Jana Jagriti Secondary School

**Ratnanagar Municipality -14, Pithuwa Chitwan**

Survey Camp-2079

Dhampus Resort, Pokhara

**(29th Shrawan to 5th Bhadra)**

Survey Camp Report

Diploma In Civil Engineering

Submitted to**:**

Department of Civil Engineering

Jana Jagriti Secondary School

Ra.Na.Pa.-14 Chitwan, Nepal

Submitted by**:**

Name: -Rajan Shrestha

Roll No: - 075-DCE-26

Contact No: - 9824228408

**ACKNOWLEDGEMENTS**

At first, we are deeply indebted to Survey Instruction committee - 2079, J.J.S.S.for their contribution with supportive acts, best arrangements and helpful suggestions in successfully completing the Survey Camp -2079.

We would like to express our sincere thanks to the Department of Civil Engineering Jana Jagriti Secondary School Ra.Na.Pa.-14 Chitwanfor providing us golden opportunity of Survey Camp with real and precise program to upgrade our practical and theoretical knowledge on surveying. We hope it would be helpful for the future practice in the field of Civil Engineering, as it has enhanced our know-how in actual field conditions

We express our deep sense of gratitude to Er. Bikash Poudel (Co-Ordinator), Er. Shishir Lamsal, Er. Aastha Pokharel, Er. Krishna Poudel and all other teachers for their tremendous efforts on helping us in the survey camp by providing all the necessary assistant while doing a field work, calculation as well as to prepare this complete report. We are also thankful to all our friends and colleagues for their support and help. We also appreciate the help of all the non-teaching staff of the survey instruction committee for making our survey work at Chapeau a success.

We would like to respect the entire instrument and store personnel and everyone who helped us directly or indirectly in the duration of survey camp. The main goal of that camp was to make us confident in carrying out the field work that we will encounter in future, which we think was well satisfied.

Thank You…

**ABSTRACT**

This is a report of survey camp of 2079 organized by Department of civil engineering- “Survey Instruction committee**”** Jana Jagriti Secondary School. Ra.Na.Pa.-14 Chitwan, Nepal for the students of 075-DCE batch as per the Syllabus of DCE. The camp was held Pokhara Dhampus **30th Shrawan**, 2079 to 5THBhadra, 2079.

It aimed to be perfect in presentation of theoretical and practical knowledge in engineering surveying in the actual field condition and habituate to work in different environment with different people.

This survey camp is scheduled with “The introduction of the area”, “The bridge site survey” and “The Road Alignment and Geometric Design” serially. The report reflects the methodology, observations, and calculations made by the students in the Camp with the corresponding drawings. The large portion is covered with elements of topographic surveying along with those of road alignment and bridge site survey.

This survey camp helped us to build in our confidence to conduct engineering survey on required accuracy and we assume that it would be of great use in our future engineering works.

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 conscience. Therefore, we feel that this report deserves the excuses and tolerances from the readers for any errors or blunders present, despite the best efforts.

**WORKING SCHEDULE**

**Project title:** Survey Camp 2079

**Location:** Pokhara Dhampus

**Duration:** 29th Shrawan -5th Bhadra

**Working time:** 7:00am to 6:00pm

**Class time:** 7:00 pm to 8:00 pm daily

**Surveyed by:** Group ‘C’ (2075 Batch of Diploma in Civil Engineering)

|  |  |  |
| --- | --- | --- |
| S. N | Date | Survey Field Work |
| 1 | 2079-04-31 | Three-point Reference (Major & Minor Station) |
| 2 | 2079-04-31 | Linear Distance Measurement (Major Traverse) |
| 3 | 2079-04-31 | Horizontal Angle Measurement (Traversing) |
| 4 | 2079-05-01 | TACHEOMETRIC SURVEY MESURMENT DETAILLING |
| 5 | 2079-05-02 | Two peg test & fly levelling |
| 6 | 2079-05-03 | Road survey (profile and cross section levelling) curve setting |
| 7 | 2079-05-04 | Bridge Survey |

**ABBREVIATIONS AND ACRONYMS**

* B.B- Back Bearing
* BC -Beginning of Curve
* BM -Bench Mark
* EC --End of Curve
* FB Fore Bearing
* HA -Horizontal Angle
* HCR- Horizontal Circle Reading
* HI- Height of Instrument
* IP -Intersection Point
* Km -Kilometer
* RL-- Reduced Level
* TBM -Temporary Bench Mark
* TC -Tangent Length
* VDC- Village Development Committee
* VCR -Vertical Circle Reading
* WCB -Whole Circle Bearing
* BR -Bank Right
* BL --Bank Left
* HFL -High Flow Level
* NFL Normal Flood Level
* RB -Right Bank
* LB --Left Bank
* RM -River Mid

**INTRODUCTION**

surveying is an art and science of determining the relative position of points on, above or beneath the surface of the earth by means of main two measurements i.e., linear and angular with direct or indirect measurement. The actual measurements are accompanied by mathematical calculations for determining distances, angles, directions, locations, elevations, areas and volumes. The information thus collected is then portrayed graphically by the construction of maps, profiles, cross-sections and other diagrams. This subject matter is widely used quite important before and during all Civil Engineering works such as designing and construction of building, Factory area, Highways, Bridge, Water supply systems etc.

The Survey Camp 2079 organized by, Shree Jana Jagriti Secondary School Ra.Na.Pa.-14 Chitwan, Nepal is the continuation of the course of study included in Surveying for Diploma level of Engineering. is introduced as the partial fulfillment of the course. The main objectives of this camp Pokhara Dhampus to provide opportunities to be familiar and face actual field related problems to civil engineering Survey. The camp is designed to further enhance the knowledge of different surveying works and to build confidence among the students, as only the critical concepts are not sufficient to tackle with real field problems.

The frist task dealt during the project is road alignment survey. It is mainly focused on the fixing the alignment of the road depending on field condition. The curve designing, L-section along the proposed road alignment, Cross-section at every 20m interval and other geological and topographical information of the site are site are also presented on this report.

The second task mainly dealt during the camping is topographic survey. The major traverse is run to cover the entire area of the, Bode. As the area is very large, the overall area is divided in to two parts of about equal area. Then each area is surveyed by the different groups. Our area is no.1, so to cover all the details of own area, minor traverses are established in suitable direction and position which can control all the area. The minor loop may be one or more up to three. The no of station in minor traverse is kept more then two. Then the topographic map of own area is prepared and presented here. The level is first transferred from BM to the TBM. Then after TBM to the all major and minor traverse stations. All the calculation and plotting of the above mentioned task are presented in systematic way in this report.

The third task dealt during the camp is Bridge Site Survey. It is mainly oriented on preliminary knowledge on selection and planning of the site for the future construction of bridge. This survey focused on collecting the preliminarily data such as normal water flow, high water level, geological features of the ground for planning and designing of the bridge. The L-section along the river, few cross-sections of upstream and down stream of the bridge axis and topographical map of the site and the control survey i.e. Triangulation survey is presented here.

Resection, Intersection, Different type of curves setting, Two peg test, Fly Leveling are also carried out in this survey camp and the corresponding data are calculated and plotted and finally presented in this report.

