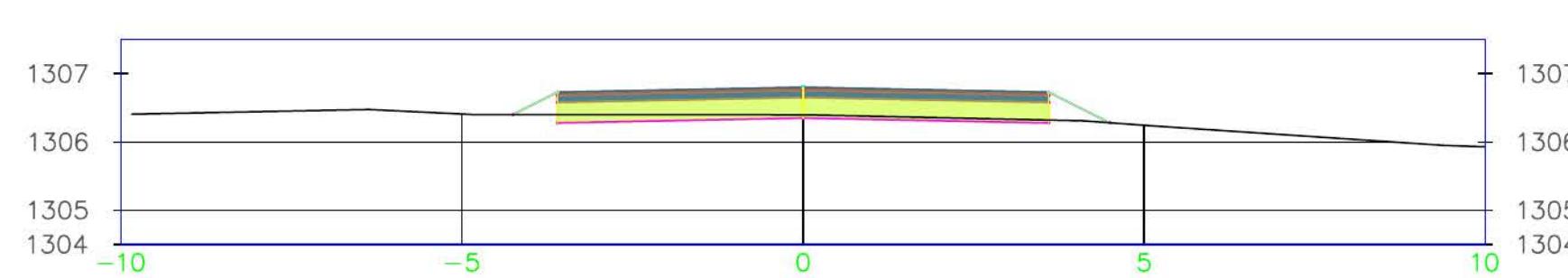
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Elevation

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Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

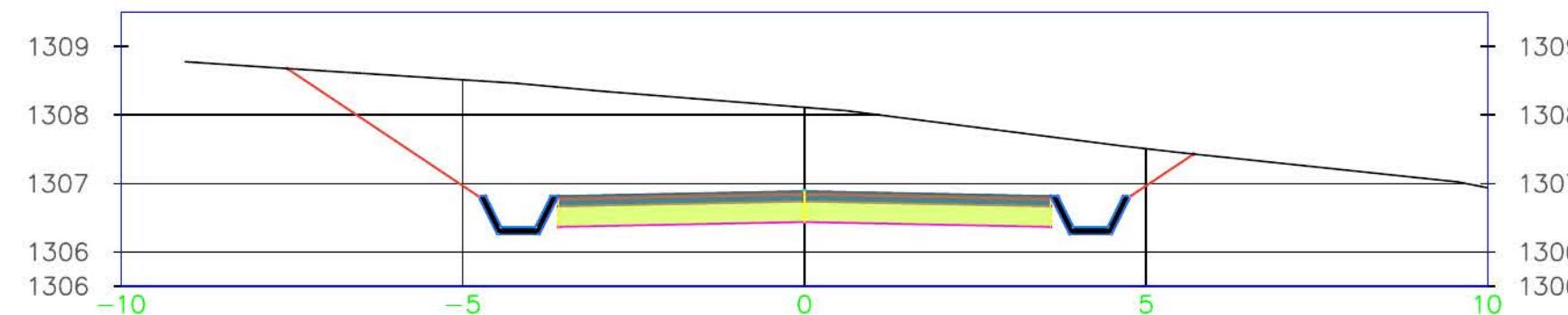
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Road Alignment Survey
Cross-Section

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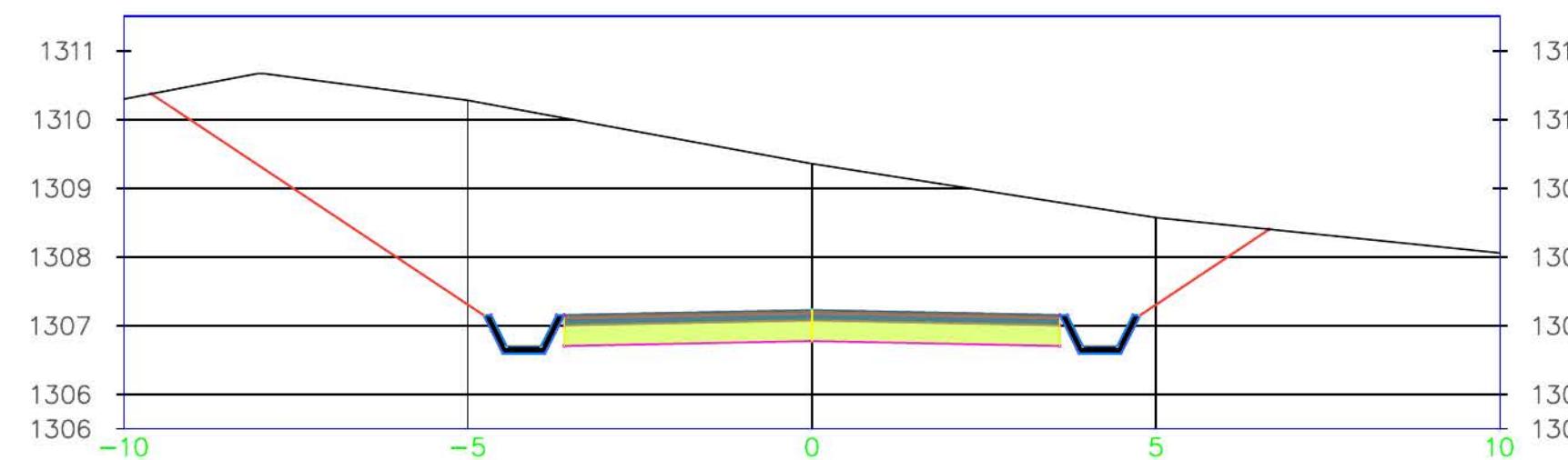
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Tribhuvan University
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Department of Civil Engineering
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Survey Camp - 2076
Road Alignment Survey
Cross-Section

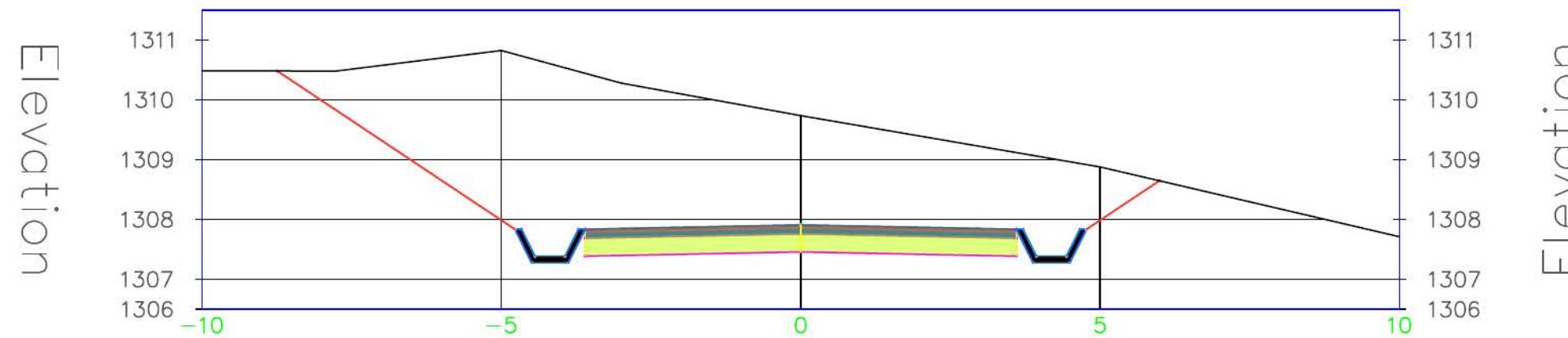
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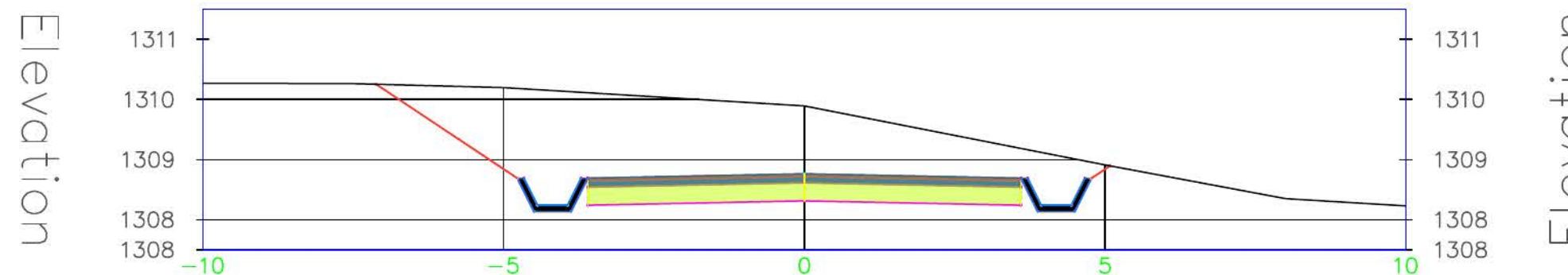
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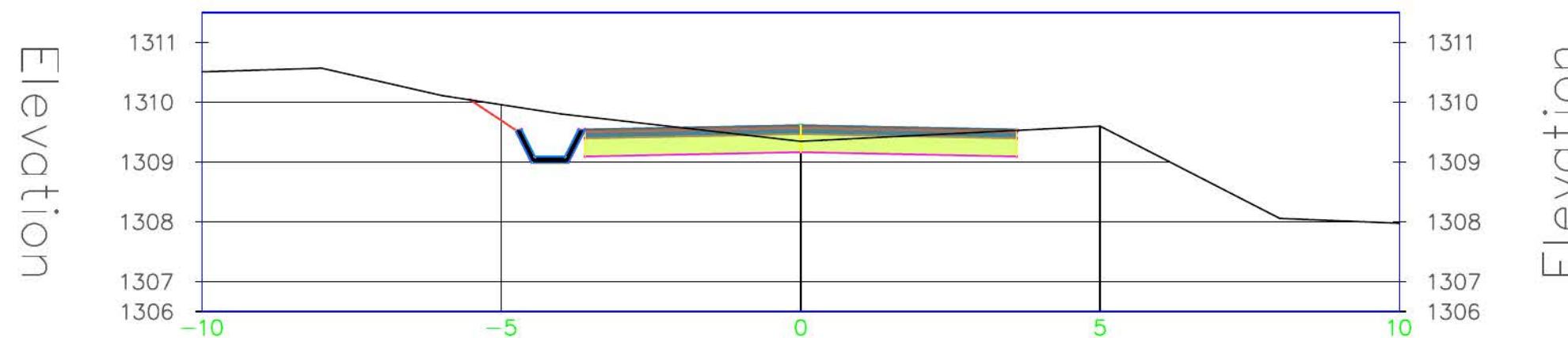
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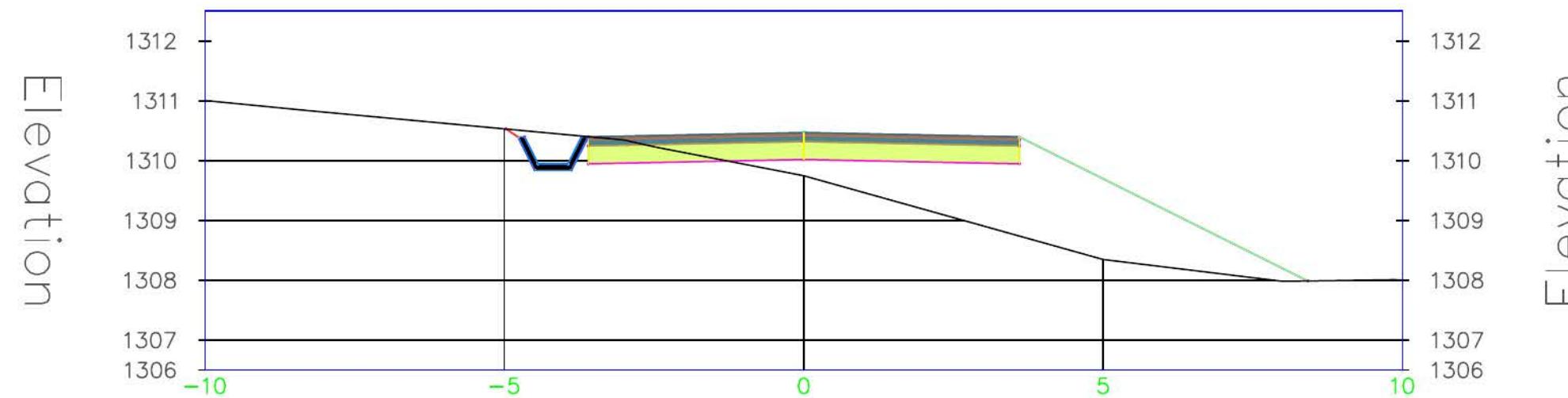
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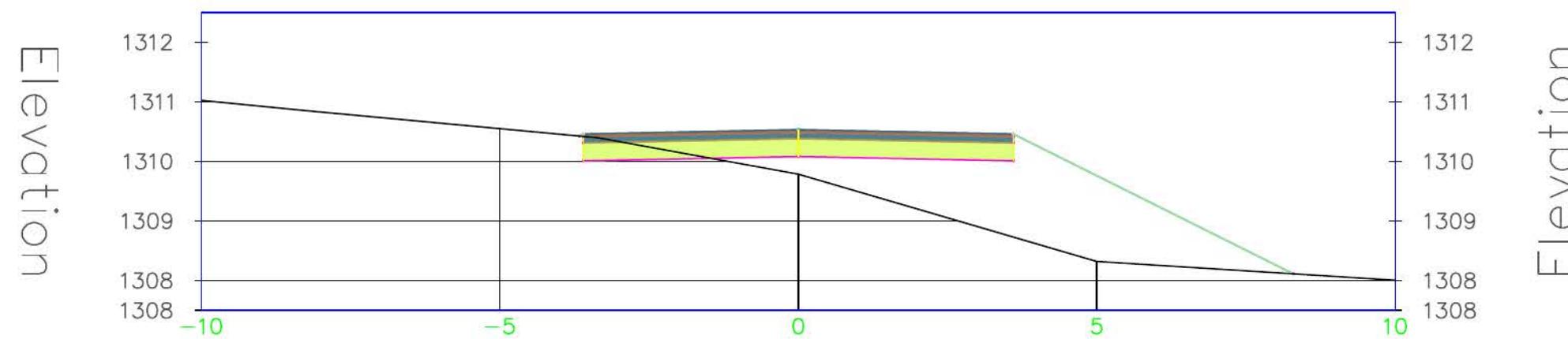
Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