Broadly speaking, this camp contains all type of problem of real Engineering work, which we have to face in the future. From above mentioned points, we can conclude that this Survey Camp makes us capable to face the problem on future and make independent to complete any type of survey works.

**OBJECTIVES OF SURVEY CAMP**

From the early civilization of men, surveying has been developing since then. The art of surveying and the preparation of maps have been practiced from the ancient times. In absence of the accurate maps, it is impossible to layout the alignment of roads, canals, bridges, tunnels, transmission power lines and waves relaying towers accurately. Surveying is the preliminary step for the execution of such projects.

The main objective of the survey camp is to provide a basic knowledge of practical implementation of different surveying works. It helps to build up the self-confidence level by implementing different surveying works.

The main objectives of survey camp can be listed as follows:

* To become familiar with the surveying problems that are arise during the field works.
* To give the opportunity to use the theoretical knowledge on Civil engineering survey on the real field condition.
* To become familiar with the different surveying instruments, their parts, their functions and their handling procedure for efficient surveying.
* To conduct the topographical survey of given area with horizontal and vertical control and accomplishing the relevant specification and produce a topographic map.
* To transfer the level or vertical control from known point (BM) to TBM near the site and to find level of different control points.
* To align the road interconnecting the points and find the longitudinal and cross sections.
* To study the details of bridge site and align a bridge axis.
* 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.
* To become familiar with the team work as the surveying is not a single person work.

**PROJECT AREA:**

Pokhara Dhampus is a village is located at 28°18’36” N & 83°51’0’E. The area allocated to us for survey of land with variable land features and almost all the man-made mentors like road, building and pond etc.

**LOCATION & ACCESSIBILITY**

It is about 4-hour 52min drive from Jana Jagriti Secondary School to Pokhara Dhampus is a village. The project site is situated in the range of about 2045 m. above mean sea level. There are ample amount of local transportation facilities connecting this VDC with the main city which has enhanced its development.

1. Region: Pokhara Dhampus is a village.
2. District: Kaski, Pokhara.
3. Province: Gandaki Province.

**Sites:**

* Theodolite traversing and Tachometric detailing at Pokhara Dhampus is a village.
* Road Alignment at same periphery
* Bridge

**TOPOGRAPHICAL SURVEY**

Topographical surveying is the process of determining the positions of natural and artificial features of the locality by means of conventional signs up on a topographical map. Topographic surveys are three-dimensional; they provide the techniques of plane surveying and other special techniques to establish both horizontal and vertical control. Hence the fieldwork in a topographical surveying consists of three parts.

⮚ It establishes both horizontal and vertical control.

⮚ It locates the contours.

⮚ It also locates the details such as rivers, roads, houses, and trees etc.

Topographical map is defined as the map representing the positions of all the features in x and y axes along with the vertical positions with the help of contour lines. In order to prepare the map, survey was done in the given area by establishing the major and minor traverses. Also, the elevations (R.L.) were transferred from the given benchmark (TBM) firstly to a temporary bench mark (TBM-1) allocated within the survey camp area, then to all the traverse stations and to all the detailed points. The contour lines were drawn later by performing the necessary calculations. Finally, the detailed Topographic Map including the major and minor traverse, details and contour lines of the surveyed area was plotted in the given scale. All the calculations in tabular form along with the topographic map are presented in this report.

**OBJECTIVE**

The main Objective is to prepare the topographic map of the given area with horizontal control and vertical control with required accuracy. This also includes the calculation and diagrammatic representation of the area with the help of coordinates in the paper with gridlines.

**BRIEF DESCRIPTION OF THE AREA**

The area, where surveying was performing, is situated at Dhampus, Resort Pokhara compound. The survey area includes nearly whole training center. i.e major and minor traverse includes building, road, and wall etc.

1. Conduct reconnaissance survey of the given area. Form a close traverse (major and minor traverse) 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 1 for major and less than 2 for minor.

2. Measure the traverse leg in the forward and revere directions by means of tape calibrated against the standard length provided in the field, note the discrepancy between forward and backward measurement should be better than 1:2000.

3. Measure traverse angle on two sets of reading by theodolite. Note the difference between the mean angle of two sets reading should be within the square root of number of station times least count of the instrument.

4. Determine the R.L of traverse station by fly leveling from the given B.M. perform two peg test before the start of fly leveling. Note that collimation should be less than 1:10000. Maintain equal foresight and back sight distance to eliminate collimation error. The permissible error for fly leveling is ± 25√kmm.

5. Balance the traverse. The permissible angular error for the sum of interior angles of the traverse should be less than ± √n minute. For major and minor traverse the relative closing error should be less than 1:2000 and 1:1000 respectively.

6. Plot the traverse station by coordinate method in appropriate scale, that is 1:1000 for major traverse and 1:500 for minor traverse.

7. Carry out the detail survey of the given area by tachometric method with reference to the major and minor traverse station, which have been already plotted. Use conventional symbols for plotting.

**EQUIPMENTS**

The equipment’s used in the survey during the preparation of topographic map are:

a) Theodolite

b) Staff

c) Ranging rod

d) Tapes

e) Leveling instruments

f) Hammer

g) Nails, pegs

h) Compass

i) Marker

**METHODOLOGY**

The methodology of the surveying is best on the principle of surveying. They are:

a) Working from whole to a part

b) Independent check

c) Consistency of work

d) Accuracy required

**The different methodology were use in surveying to solve the problems arise in the field. These methodologies are as fallows:**

**RECONNAISSANCE**

The planning of the work is necessary to accomplish the work without any irregularity and difficult in routing. Planning also helps to complete the work in systematic order in short span of time with the least effort of time. So, for better planning details inspection of the area to be surveyed that is Chapagaun are was perform by the method known as RECONNAISSANCE ( RECCE) survey.

The following points should be kept in mind while selecting major and minor traverse control points to form a close traverse around the perimeter of the area:

**1.** The adjacent station should be clearly intervisible and cover the whole area with least numbers of stations as far as possible. The traverse station should maintain the ratio of maximum traverse leg to minimum traverse leg less than 1:2 for major and 1:3 for minor traverse.

**2.** The steep slope and badly broken ground should be avoided as far as possible, which ma cause in accuracy in tapping.

**3.** The station should provide minimum level surface required setting of the tripod of the instrument.

**4.** Traverse line of the sight should not be near ground level to avoid the refraction.

**5.** If possible well condition triangle should be formed to give graphical intersection during plotting.

The whole area was inspected by working around two times and major ground features were noted. The possible location of major and minor control points were decided by inspecting the indivisibility of the station. After sketching the rough outlines of the area and possible station distance of leg were estimated to make them within specific range that is 1:2 ratio for major traverse and 1:3 for minor traverse. 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 station by driving wooded pegs on the ground and it was name by a marker or enamel. The measurement of each station from reference point such as permanent object near it were taken hence, the **reconnaissance** survey was completed after fixing all the control points.