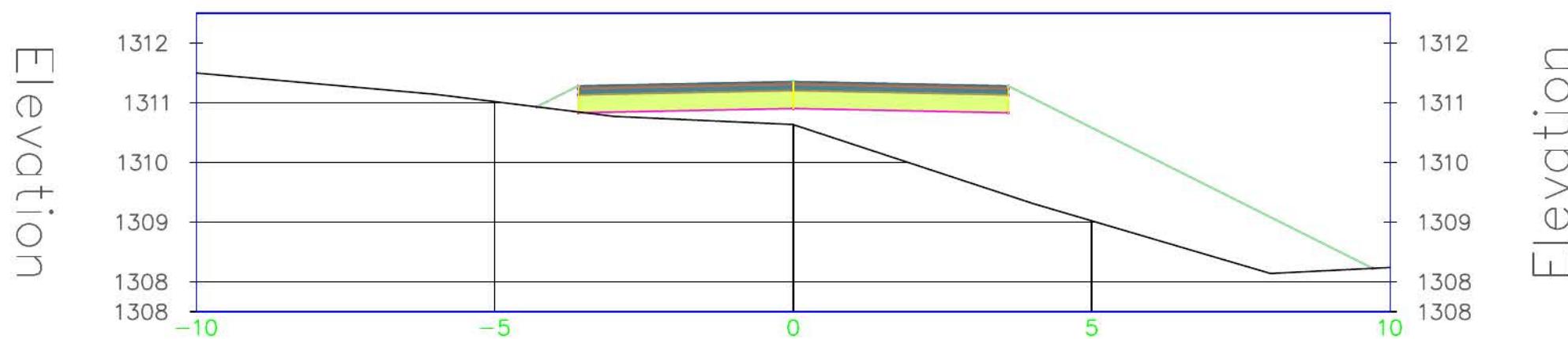
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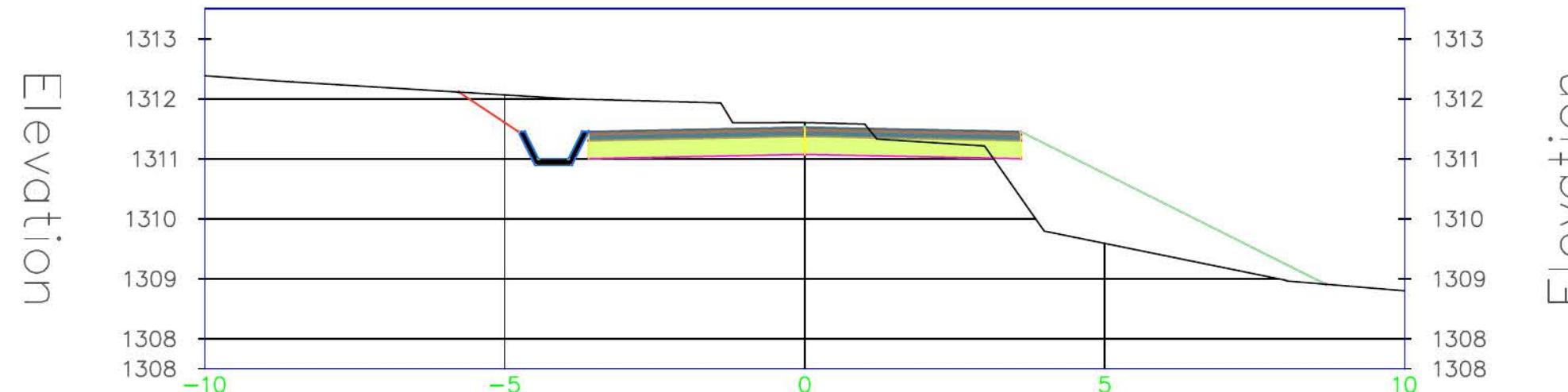
Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

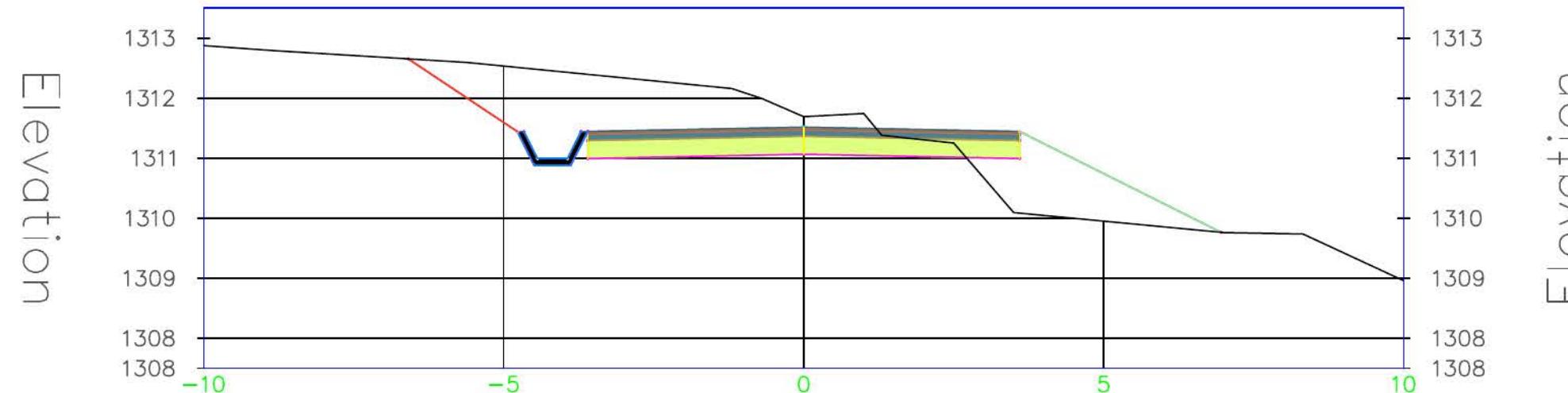
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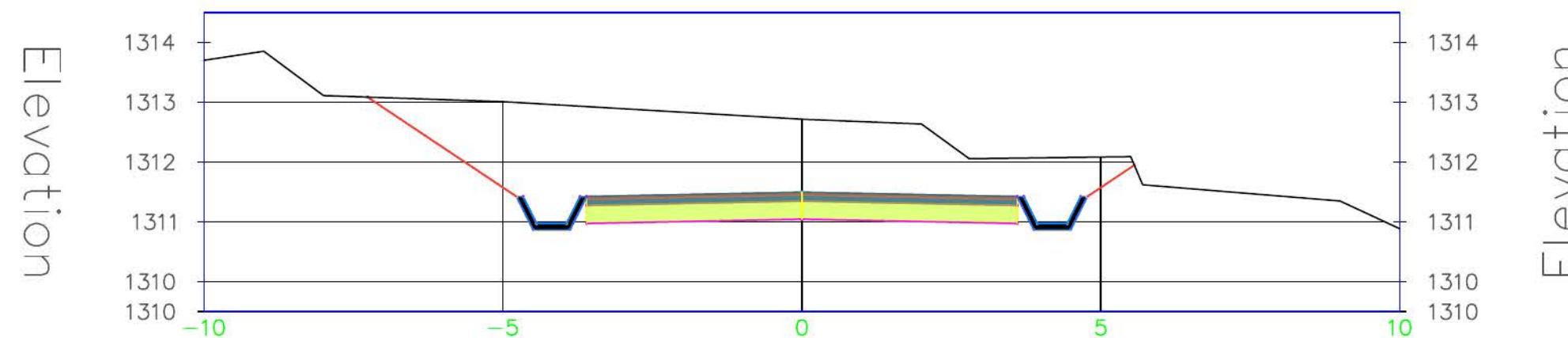
Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

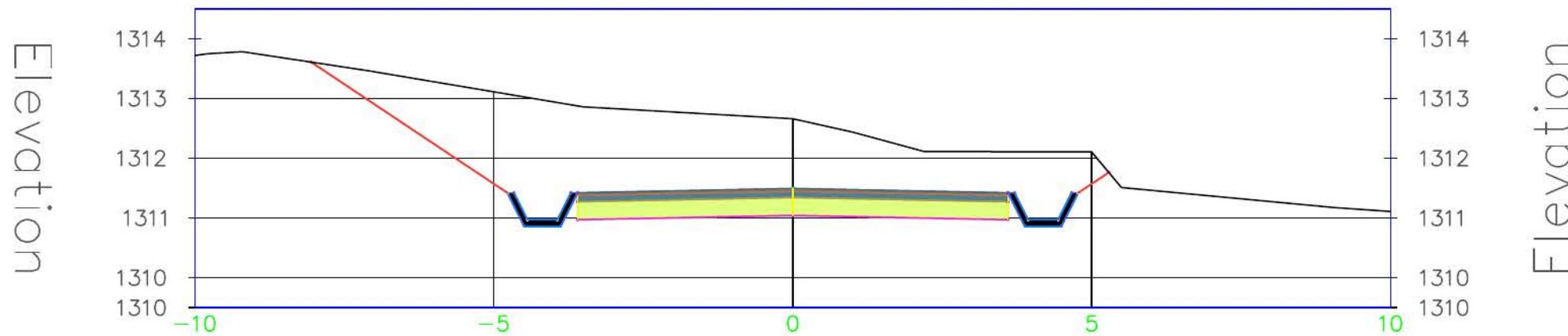
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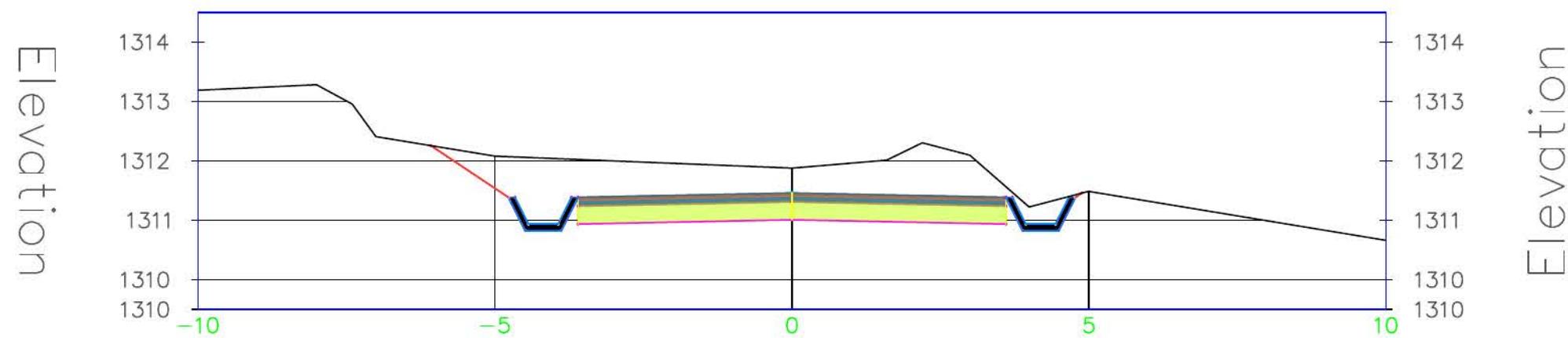
Tribhuvan University
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Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

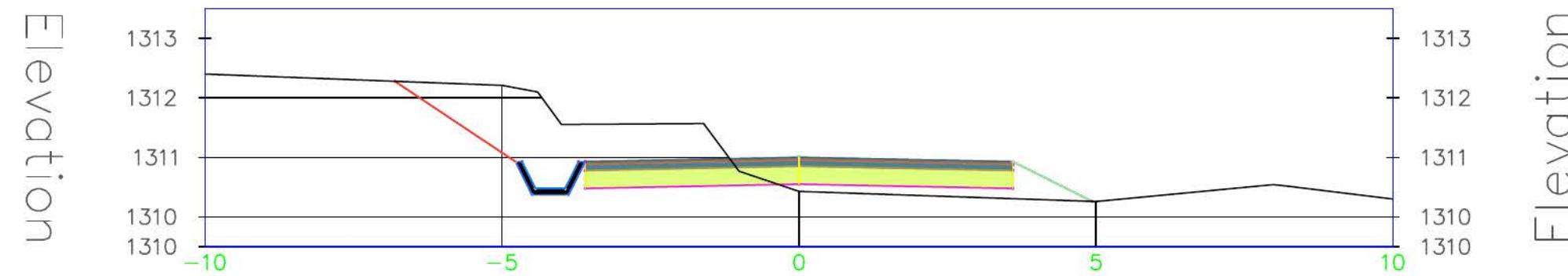
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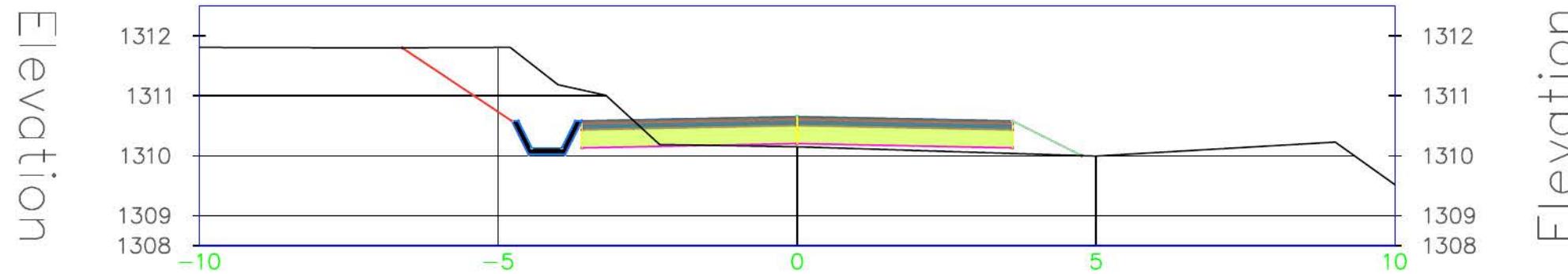
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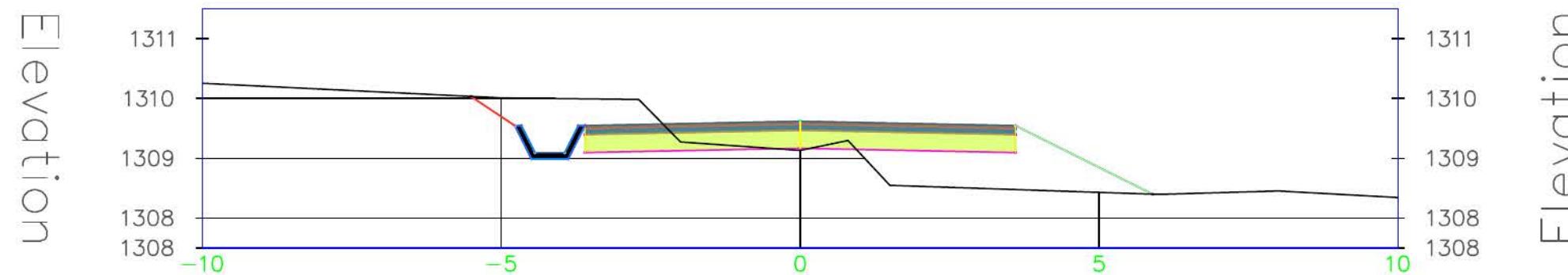
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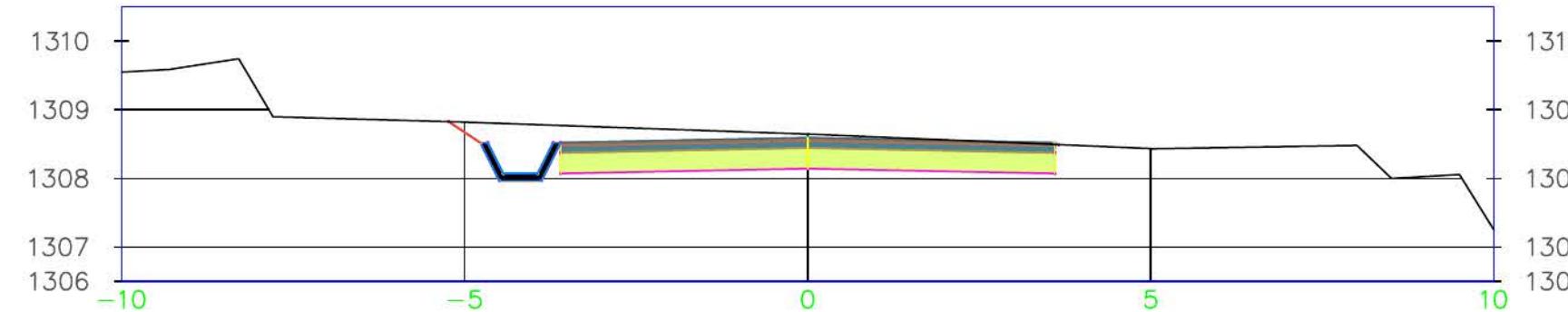


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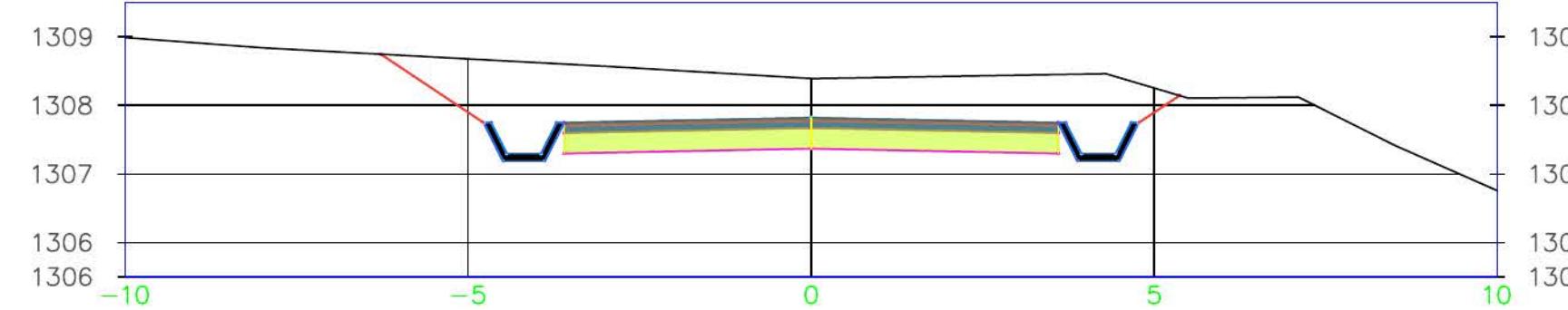
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Elevation



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Tribhuvan University
Institute of Engineering
Department of Civil Engineering
Survey Instruction Committee
Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
Cross-Section

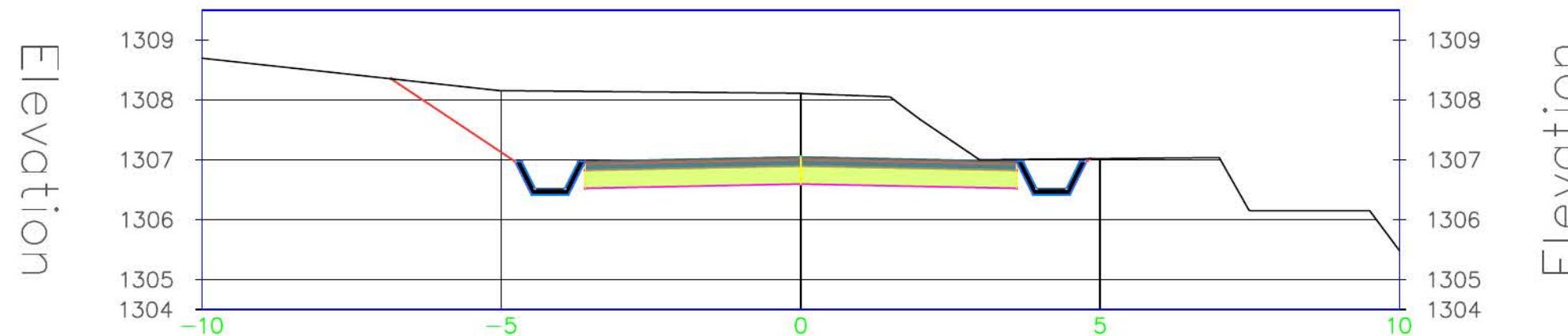
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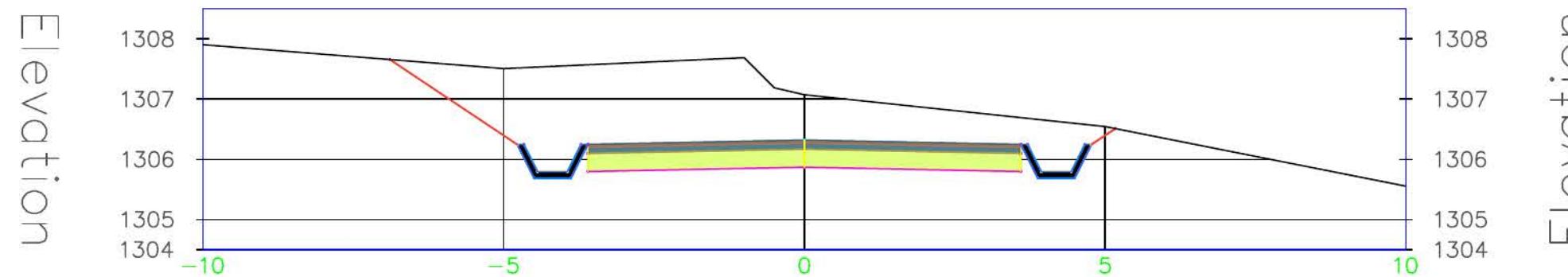
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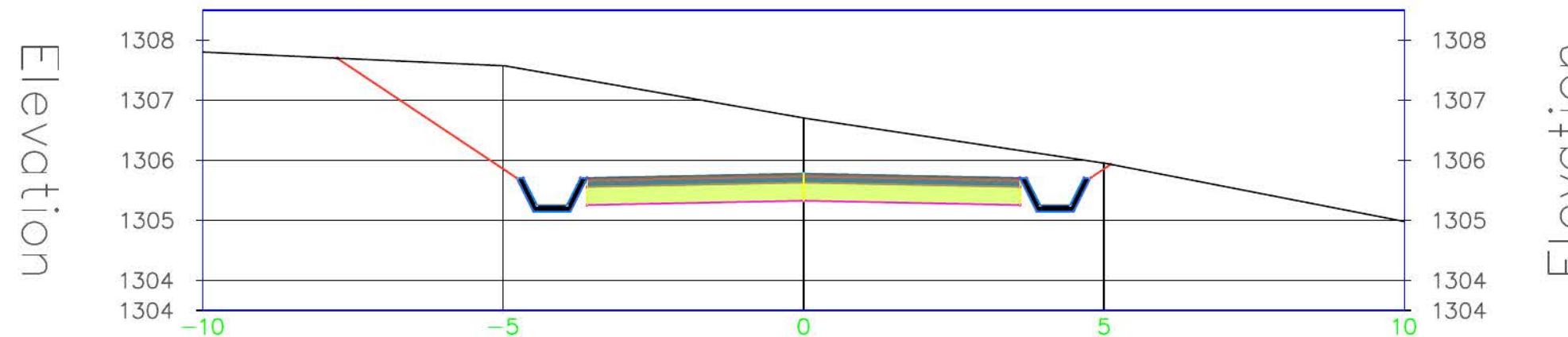