**TRAVERSING**

Traversing is a type of surveying in which a number of connected survey lines form the framework. It is also a method of control surveying. The survey consists of the measurement of

**1.** Angles between successive lines or bearings of each line

**2.** The length of each line

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

XB=XA+Lsinθ; YB=YA+Lcosθ

Where, L=Length of traverse leg

Ө=Bearing of AB

**CLOSE TRAVERSE**: The traverse in which final station co-incide with initial station is called closed traverse. In other words the traverse in which traverse line runs in between known co-ordinates is also known as close traverse. Linked traverse is one of the example of closed.

*ADJUSTMENT OF ANGULAR ERROR AND BEARING*

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. If the closed

traverse, has **N** number of sides then,

Correction for the first line = **e/N**

Correction for the second line = **2\*(e/N)**

And similarly, correction for the last line = **N\*(e/N)** = **e**

In a closed traverse, by geometry, the sum of the interior angles should be equal to **(2n-4)\*90˚** where **n** is the number of traverse stations. If the angles are measured with the same degree of precision, the error in the sum of the angles may be distributed equally among each angle of the traverse.

**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 theodolite at 0°00’00” for one set and 90°00’00” for the second.**SE:**

In the Survey Camp, two traverses - major and minor had to be established. The major traverse had 15 control stations including two given control points. The control stations were named as HM1, HM2 and so on along with CP1 and CP2 (the two given control points) .The leg ratio of maximum traverse leg to minimum traverse leg was maintained within 2:1. 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.

**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 minor traverse. The minor traverse had 10 control stations and enclosed the Population Building and Education, which was named Plot No 2. The control stations were named as 10m1, 10m2 and so on up to 10m10 along with the three control stations of major loop 10M7, 10M8, 10M12 common for both the major and the minor traverses. The leg ratio of maximum traverse leg to minimum traverse leg was maintained within 3:1. The discrepancy in length between the forward measurements and the backward measurements of all the traverse legs was within 1:2000.

**DETAILING**

**TACHEOMETRY**

Tacheometry is a branch of angular surveying in which the horizontal and vertical distances of points are obtained by optical means. Though it has less accuracy, about 1/300 to 1/500, it is faster and convenient than the measurements by tape or chain. It is very suitable for steep or broken ground, deep ravines, and stretches of water or swamp where taping is impossible. The objective of the tachometric survey is the preparation of the topographic map or plan with both horizontal and vertical controls. For the survey of high accuracy, it provides a check on the distances measured by tape.

The formula for the horizontal distance, for the tachometer with the additive constant 0.00 and multiplying constant 100.00 is,

**H= K S Cos2θ**

The formula for the vertical distance is,

**V = (K S Sin2 θ)/2 = HTan θ**

Were,

S = staff intercept =Top Reading – Bottom Reading

K = Multiplying Constant (Generally = 100)

**θ** = Vertical angle on Theodolite.

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

**R. L. of Point = R. L. of Instrument Station + H. I. + V- R**

**CONTOURING:**

A contour is an imaginary line, which passes through the points of equal elevation. It is a line in which the surface of ground is intersected by a level surface. Every fifth contour lines must be made darken. While drawing the contour lines, the characteristics of the contours should be approached.

⮚ 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 ridgeline, 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.

**METHODS OF CONTOURING:**

Taking the reading at the change point on the ground does the indirect method of locating contours. The interpolation method is used to draw the contour lines. Interpolation of contours is done by estimation, by arithmetic calculations or by graphical method. The eye estimation method is extremely rough and is used for small-scale work only.

There are two method of locating contour:

**a) The Direct Method**:

In this method, the points of equal elevations are found directly on the field. The horizontal control of the point is found by the help of plane table.

**b) The Indirect Method:**

In this method, some suitable guide points need not necessarily be on the contour. There are some of the indirect methods of location the ground points:

a) Square Method

b) Cross- Section Method

c)Tachometric Method

Interpolation is the process of spacing the contours proportionately between the slopes of the ground between the two points is uniform. The interpolation of contour cans be done on following three ways:

**LEVELLING**

Leveling is a branch of surveying, the objectives of which are:

❖ 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 respects to a given or assumed datum.

Two types of leveling are used in general Engineering practices, namely direct leveling (spirit leveling) and indirect leveling (trigonometric leveling).

**DIRECT LEVELLING**

It is the branch of leveling in which the vertical distances with respect to a horizontal line (perpendicular to the direction of gravity) may be used to determine the relative difference in elevation between two adjacent points. A level provides horizontal line of sight, i.e. a line tangential to a level surface at the point where the instrument stands. The difference in elevation between two points is the vertical distance between two level lines. With a level set up at any place, the difference in elevation between any two points within proper lengths

of sight is given by the difference between the staff readings taken on these points. By a succession of instrument stations and related readings, the difference in elevation between widely separated points is thus obtained.Following are some special methods of direct (spirit) leveling:

**DIFFERENTIAL LEVELING**

It is the method of direct leveling the objective of which is solely to determine the difference in elevation of two points regardless of the horizontal positions of the points with respect of each other. This type of leveling is also known as fly leveling.

**PROFILE LEVELING**

It is the method of direct leveling the objective of which is to determine the elevations of points at measured intervals along a given line in order to obtain a profile of the surface along that line.

**CROSS SECTIONING**

Cross-sectioning or cross leveling is the process of taking levels on each side of main line at right angles to that line, in order to determine a vertical cross-section of the surface of the ground, or of underlying strata, or of both.

**RECIPROCAL LEVELING**

It is the method of leveling in which the difference in elevation between two points is accurately determined by two sets of reciprocal observations when it is not possible to set up the level between the two points.

**INDIRECT LEVELING**

Indirect method or trigonometric leveling is the process of leveling in which the elevations of points are computed from the vertical angles and horizontal distances measured in the field, just as the length of any side in any triangle can be computed from proper trigonometric relations.

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 ADJUSTMENT OF LEVEL**

The adjustment made at every set up of the level before the staff reading are taken are known as the temporary adjustments. The following steps are followed for the temporary adjustments of level:

⮚ **Setting up the level:** a suitable location is chosen to set the level. The instrument is fixed on the tripod and the instrument is roughly leveled using the legs of the tripod in such a way that the plate level of levelling machine gets tentitively horizontal.

⮚ **Levelling up:** In this process the levelling machine is made horizontal parallel to the ground by moving the foot screws inward or outwards by making bubble of levelling machine at central position.

⮚ **Elimation of parallex:**The image forme by the objective lens of the telescope must lies on the plane of the cross hairs. If the image formed by the obsective is not the plane of cross-hairs, then there exists parallex. For accurate sighting parallex must be eliminated which cab be done in

❖ **Focusing the eye piece**: To focus the eye piece for the distinct vision of the cross-hairs, point the telescope towards the sky(or hold a sheet of white paper in front of the objective) and move the eye piece in or out till the cross-hairs are seen sharp and distinct.

❖ **Focusing the objective**: The telescope is now directed towards the staff and the focusing screw is turned till the image appears clear and sharp. The image hence formed lies on the plane of the cross hair.

**PERMANENT ADJUSTMENT OF LEVELLING**

To check for the permanent adjustments of level **two-peg test**

**Two peg test**

It is the test which is carried out to check whether the machine is useable or not. Test carried out to determine whether the machine needs permanent adjustment or not is known as two peg test. Following steps are procedure in two peg test: (refer fig:5.5)

⮚ Fix two pegs A and B at a distance L on a fairly level ground.