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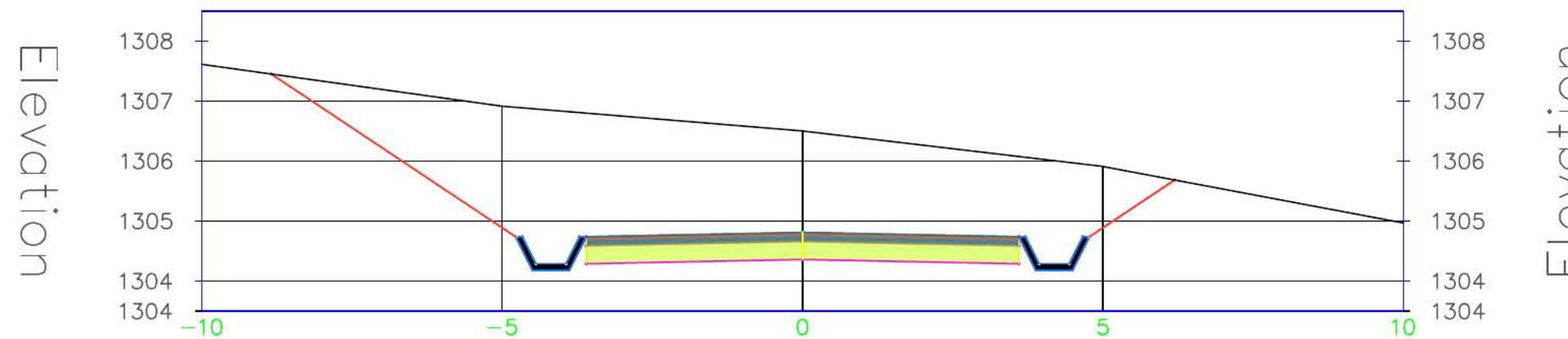


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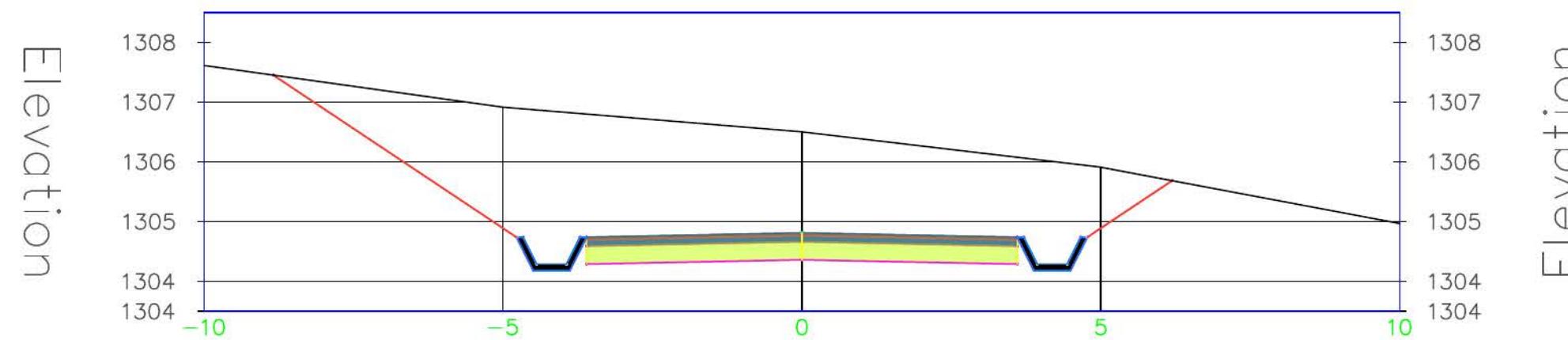
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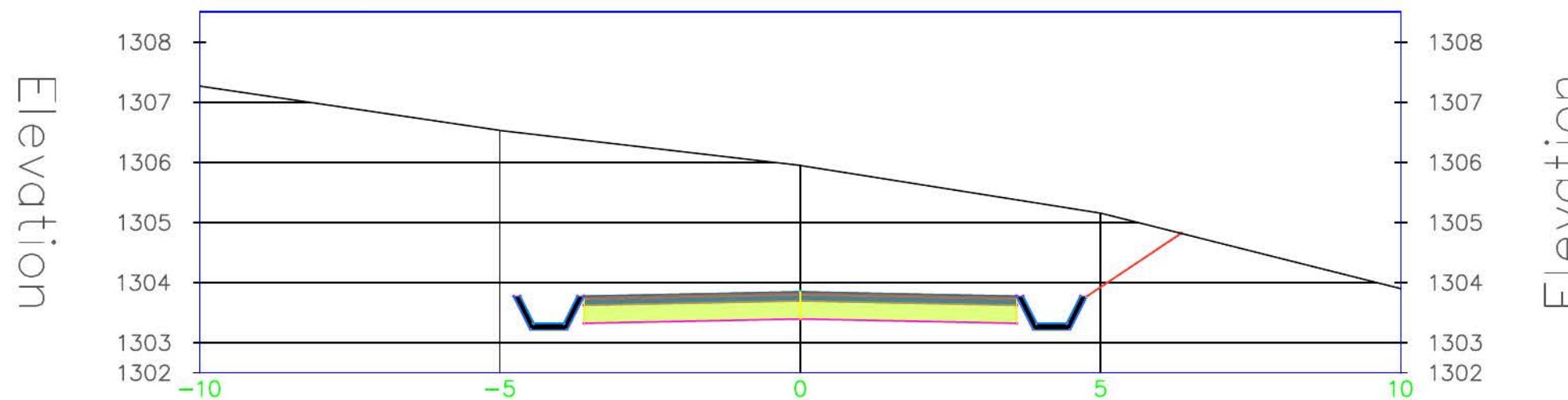
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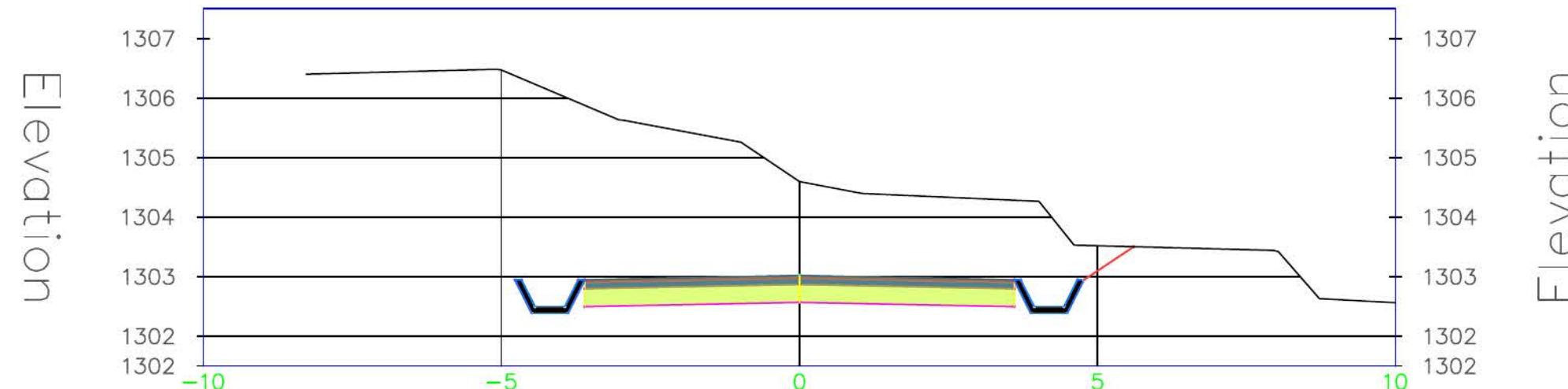
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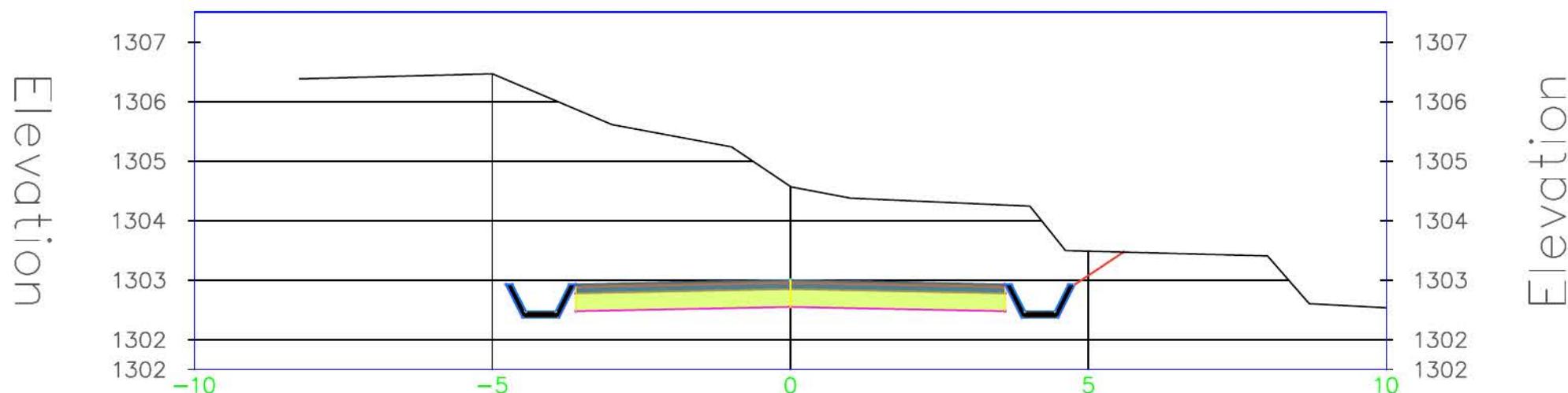
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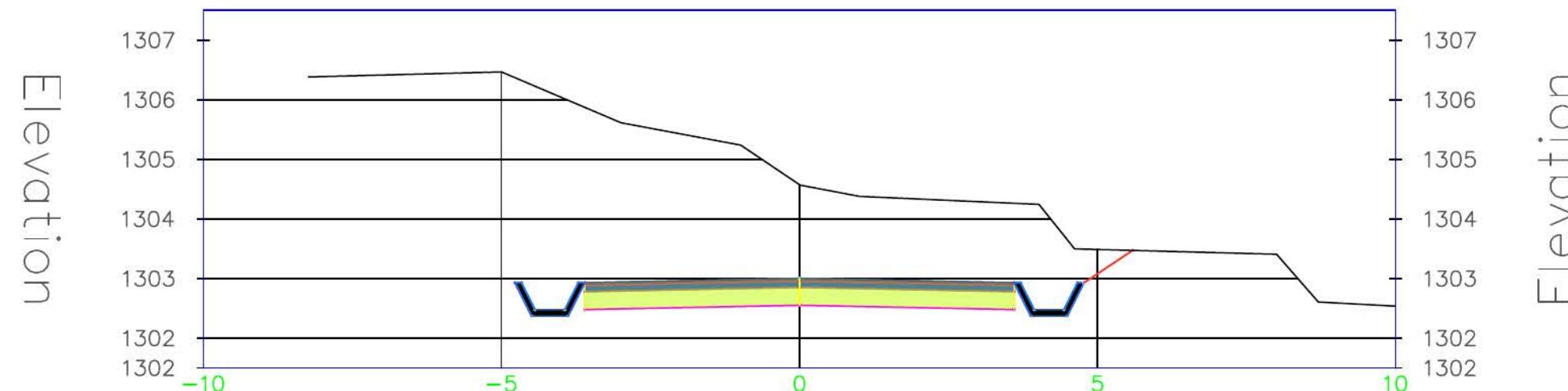
Tribhuvan University
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Central Campus, Pulchowk

Survey Camp - 2076
Road Alignment Survey
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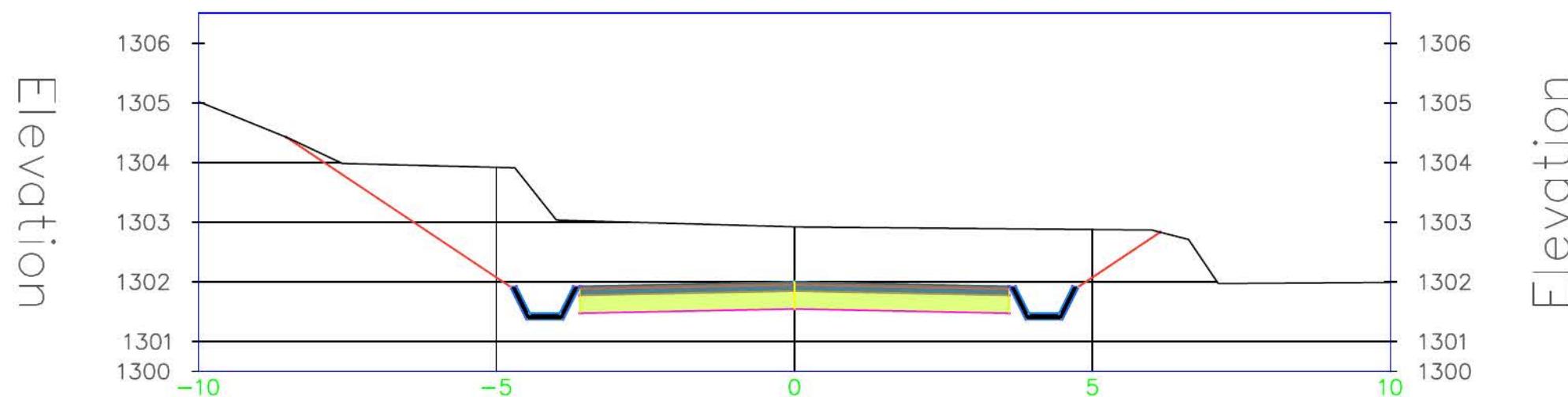
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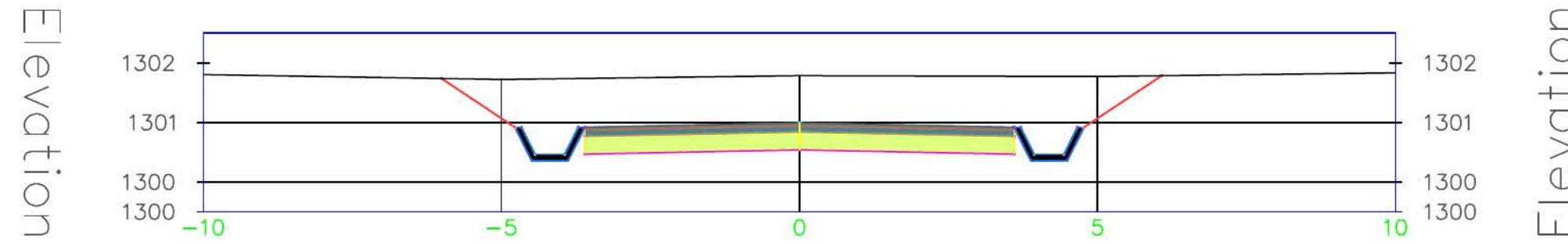
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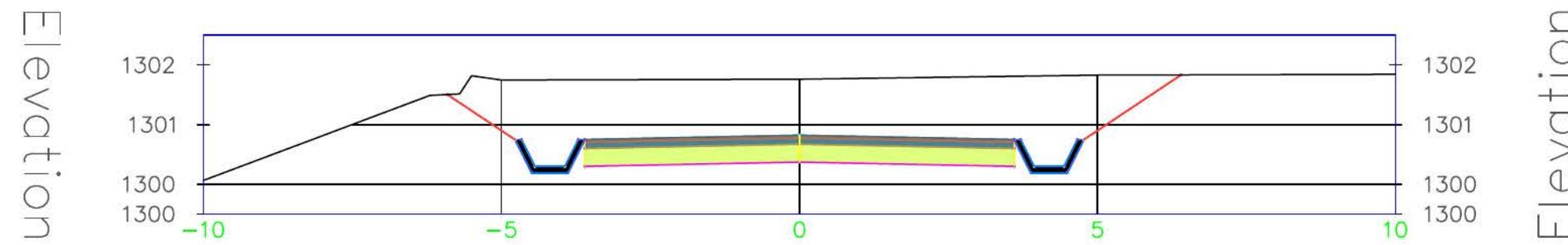
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Tribhuvan University
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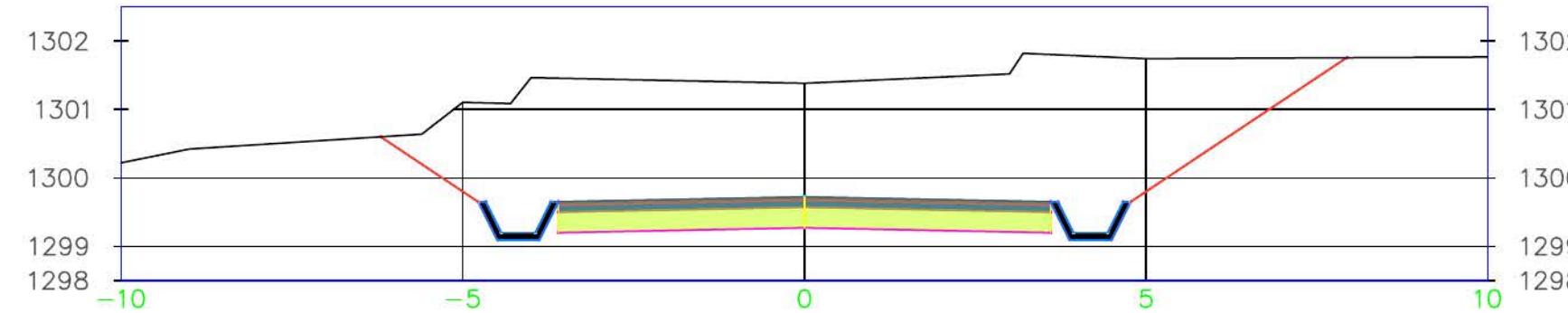
Survey Camp - 2076
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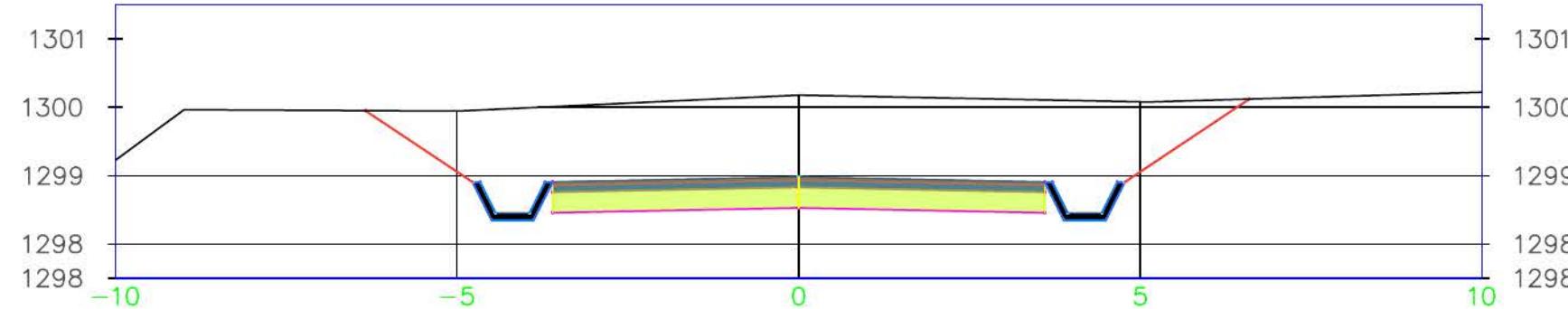
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Elevation



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Elevation



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Central Campus, Pulchowk

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Cross-Section

Group 29		Group 30	
Kushal Khatiwada	074BCE072	Kushal Wagle	074BCE073
Pragyan Shrestha	074BCE104	Prajwal Panthi	074BCE105
Sanjeev Bashyal	074BCE143	Shiyam Rai	074BCE159
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Yubin Baniyaa	074BCE192	Utsav Pradhan	074BCE188

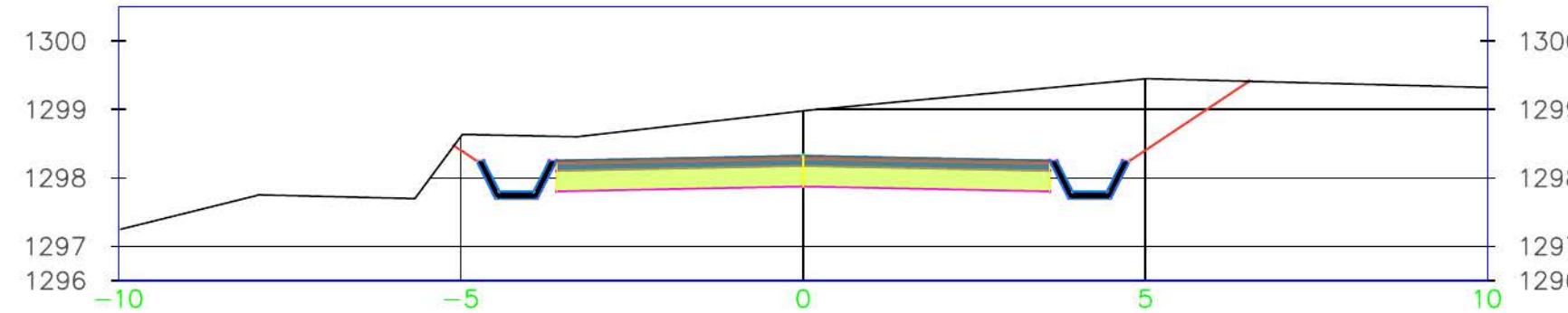
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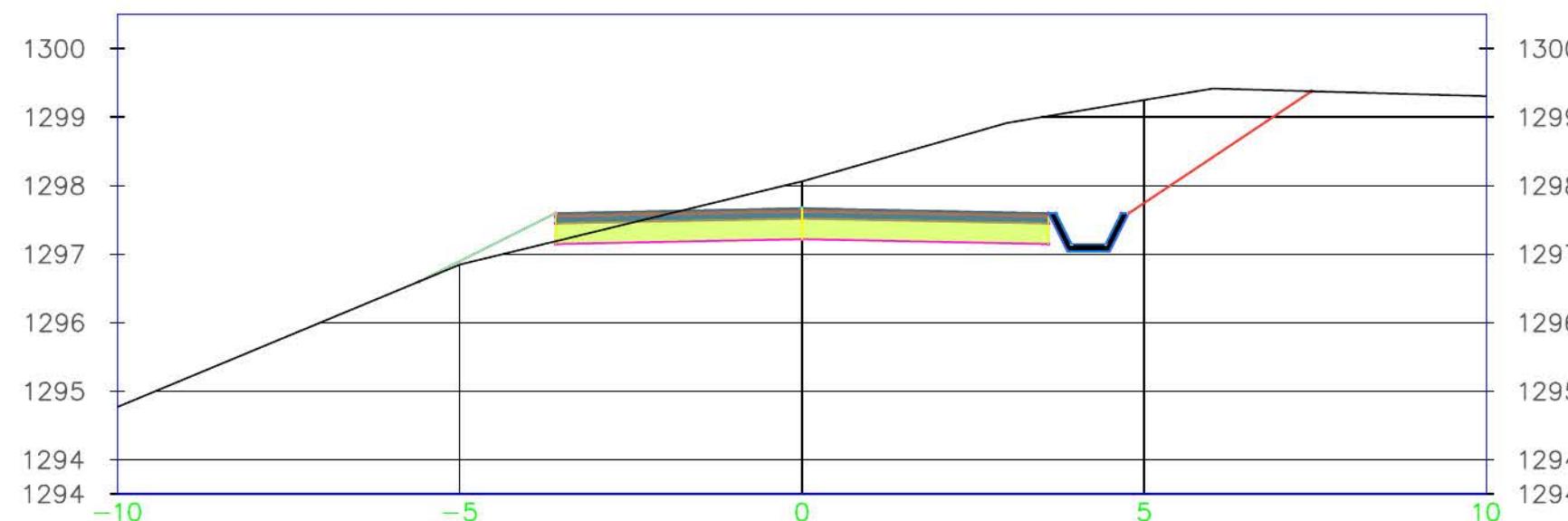
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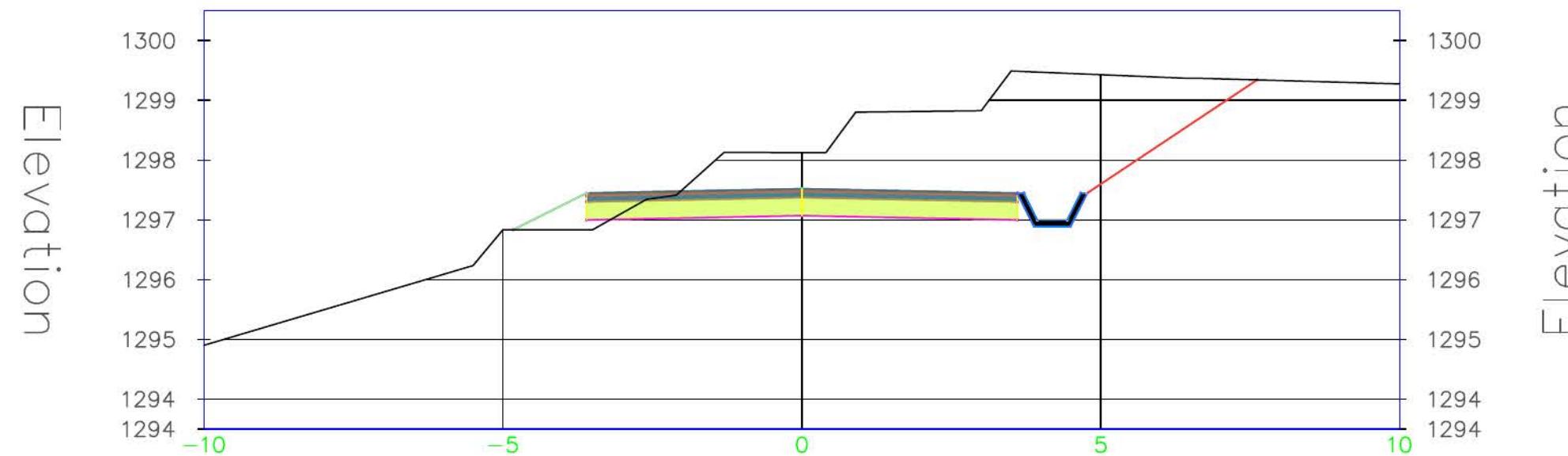
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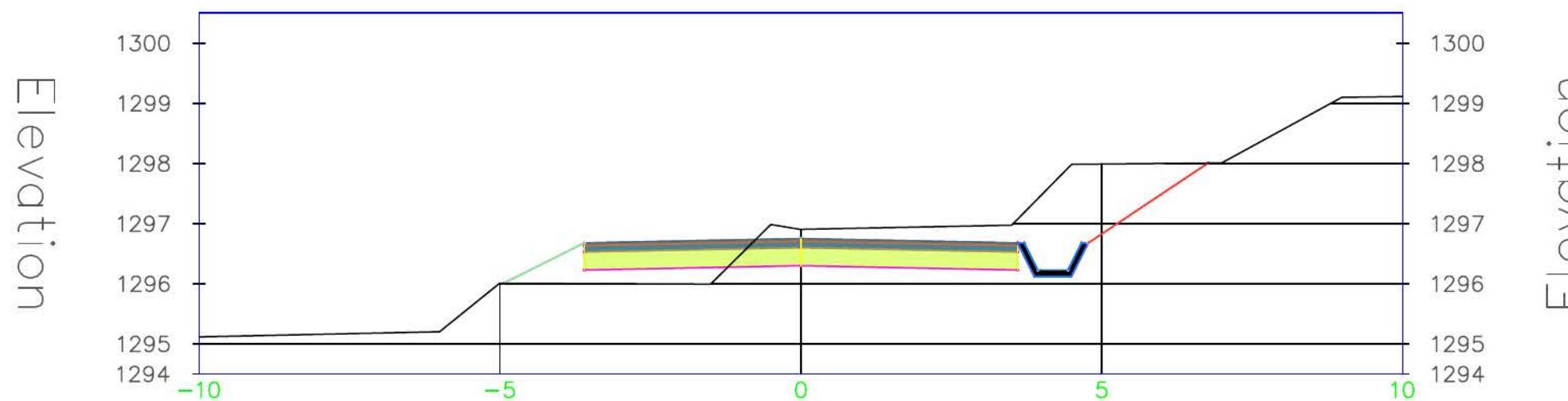
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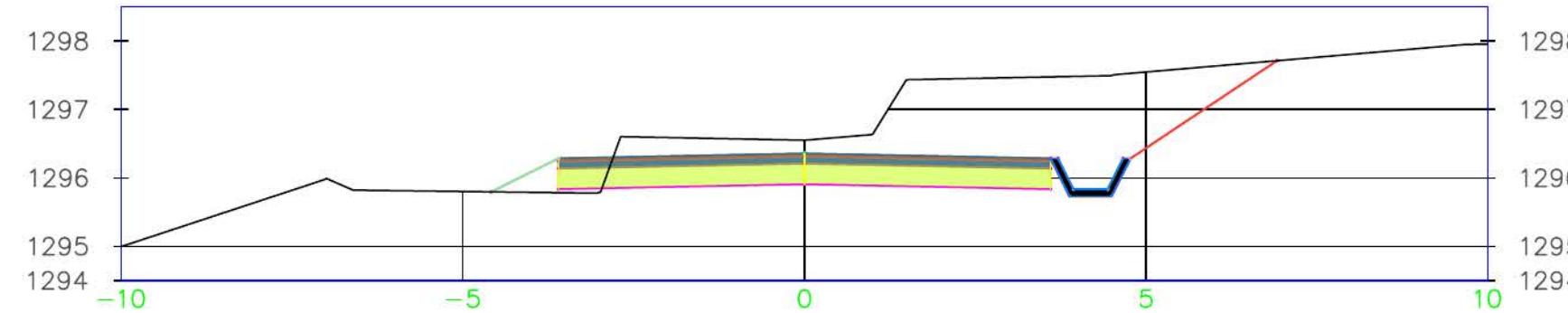
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Cross-Section