⮚ Set up the level exactly at the midpoint C of AB take the staff reading on A and B, keeping the bubble cental of its run. Let the staff reding be X and Y respectively.

⮚ Shift the level to a point D at a distance I from A on the line BA produced.

⮚ Read the staff reading on A and B. let the staff reading X1 and Y1 respectively.

⮚ Calculate the true difference of level by subtracting the readings X from reading Y when the level was at C.

⮚ Calculate the apparent difference of level by subtracting the readings X1 from reading Y1 when the level was at C.

⮚ If two difference are equal the instrument is in adjustment.

⮚ If not find whether there is rise or a fall from a peg A to B. If X ie .greater than Y, B is higher than A and vise versa.



Calculate the readings Y2 on the peg B ata the same level as of X1 i.e.

Reading on Peg B = Reading on A ±True difference

i.e. Y2=X1±True difference [+ for fall and – for rise]

⮚ If Y1 is greater than Y2 , the line of collimation is inclined upwards. If Y1 is smaller than Y2 the line of collimation is inclined downwards.

⮚ Calculate the net collimation error in distance L

i.e. collimation error in distance L= Y1 – Y2

collimation error per unit distance =

⮚ Calculate the required correction for the readings on pegs A and B

Collimation correction to the reading on peg A =

Collimation correction to the reading on peg B =

⮚ Add the collimation correction to the staff readings if the line of sight is inclined downward and subtract it, in case it is inclined upwards.

⮚ Loosen the capstan headed screw and shift the horizontal wire read the corrected reading of B. check the reading on A whether it agrees with the calculated reading. Repeat the adjustment, if found necessary.

**BOOKING METHODS, THEIR REDUCTION AND ARTHEMATIC CHECKS**

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

**Rise and fall method:** In this method, the difference of level between two consecutive points for each seeting of the instrument is obtained by comparing their staff readings. The difference between their staff readingd indicates a rise if the back staff resding is more than the fore sight and fall if it is less than the fore sight. The rise and fall is computed for all the points which gives the verticla distance of each pount relative to preceeding one. If RL of back staff point is known, the RL of following point may be obtained by adding the rise or subtracting its fall from RL of preceeding point as the case may be.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | **BS** | **IS** | **FS** | **Rise** | **Fall** | **RL** | **Remarks** |
|  |  |  |  |  |  |  |  |
| **total** |  |  |  |  |  |  |  |

**Arithmetic check:**

The difference between the sum of Back sights and the sum of fore sight should be equal to the difference of sum of rises and the sum of falls and should also be equal to difference between the RL of last point and RL of frist point

**Height of collimation(Instrument) method:**In this method , height of the instrument(HI) is calculated for each setting of the instrument by adding the back sight(BS) reading to the elevation of the BM. The reduced level of the frist station is obtained by substracting its fore sight from the instrument height(HI).For the second setting of the instrument, the height of the

instrument is calculated by adding the back sight taken to the frist station to its reduced level. The reduced level of the last point is obtained by substracting the fore sight of the last point from the height of instrument at the last setting. If the intermediate sight is observed to an intermediate station, its reduced level is obtained by subtracting its foresight from the height of instrument for its setting.

RL of HI = RL of known point(BM) – BS

RL of ground=RL of HI – IS(or FS)

**Arithmetic check:** The difference between the sum of the back sights and the sum of the fore sights should be equal to the difference between the RL of the last point and RL of the frist point

**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 MAJOR AND MINOR TRAVERSE STATIONS**

The R. L of the temporary benchmark was then transferred to the control stations of the major and minor traverse. The closing error was found to be within the permissible limits. The misclosure was adjusted in each leg of the leveling path by using the following

formula:

Permissible error = ±25√ mm.

Where k is perimeter in Km

Actual Error (e) = ΣBS – ΣF.S. = Last R.L. – First R.L.

Correction ith leg=-(e x (L1 + L2 +….+ Li)/P

Where L1, L2… Li are Length of 1st 2nd,.. ith leg.

P is perimeter

Relative Precision= 1/(p/e)

**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:

Latitude = L Cos **θ**

Departure = L Sin **θ**

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 and error is known as closing error.

Mathematically,

Closing error (e)=

Direction, tan **θ=**

The sign of ΣL and ΣD will thus define the quadrant in which the closing error lies. The relative error of closure = Error of Closure / Perimeter of the traverse

= e / p

= 1 / (p / e)

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. If the closed

traverse, has N number of sides then,

Correction for the first line = e/N

Correction for the second line = 2e/N

And similarly, correction for the last line = Ne/N = e

In a closed traverse, by geometry, the sum of the interior angles should be equal to (2n-4) x 90˚ where n is the number of traverse sides. If the angles are measured with the same degree of precision, the error in the sum of the angles may be distributed equally among each angle of the traverse. The Bow ditch’s method or the compass rule is mostly used to balance a traverse where linear and angular measurements are of equal precision. The total error in latitude and in the departure is distributed in proportion to the lengths of the sides.

**Mathematically,**

1) Correction in departure of a side of traverse = (Total Dept. Misclosure / Traverse Perimeter) \*(length of that side)

2) Correction in latitude of a side of traverse = (Total Lat. Misclosure / Traverse Perimeter) \* (length of that side)

In order to measure the lengths of the sides of the traverse, two ways taping (forward and backward) is done. In difficult areas where taping is not possible, other methods like the subtense bar is used. The difference in values obtained by forward and backward taping is called discrepancy. In addition, the reciprocal of the discrepancy divided by the mean of the two measurements is called precision. Both the discrepancy and the precision for each traverse leg should be within the given limits.

Mathematically

Discrepancy = | Forward length - Backward length | And

Linear precision = 1 / (Mean length / Discrepancy)

The coordinates of traverse station were found out by resection. The resection point was selected at the top of hostel building from where all the known points can be sighted. The coordinates of known points are given below.

**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:

1) Observing horizontal angles from the unknown point to three known points.

2) Observing horizontal angles from two unknown points to two known points.

3) Observing horizontal angles from one unknown point to two known points when the Azimuth of one of them is known.

In the camp we had adopt first method i.e. resection by observing horizontal angles from the unknown point to three known points.

**PLOTTING OF MAJOR & MINOR TRAVERSE**

The traverse was made closed in order to check the sum of interior angles, which should be equal to **(2n-4) \*90** degrees, where n= number of control points. (Traverse stations or legs).

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

After computing the co-ordinate of each of the control points, they were made ready to plot. Full size drawing sheets i.e. A0 sizes were divided into gridlines of 5cm Square. The gridlines were made with the help of a beam compass. 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 coordinates.

Minor Traverse was plotted in similar way to scale **1:500** over which later detailing by tachometry was done.

**COMMENTS AND CONCLUSION**

The site for survey camping was Dhampus Resort, Pokhara. 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 given the accurate reading. We hope that there will be sufficient number of instruments for next survey camp.

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. Thus, this camp helps us by practicing the survey work to gain the much essential knowledge as far as possible. 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 Dhampus Resort, Pokhara 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 Dhampus Resort, Pokhara after combining it.