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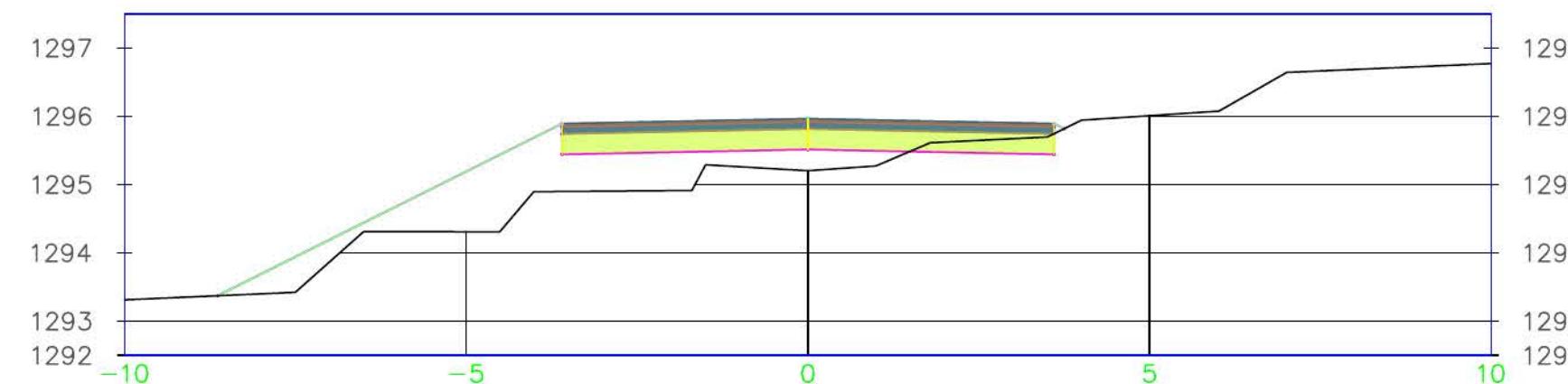
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Elevation

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Elevation



Elevation

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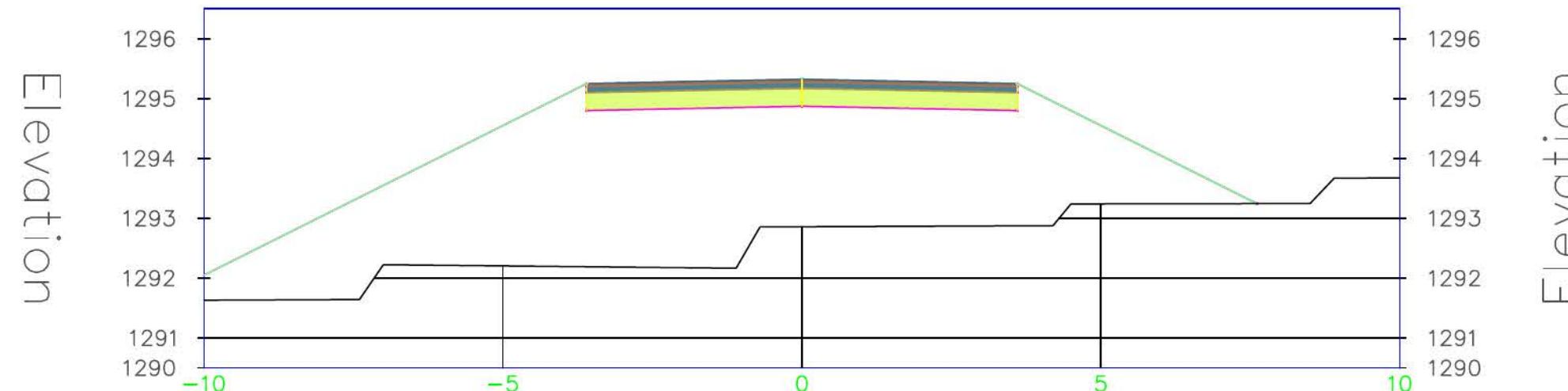
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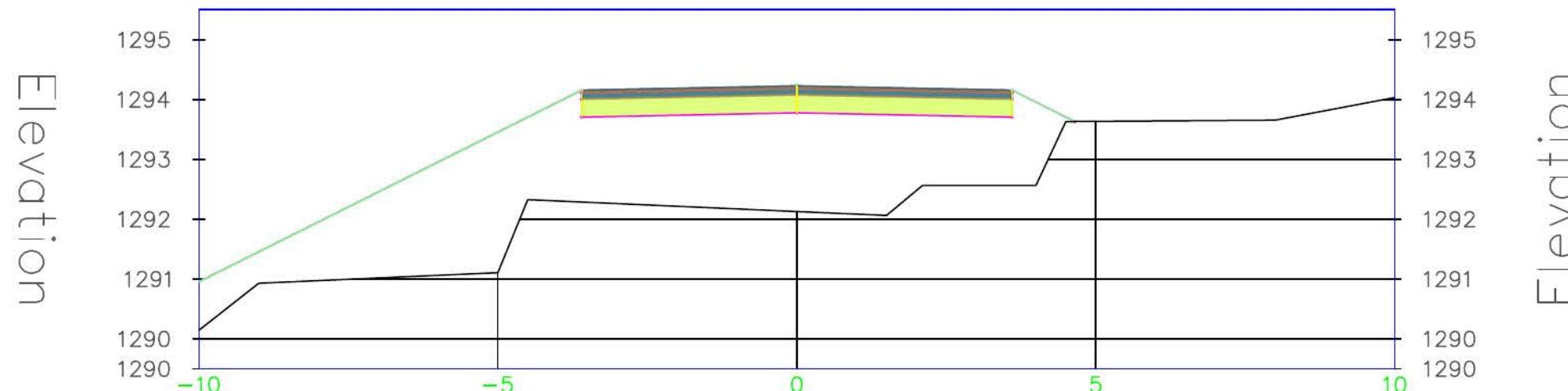
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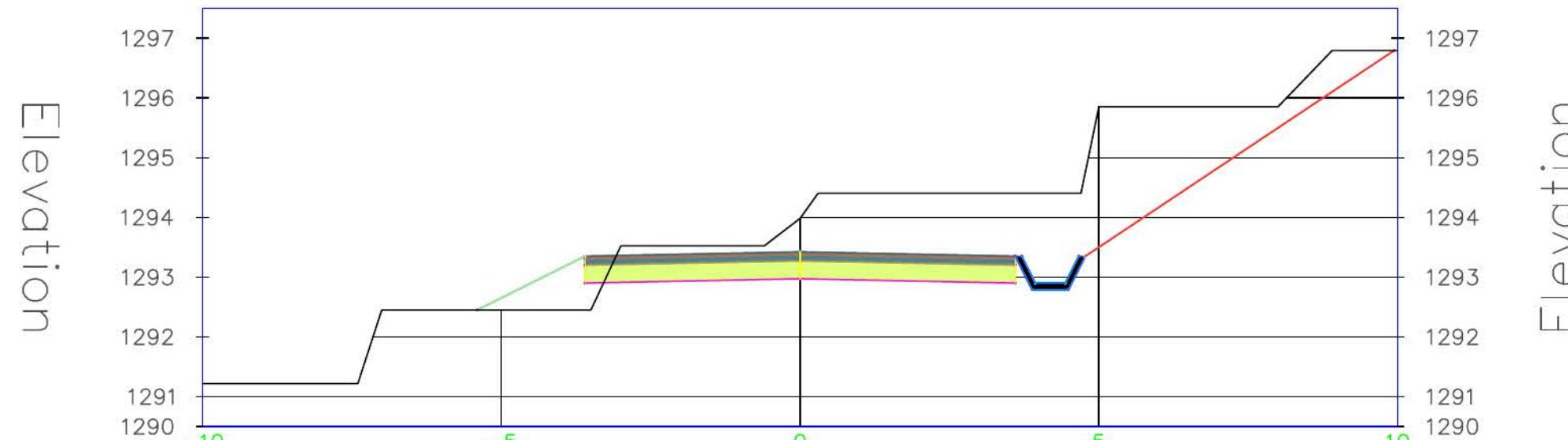
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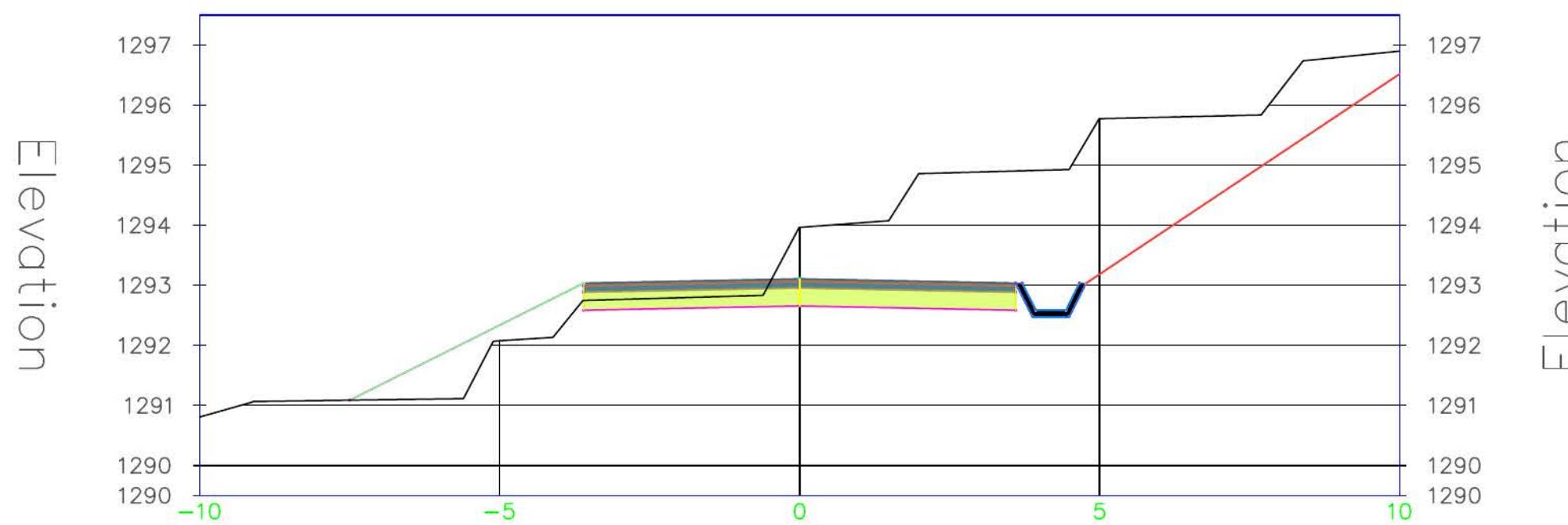
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Group 29