**BRIDGE SITE SURVEY**

Bridges are structures constructed to connect localities separated by depressions and obstructions like valley, gorges and rivers. They usually come as a part of road and helps to lay and continue the road across these natural obstructions as mentioned above and thereby making the road short and convenient.

For countries like us where the areas are mostly mountainous and with a number of rivers flowing, also being a land locked country road becomes a very important means of transportation. And thus, there may be a number of places where bridges are needed to be constructed.

This part of the report covers the bridge site survey done at ……………………during the Survey Camp 2079. The duration of the survey was for one days from 2079/05/4

In this survey, we had to:

⮚ Decide the best possible alignment for a bridge to be constructed across the river.

⮚ Determine the bridge axis.

⮚ Take sufficient data to get the length of the bridge proposed.

⮚ Take data for L- section, X- Section of river upstream and downstream for the bridge axis to study the properties of river, like – discharge of water, bed slope, velocity of water etc.

⮚ Take spot heights of area around the bridge axis for preparation of topographic map.

**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.

**BRIEF DESCRIPTION OF THE AREAS**

Bridge site survey includes both the works 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. Road alignment survey was conducted at………. Dhampus Pokhara. Along its side most of the land is cultivated.

**HYDROLOGY AND GEOLOGY**

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 side show that the highest flood level.

**NORMS (TECHNICAL SPECIFICATION)**

A bridge site topographical survey was carried out and the alignment of the bridge axis was fixed by triangulation. Along with these we were also supposed to read L-section and X-section of the river downstream and upstream. A topographic map was prepared by tacheometric surveying and longitudinal and cross-sectional profile of the area was drawn. The scales for plotting are as follows:

Scale of topographic map =1:500

**Scale of L-Section:**

Horizontal scale =1:1000

Vertical scale = 1:100

**Scale of Cross-section**

Horizontal scale = 1:100

Vertical scale =1:100

**EQUIPMENT & ACCESSORIES**

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

1. Theodolite

2. Leveling Staffs

3. Ranging rods

4. Measuring Tapes 50m

5. Leveling instruments

6. Compass

7. Pegs

8. Marker

**METHODOLOGY**

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

**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. 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.

The main factors to be considered for a bridge site selection can be summed as follows:

❖ Geological conditions

❖ Topographical situations

❖ Appropriate span of the bridge and possible bridge type

❖ Width of the river

❖ High flood level

❖ Presence of rivulets, sprigs, drains, irrigation channels etc

❖ Necessity of new trial development after the construction of the bridge

❖ Tendency of the river banks erosion, silting and following up

❖ Flow direction and the speed of the water flow

❖ Condition of the river bank

❖ Possibility of change of river coarse

❖ Hydrological condition

❖ Geomorphic of the area

❖ Lithe logical factor

❖ Vegetation cover

**TOPOGRAPHIC SURVEY**

For the topographic survey of the bridge site triangulation was done. First the bridge axis was set and horizontal control stations were fixed on either side for detailing. Distances between stations on the same sides of river i.e. base line were measured with tape precisely. Then the interconnecting triangles were formed and angles were measured with theodolite. The bridge axis length or span was calculated by solving the triangles using the **Sine** rule. Thus, the horizontal control was set out.

For vertical control, the level was transferred from the TBM to the I.P.s of the road and was transferred to the stations on the next bank by reciprocal leveling. For the same bank direct level transfer method was used.

**LONGITUDINAL SECTIONING**

The L-section of the river is needed to have an idea about the nature of the river bed and elevation at different points and its change in gradient along the length of the river.

For the longitudinal section of the river, the staff reading was taken at the interval of 15m. This was done up to 45m downstream and 60m upstream. While taking the reading, the staff was erected on the bed of the river and not over the stones. The chainage was measured along the river flow direction by spreading the tape over water.

L-section was plotted on a graph with the horizontal and vertical elevation to a scale 1:1000 and 1:100 respectively.

**CROSS SECTIONING**

Cross sectioning of a river at a point extends laterally on either side of the center line of the river at right angle to the L-section. They are used to determine the lateral outline of the riverbed and to calculate volume of water flowing at particular section and also the discharge of water, knowing the velocity at that section.

At every 15 m chainage, the readings were taken for cross sectioning. The spot heights were taken where the change in slope was noticed or remarkable points were noticed such as normal depth level, flood depth level, riverbank etc. Theodolite was used for this purpose. Cross sectioning was plotted on the graph at a scale of 1:100. The cross-section was plotted by using the topographic map of bridge site previously plotted.

**LEVELING**

**TRANSFERRING R.L. FROM B.M. TO CONTROL POINTS:**

Transferring R.L. was transferred from the B.M. by fly leveling taking the back sight reading to the bench mark which should be within the given accuracy. The R.L. to the opposite bank of the river was transferred by reciprocal leveling.

**RECIPROCAL LEVELING:**

The operation of leveling in which difference in elevations between the points is accurately determined by two sets of reciprocal observations, is called reciprocal leveling. Reciprocal leveling is employed when it is not possible to set up the level between two points due to an intervening obstruction such as large water body.may be determined as follows:

i. Set up the level very near to A.

ii. Keeping the bubble of the level tube central, take readings on the staff held at A and B.

iii. Let the staff readings on A and B be a1 and b1 respectively.

iv. Transfer the instrument to B and set it up very near to B.

v. With the bubble at center of its run, read the staff held at A and at B.

vi. Let the staff readings at A and B be a2 and b2 respectively.



**DETAILING**

The detailing was done with the help of Total Station. The important details, which were not included in the cross-section data, were taken. Trigonometric leveling was also done to find out the RL of the inaccessible points. All the detailing points were noted for the topographic view of the bridge site.

Triangulation was performed for the determination of the approximate span of the bridge axis. The triangulation stations can be taken as the control points for detailing. Two points on either bank of the river were fixed as control points and one of the sides of the triangle was taken as the bridge axis. Then two triangles from each bank were fixed.

The base line was measured accurately by two ways tapping as well as tacheometry and interior angles were measured by taking two sets of reading by theodolite. The accurate span of bridge was computed by applying sine rule. To minimize the plotting error well-conditioned triangles were constructed i.e. the angles greater than 30 degree, less then 120 degree and nearer to 60 degree. The best triangle is equilateral triangle.

**COMPUTATION AND PLOTTING**

Let,

h = true difference of level between A and B

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

**First position of the level:**

The correct reading on staff B = b1 - e

The correct reading on staff A = a1

Assuming A to be higher than B, the true difference of level

h = (b1 – e ) – a1

h = (b1–a1) –e …………(i)

**Second position of the level:**

The correct reading on staff B = b2

The correct reading on staff A = a2 - e

The true difference of level

h = b2 –( a2 – e)

h = (b2–a2) + e ……….. (ii)

Adding equation i and ii and dividing by 2, we get

h =

i.e. the true difference of level between A and B is equal to the mean of the two apparent differences of levels.

The combined error can be obtained by equating the equations i and ii

i.e. (b1–a1) –e = (b2–a2) + e

e =

i.e., the combined error is equal to the half of the difference of the apparent differences of level.