Kushal Khatiwada	074BCE072
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Group 30

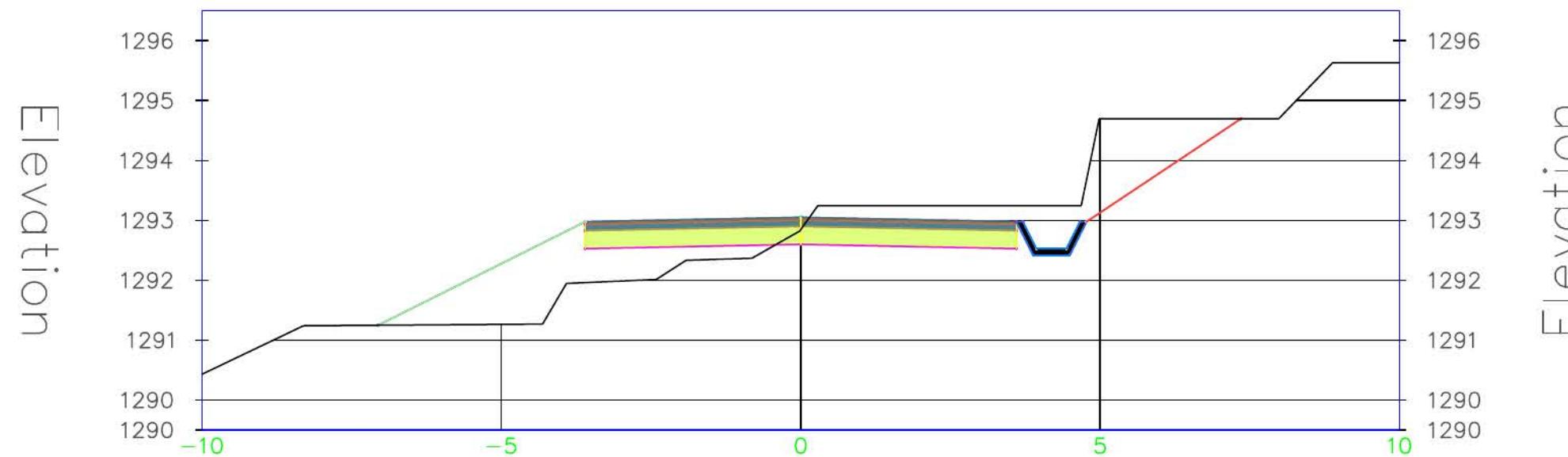
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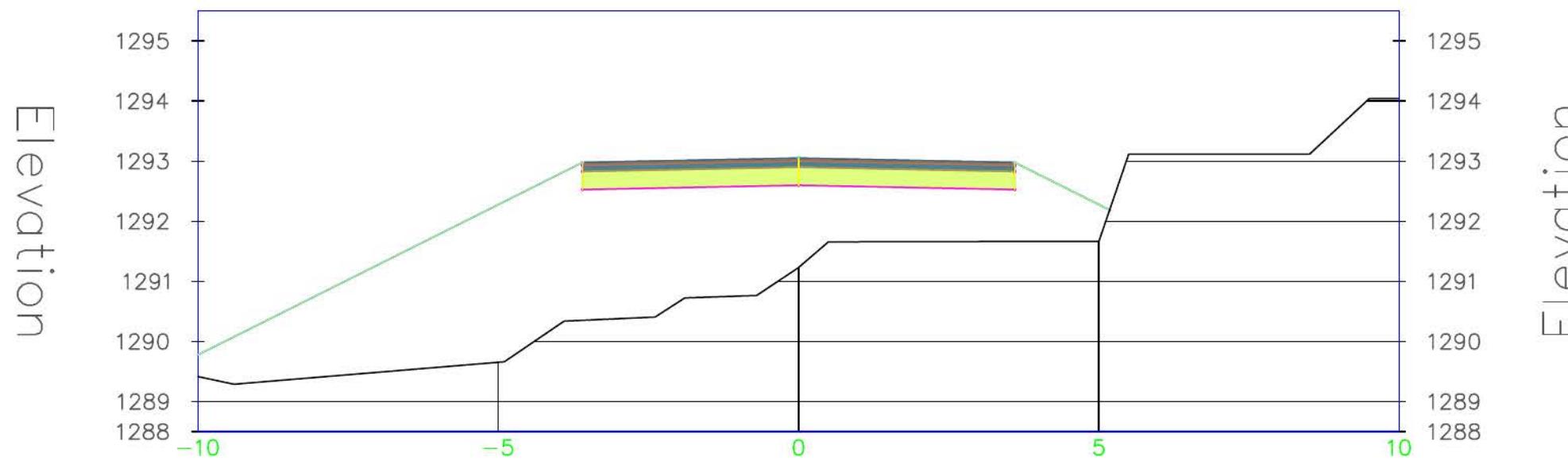
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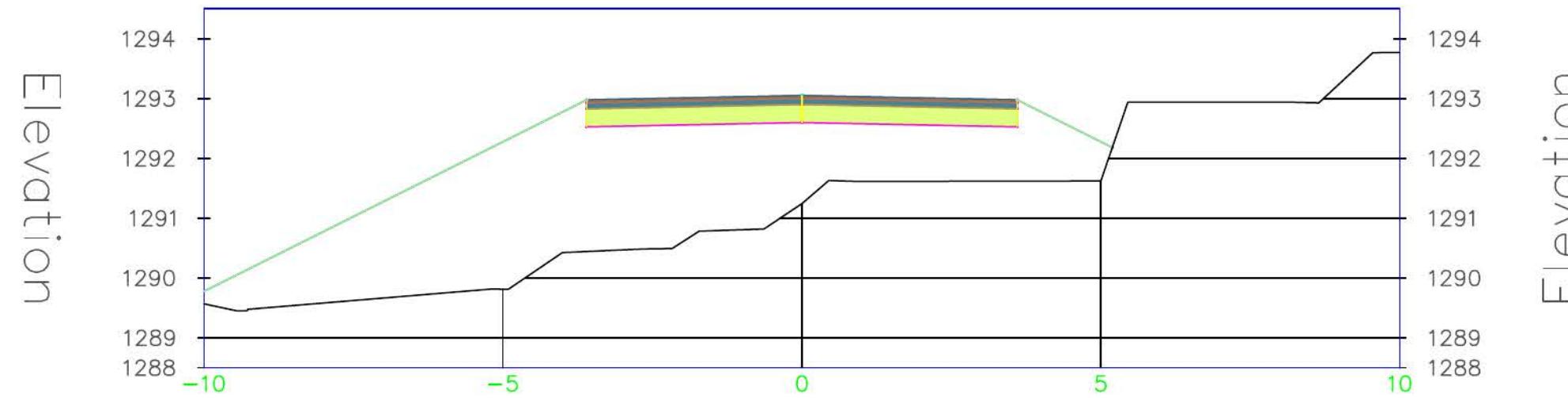
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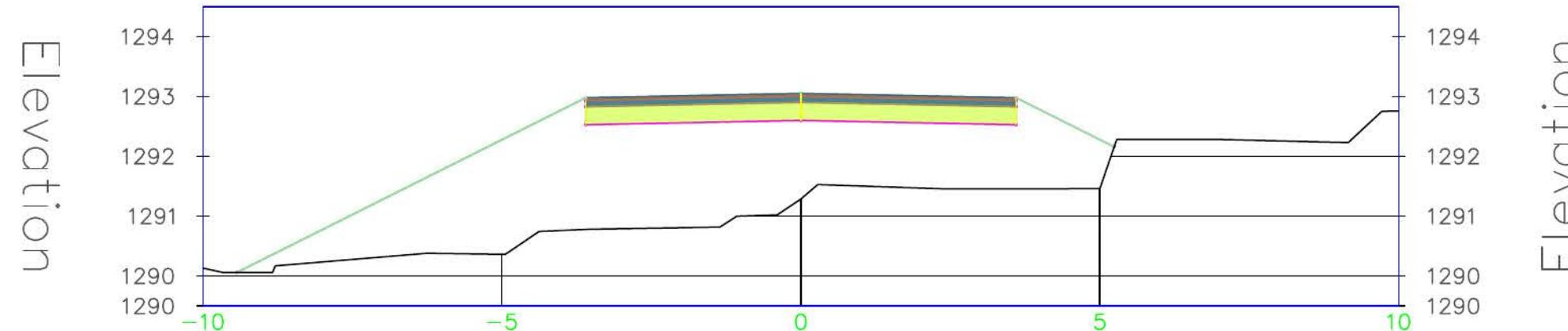
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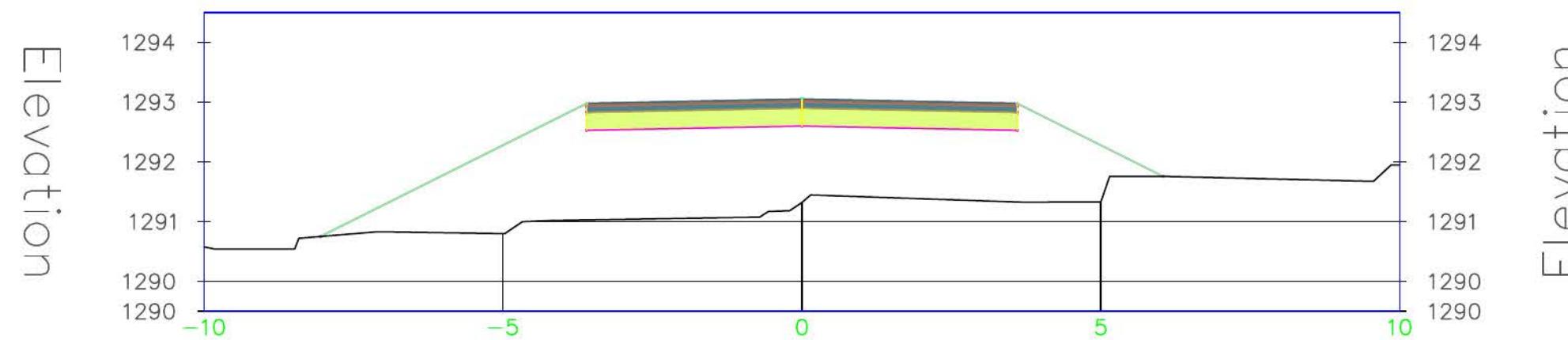
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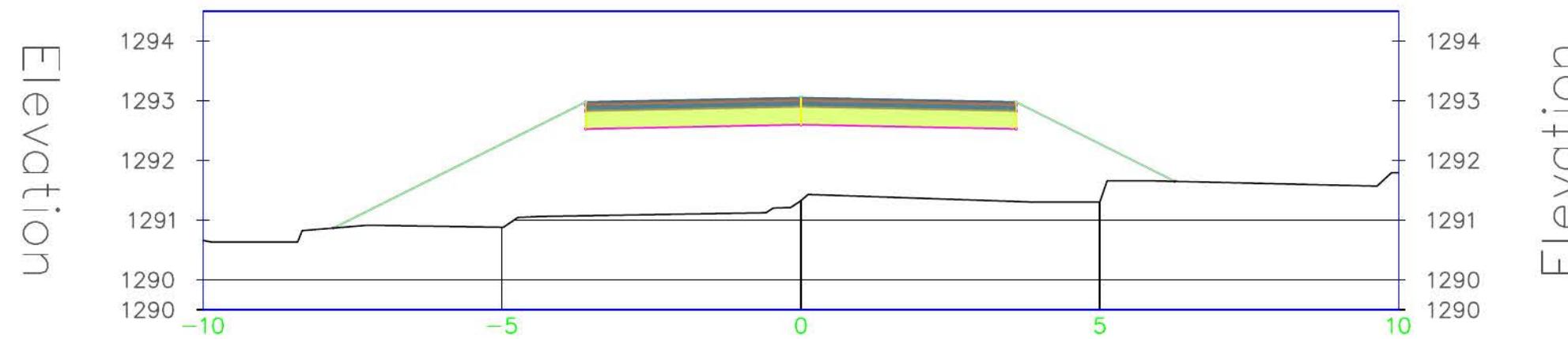
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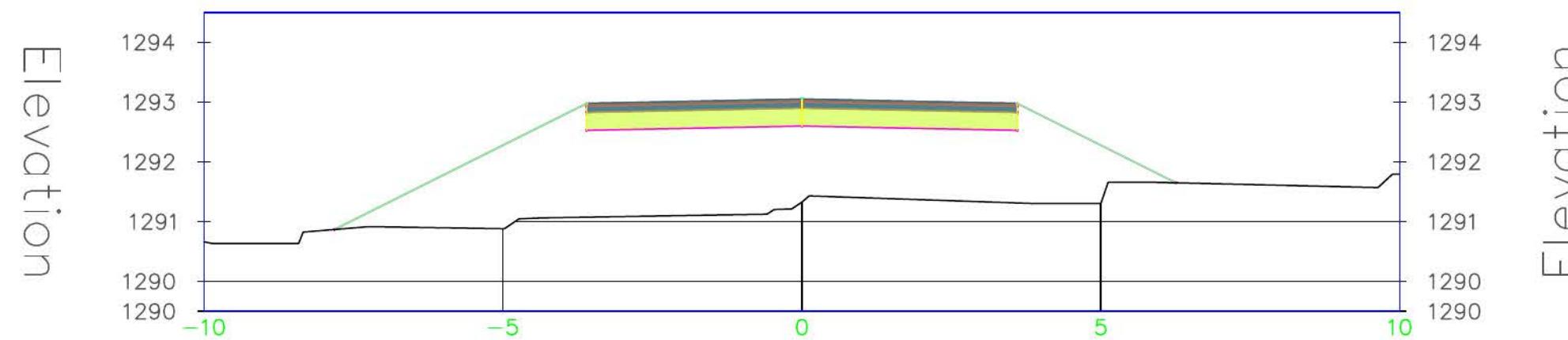
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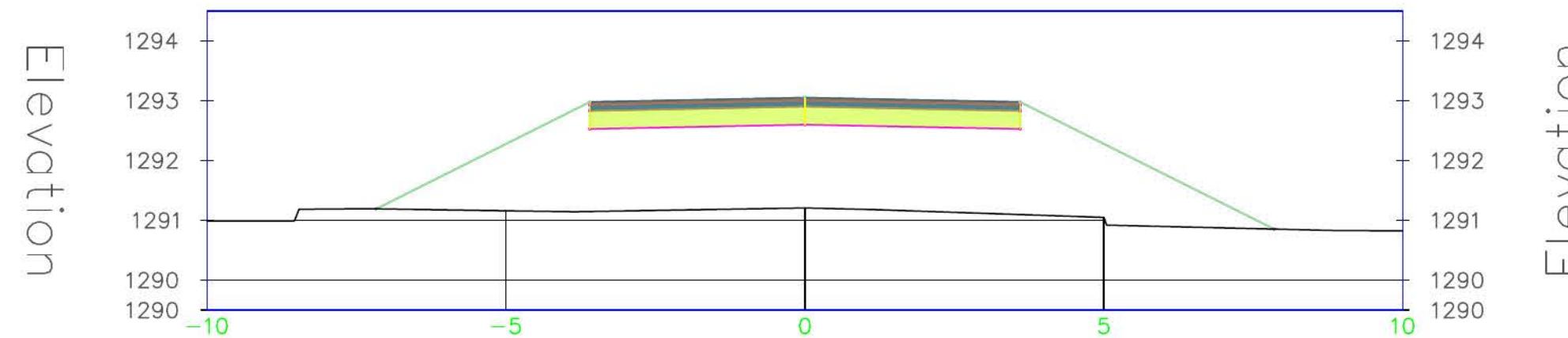
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Sheet Number