The Calculations are shown in the Appendix.

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.

**COMMENTS AND CONCLUSION**

The bridge axis was set keeping in mind all the requisites that the proper site for the bridge has to be fixed. During the selection of the site all the considerations like geological, socio-economical and topographical considerations were made and the best site was selected. The inspection of the area showed that no springs, streams and sewer were discharged into the river up to the 60m upstream and 45m downstream of the axis site. The flow in river was normal and showed no danger of changing its direction of flow for the design period of the bridge.

**ROAD ALIGNMENT SURVEY**

Roads are one of the most important structures of a country. In case of country like ours where we have no boundary connected to Sea, Road becomes a major means of transportation. Thus, it has got great importance for us.

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.

**BRIEF DESCRIPTION OF THE PROJECT AREA**

Road alignment and bridge site survey includes both the works - to run a road between two far distance points 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.

Road alignment and bridge site survey includes both the works 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. The site is surrounded with steep hill, which is covered with densely planted shrubs. The route selected by our group H contained 14 I.P. with minimum grade of 0% and maximum grade of 12%. There are several rise and fall along the route needing lots of cutting, and filling.

**HYDROLOGY AND GEOLOGY**

The road had to go along a Forest route to the next village. There were no large boulders or rocks of any kind along the proposed site. The soil is uniform throughout the whole length of the road. Although the road alignment has certain up and downs with constant slopes. Finally, the starting and ending point of the road has not significant level differences.

**NORMS (TECHNICAL SPECIFICATION)**

Reconnaissance 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, 2m right of way (corridor width 2m left and 2m right) from proposed centre line, location of intersection point (IP), geometry of curves with BC, MC, EC and chainages of vegetation, forest, cultivation and barren land.

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

⮚ Recce and alignment selection of road corridor of about 250m or more.

⮚ Starting and ending point will be provided at the site.

⮚ 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 not less than 15m. While assuming the radius of horizontal curve, it should be in the multiple of 5 or 10.

⮚ The gradient of the road had to be maintained below 12 %.

⮚ 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.

**EQUIPMENTS & ACCESSORIES**

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

1. Theodolite

2. Leveling Staffs

3. Ranging rods

4. Measuring Tapes

5. Leveling instruments

6. Compass

7. Pegs

8. Marker

**METHODOLOGY**

The reconnaissance survey was performed along the proposed route from starting point and guess works were done for Intersection points where the direction had to be changed. While returning back the route, the IP’s were fixed. For this the inter visibility of the stations were checked. Meanwhile the pegs with IP number were driven at these points.

**RECONNAISSANCE**

The reconnaissance survey was performed by members of various groups at their minor traverses. Reece was done two times. At first site was seriously observed and at another time pegs were embedded on the ground. While returning back the route, the IP's were fixed. For this the inter-visibility of the stations was checked and gradient between the two IP was adjusted such that it does not exceed 12%. Meanwhile the pegs with IP number were driven at these points.

**SELECTION OF INTERSECTION POINTS (IP’S)**

The starting point of the road was taken as IP0. Obligatory points, permissible gradient, geometry of tentative horizontal and vertical curves must be considered. in this regard the following points should be taken in considerations.

 Longitudinal gradient should not exceed 12%.

 Radius of the horizontal curve should not be less than 12m.

 Two successive curves must not be overlapped.

**4.6.3 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 Theodolite at each IP and then deflection angles were calculated.

Deflection angle = (360or 180) - 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, BC, MC, EC, apex distance along with their chainage were found by using following formulae,

Tangent length (T L) = R \* Tan (/2)

Length of curve (L.C) = 3.142 \* R \* /180

Apex distance = R \* 1/(Cos (/2)-1)

Chainage of BC = Chainage of IP – Tangent Length

Chainage of MC = Chainage of BC +LC/2

Chainage of EC = 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.

**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.

**LEVELING**

The R.L. of the temporary bench mark was given to be 1347.812m. The method of fly leveling was applied in transferring the level from the given T.B.M. to all the I.Ps, BC, MC and EC as well as to the points along the center line of the road where the cross sections were taken. The difference in the R.L. of the B.M. before and after forming the loops should be less than 25√K mm, where K is the total distance in Km.

**SECTION**

For the longitudinal section of the road the staff reading was taken at the interval of every 15m along the centerline of the road. Besides, these staff readings at beginning of the curve, mid of the curve and ending of the curve and apex distance were also taken. The RL of each point was calculated.

The profile was plotted on the graph at the horizontal scale of 1:1000 and vertical scale of 1:100; chainage of each point along the horizontal direction and RL in the vertical direction.

**CROSS - SECTION**

Cross section was run at right angles to the longitudinal profile on either side up to 15m distances wherever possible and the change in the slope was directly measured using the staff intercept made by the horizontal tape i.e. the stepping method.

Horizontal scale =1:100

Vertical scale =1:100

**TOPOGRAPHIC SURVEY**

Firstly we noted the necessary details to be taken along the site of road alignment and then the details were taken from IP, which gave the idea of the geological and topographical aspect along the alignment.

**STRUCTURES**

The main structures provided for road constructions are retaining structures, cross drain, side-drain, bio-engineering structures etc. retaining structures are provided where the slope is critical. Gabion structure, dry masonry structures are the example. The camber of the road is made perfectly by putting 4% of stage for gravel road so as to avoid any collection of water on it.

The maximum gradient of the road is about 9% and the minimum gradient of road is about 0% so as to facilitate the flow of drainage to specified direction. However, the maximum of 12% was taken wherever not possible. Longitudinal drain is provided on the sides of the road. Retaining walls are provided on required places.

Construction of hill roads involves many special structures. These may include wide range of structures which are used to retain soil mass, to increase stability of road embankment slopes as well as natural hill slopes, to accommodate road bed in steep slope, to penetrate deep through mountain pass and so on. Integration of bioengineering measures with engineering structures is yet another sector requiring special attention. The following types of structures are used normally on the hill road:

⮚ Retaining structures

⮚ Drainage structures

⮚ Slope protection structures

**RETAINING STRUCTURES**

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

1. Gravity walls

2. Semi gravity walls

3. Cantilever walls

4. Counter fort walls

5. Buttressed walls

6. Crib walls

7. Breast walls

8. Reinforced soil walls

**COMMENTS & CONCLUSION**

Survey of the road alignment is done to make most economical, comfortable, and durable. Extra case 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.

**CONCLUSION**

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 due to rain especially during our orientation. 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 Every Engineering College 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 heartly acceptable. During report preparation all confusion are cleared by teacher whom we are very grateful.

**“THANK YOU”**

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**Linear Distance Measurement Sheet**

**(MAJOR TRAVERSE)**

**Group: - “C”**

**Date: -2079/04/31**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. N** | **Leg.** | **DISTANCE** | | **Discrepancy**  **(D=)** | **Average**  **Avg=[(F+B)/2]** | **Precision=D/Avg.** | **Remarks** |
| **Forward (F)** | **Backward (B)** |
| 1. | 1-2 | 28.372M | 28.370M | 0.002M | 28.371M | 1:14185.5 | OK |
| 2. | 2-3 | 35.447M | 35.446M | 0.001M | 35.446M | 1:35446.0 | OK |
| 3. | 3-4 | 32.336M | 32.337M | 0.001M | 32.336M | 1:32336.5 | OK |
| 4. | 4-1 | 37.100M | 37.098M | 0.002M | 37.099M | 1:18549.5 | OK |

**Discrepancy = Forward- Backward , Different in two measurements, always +ve.**

**Average= (Forward+ Backward)/2**

**Precision=** (**Discrepancy/ Average), to be found out in (1:2000)**

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**TRAVERSING (Major and Minor)**

**HORIZONTAL ANGLE MEASURMENT SHEET**

**Group: - “C”**

**Date: -2079/04/31**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **INST. &**  **HI** | **SIGHTED**  **TO** | **FACE** | **HORIZONTAL ANGLE** | | | | | | | | | | | | | | | | | | **MEAN HORIZON-TAL**  **ANGLE** | | | **REMARKS** |
| **SET 1 (00 SET)** | | | | | | | | | **SET 2 (90 SET)** | | | | | | | | |
| **Hor.circle. reading** | | | **Hor. Angle** | | | **Mean Hor. Angle** | | | **Hor.circle. reading** | | | **Hor. Angle** | | | **Mean Hor. Angle** | | |
| **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** |
| **1** | **4** | **L** | 0 | 0 | 0 | 103 | 13 | 48 | 103 | 13 | 58.5 | 90 | 0 | 0 | 103 | 13 | 48 | 103 | 13 | 58.5 | 103 | 13 | 58.3 |  |
| **R** | 179 | 59 | 56 | 269 | 59 | 56 |
| **2** | **L** | 103 | 13 | 48 | 103 | 14 | 9 | 193 | 13 | 48 | 103 | 14 | 9 |
| **R** | 283 | 14 | 05 | 13 | 14 | 5 |
| **2** | **1** | **L** | 0 | 0 | 0 | 82 | 47 | 57 | 82 | 46 | 5 | 90 | 0 | 0 | 82 | 47 | 57 | 82 | 46 | 5 | 82 | 46 | 5 |  |
| **R** | 179 | 59 | 36 | 269 | 59 | 36 |
| **3** | **L** | 82 | 47 | 57 | 82 | 44 | 13 | 172 | 47 | 57 | 82 | 44 | 13 |
| **R** | 262 | 43 | 49 | 352 | 43 | 49 |
| **3** | **2** | **L** | 0 | 0 | 0 | 98 | 54 | 46 | 98 | 54 | 15.5 | 90 | 0 | 0 | 98 | 54 | 46 | 98 | 54 | 16.5 | 98 | 54 | 16 |  |
| **R** | 180 | 01 | 39 | 270 | 01 | 38 |
| **4** | **L** | 98 | 54 | 46 | 98 | 53 | 45 | 188 | 54 | 43 | 98 | 53 | 47 |
| **R** | 278 | 55 | 24 | 8 | 55 | 25 |
| **4** | **3** | **L** | 0 | 0 | 0 | 75 | 04 | 03 | 75 | 4 | 58.5 | 90 | 0 | 0 | 75 | 4 | 3 | 75 | 4 | 59 | 75 | 4 | 58.7 |  |
| **R** | 180 | 0 | 0 | 269 | 59 | 59 |
| **1** | **L** | 75 | 04 | 03 | 75 | 5 | 54 | 165 | 4 | 3 | 75 | 5 | 55 |
| **R** | 255 | 05 | 54 | 345 | 5 | 54 |

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**HORIZONTAL ANGLE MEASURMENT SHEET**

**Group: - “C”**

**Date: -2079/04/31**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **INST. &**  **HI** | **SIGHTED**  **TO** | **FACE** | **HORIZONTAL ANGLE** | | | | | | | | | | | | | | | | | | **MEAN HORIZON-TAL**  **ANGLE** | | | **REMARKS** |
| **SET 1 (00 SET)** | | | | | | | | | **SET 2 (90 SET)** | | | | | | | | |
| **Hor.circle. reading** | | | **Hor. Angle** | | | **Mean Hor. Angle** | | | **Hor.circle. reading** | | | **Hor. Angle** | | | **Mean Hor. Angle** | | |
| **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** | **D** | **M** | **S** |
| **1** | **4** | **L** | 0 | 0 | 0 | 103 | 13 | 48 | 103 | 13 | 58.5 | 90 | 0 | 0 | 103 | 13 | 48 | 103 | 13 | 58.5 | 103 | 14 | 8.95 |  |
| **R** | 179 | 59 | 56 | 269 | 59 | 56 |
| **2** | **L** | 103 | 13 | 48 | 103 | 14 | 9 | 193 | 13 | 48 | 103 | 14 | 9 |
| **R** | 283 | 14 | 05 | 13 | 14 | 5 |
| **2** | **1** | **L** | 0 | 0 | 0 | 82 | 47 | 57 | 82 | 46 | 5 | 90 | 0 | 0 | 82 | 47 | 57 | 82 | 46 | 5 | 82 | 46 | 14.45 |  |
| **R** | 179 | 59 | 36 | 269 | 59 | 36 |
| **3** | **L** | 82 | 47 | 57 | 82 | 44 | 13 | 172 | 47 | 57 | 82 | 44 | 13 |
| **R** | 262 | 43 | 49 | 352 | 43 | 49 |
| **3** | **2** | **L** | 0 | 0 | 0 | 98 | 54 | 46 | 98 | 54 | 15.5 | 90 | 0 | 0 | 98 | 54 | 46 | 98 | 54 | 16.5 | 98 | 54 | 26.45 |  |
| **R** | 180 | 01 | 39 | 270 | 01 | 38 |
| **4** | **L** | 98 | 54 | 46 | 98 | 53 | 45 | 188 | 54 | 43 | 98 | 53 | 47 |
| **R** | 278 | 55 | 24 | 8 | 55 | 25 |
| **4** | **3** | **L** | 0 | 0 | 0 | 75 | 04 | 03 | 75 | 4 | 58.5 | 90 | 0 | 0 | 75 | 4 | 3 | 75 | 4 | 59 | 79 | 5 | 9.15 |  |
| **R** | 180 | 0 | 0 | 269 | 59 | 59 |
| **1** | **L** | 75 | 04 | 03 | 75 | 5 | 54 | 165 | 4 | 3 | 75 | 5 | 55 |
| **R** | 255 | 05 | 54 | 345 | 5 | 54 |

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**Two-Peg Test**

**Group: - “C”**

**Date: -2079/05/02**

**When Instrument is kept at Mid of Stations A and B**

|  |  |  |  |
| --- | --- | --- | --- |
| Sighted to A | I | II | III |
| Top | 1.433 |  |  |
| Middle | 1.394 |  |  |
| Bottom | 1.360 |  |  |
| Average | 1.396 |  |  |
| Status |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Sighted to B | I | II | III |
| Top | 1.400 |  |  |
| Middle | 1.369 |  |  |
| Bottom | 1.322 |  |  |
| Average | 1.360 |  |  |
| Status |  |  |  |