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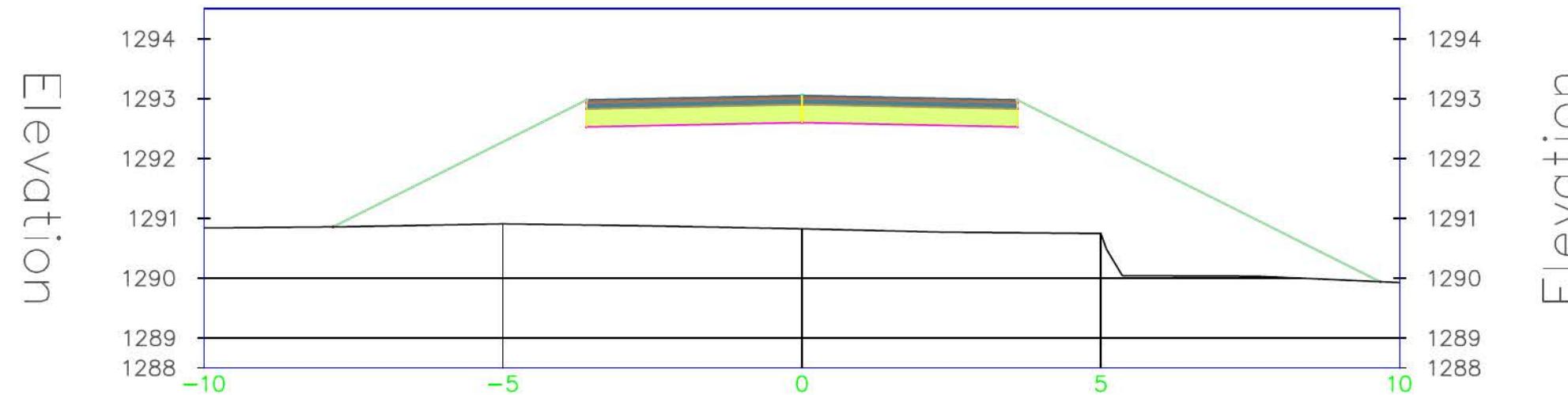
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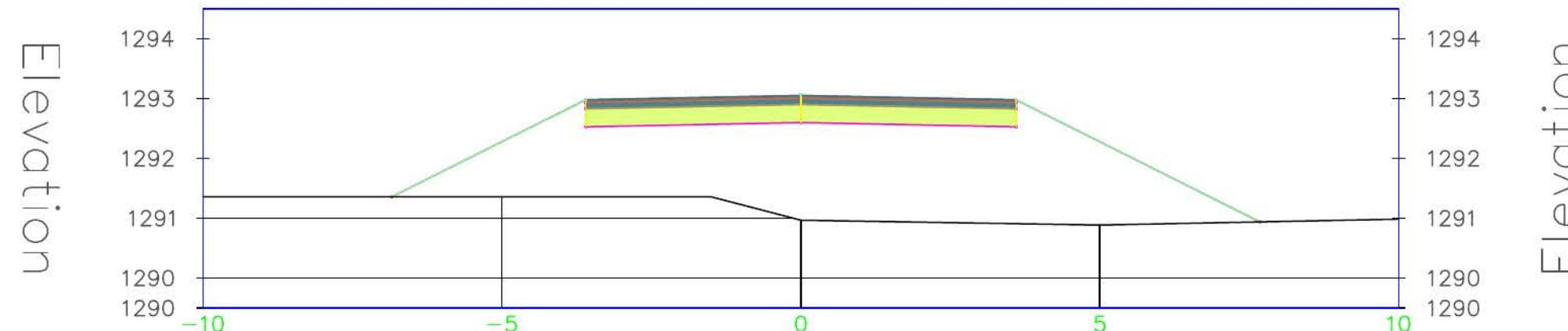
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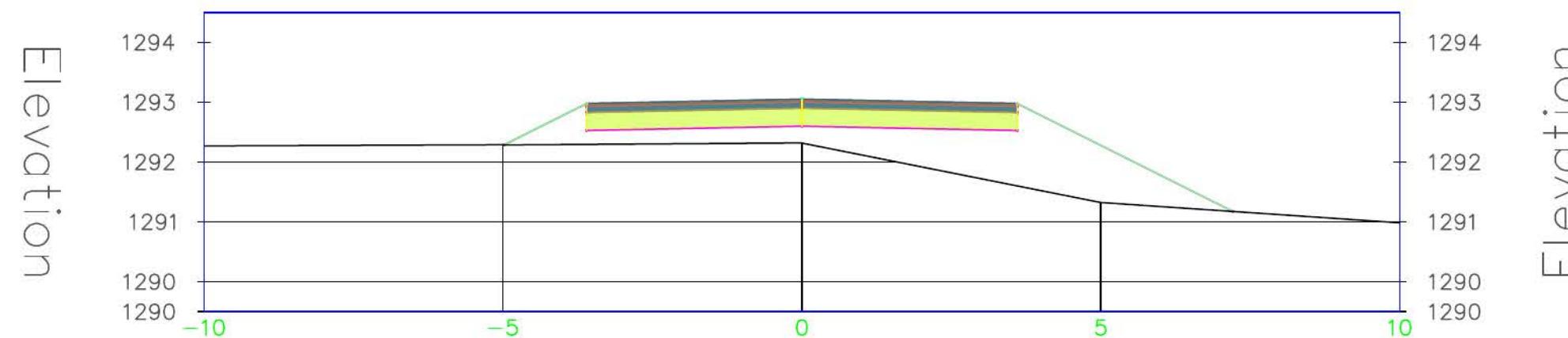
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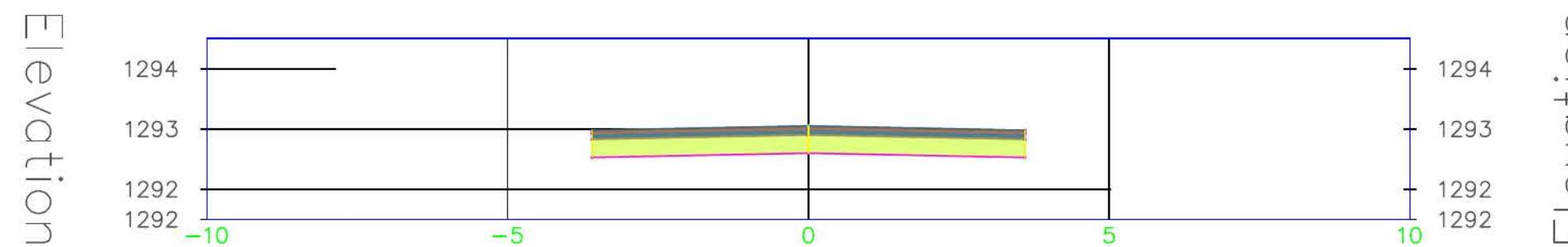
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0+738.34



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Sheet Number