Level Difference between A and B (Z)= 0.036m

**When Instrument is kept at Mid of Stations A and B**

|  |  |  |  |
| --- | --- | --- | --- |
| Sighted to A | I | II | III |
| Top | 1.191 |  |  |
| Middle | 1.176 |  |  |
| Bottom | 1.161 |  |  |
| Average | 1.176 |  |  |
| Status |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Sighted to B | I | II | III |
| Top | 1.229 |  |  |
| Middle | 1.139 |  |  |
| Bottom | 1.049 |  |  |
| Average | 1.139 |  |  |
| Status |  |  |  |

Level Difference between A and B (Z’) = 0.037m

Error (Z-Z’) = 0.001

Accuracy =Error/length

= 6.666 x 10-5

Permissible Error: 1:2000

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**FLY LEVELLING SHEET**

**Group: - “C”**

**Date: -2079/05/02**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STN** | **BACK SIGHT** | | | | | **FORE SIGHT** | | | | | **RISE** | | **FALL** | **S=(S1+S2)** | **HOR.DISTANCE**  **100S** | **RL** | **REMARKS** |
| **T** | **M** | **B** | **AVG** | **S2=T-B** | **T** | **M** | **B** | **Avg.** | **S2=T-B** |
| 1 | 1.140 | 1.092 | 1.044 | 1.092 | 0.096 |  |  |  |  |  |  | |  | 0.096 | 9.6 | 1350 | **BM** |
| 2 | 1.611 | 1.502 | 1.513 | 1.562 | 0.098 | 1.262 | 1.214 | 1.168 | 1.214 | 0.094 |  | | 0.122 | 0.192 | 19.2 | 1347.878 |  |
| 3 | 1.613 | 1.564 | 1.525 | 1.564 | 0.088 | 1.411 | 1.361 | 1.321 | 1.361 | 0.099 | 0.201 | |  | 0.187 | 18.7 | 1350.079 |  |
| 4 | 1.703 | 1.602 | 1.02 | 1.601 | 0.201 | 1.489 | 1.433 | 1.383 | 1.433 | 0.106 | 0.131 | |  | 0.307 | 30.7 | 1350.21 |  |
| 5 | 0.856 | 0.804 | 0.753 | 0.804 | 0.103 | 1.004 | 0.835 | 0.667 | 0.835 | 0.337 | 0.767 | |  | 0.44 | 44 | 1350.977 |  |
| 6 | 1.327 | 1.275 | 1.224 | 1.275 | 0.103 | 2.201 | 2.150 | 2.100 | 2.150 | 0.101 |  | | 1.346 | 0.204 | 20.4 | 1349.631 |  |
| 7 | 1.403 | 1.059 | 0.976 | 1.059 | 0.427 | 1.652 | 1.601 | 1.551 | 1.601 | 0.101 |  | | 0.326 | 0.528 | 52.8 | 1349.305 |  |
| 8 | 0.719 | 0.662 | 0.690 | 0.662 | 0.029 | 1.823 | 1.798 | 1.774 | 1.798 | 0.049 |  | | 0.739 | 0.078 | 7.8 | 1348.566 |  |
| 9 | 1.187 | 1.154 | 1.121 | 1.154 | 0.066 | 1.452 | 1.416 | 1.380 | 1.416 | 0.072 |  | | 0.754 | 0.138 | 13.8 | 1347.812 | **TBM** |
| 10 | 1.994 | 1.964 | 1.935 | 1.964 | 0.059 | 1.00 | 0.928 | 0.905 | 0.928 | 0.095 | 0.171 | |  | 0.154 | 15.4 | 1347.983 |  |
| 11 | 1.771 | 1.685 | 1.600 | 1.685 | 0.171 | 1.061 | 1.027 | 0.994 | 1.027 | 0.067 | 0.937 | |  | 0.238 | 23.8 | 1348.92 |  |
| 12 | 1.564 | 1.544 | 1.524 | 1.544 | 0.04 | 1.115 | 1.026 | 0.937 | 1.026 | 0.178 | 0.659 | |  | 0.218 | 21.8 | 1349.572 |  |
| 13 | 1.993 | 1.972 | 1.951 | 1.972 | 0.042 | 0.845 | 0.823 | 0.801 | 0.823 | 0.044 | 0.721 | |  | 0.086 | 8.6 | 1350.3 |  |
| 14 | 1.151 | 1.052 | 0.953 | 1.052 | 0.198 | 1.892 | 1.791 | 1.691 | 1.791 | 0.201 | 0.181 | |  | 0.399 | 39.9 | 1350.481 |  |
| 15 | 1.213 | 1.131 | 1.050 | 1.131 | 0.163 | 1.541 | 1.440 | 1.339 | 1.440 | 0.202 |  | | 0.338 | 0.369 | 36.9 | 1350.093 |  |
| 16 |  |  |  |  |  | 1.193 | 1.106 | 1.020 | 1.106 | 0.173 | 0.025 | |  | 0.173 | 17.3 | 1350.118 | **BM** |
| Total | | | | 20.13 |  | | | | 20.012 |  | | 3.793 | 3.675 |  | 380 |  |  |

Permissible error=25\*

=25\*

=15.41mm

**RISE-** **FALL=** **BACK SIGHT-** **FORE SIGHT=Last RL-First RL**

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**ROAD SURVEY**

(PROFILE & CROSS-SECTIONING LEVELLING)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STN** | **CHAINAGE** | | | | **BS** | **IS** | **FS** | **RISE** | **FALL** | **R. L** | **REMARKS** |
| **LEFT** | **CENTER** | | **RIGHT** |
| 2 |  |  | |  | 0.524 |  |  |  |  | 1347.812 | TBM |
|  |  |  | |  |  | 1.824 |  |  | 1.3 | 1346.512 | AP |
|  |  |  | |  |  | 1.769 |  | 0.055 |  | 1346.567 | 2 |
|  |  |  | |  |  | 1.805 |  |  | 0.036 | 1346.531 | 4 |
|  |  |  | |  |  | 1.562 |  | 0.243 |  | 1346.774 | 2 |
|  |  |  | |  |  | 1.854 |  |  | 0.292 | 1346.482 | 4 |
|  |  |  | |  |  | 1.614 |  | 0.24 |  | 1346.722 | 6 |
|  |  |  | |  |  | 1.343 |  | 0.371 |  | 1346.993 | 8 |
|  |  |  | |  |  | 1.066 |  | 0.277 |  | 1347.27 | 10 |
|  |  | |  |  |  | 1.956 |  |  | 0.89 | 1346.38 | BC |
|  |  | |  |  |  | 1.876 |  | 0.08 |  | 1346.46 | 2 |
|  |  | |  |  |  | 1.896 |  |  | 0.02 | 1346.44 | 4 |
|  |  | |  |  |  | 1.939 |  |  | 0.043 | 1346.397 | 6 |
|  |  | |  |  |  | 1.926 |  | 0.013 |  | 1346.41 | 8 |
|  |  | |  |  |  | 1.945 |  |  | 0.019 | 1346.391 | 10 |
|  |  | |  |  |  | 1.881 |  | 0.061 |  | 1346.452 | 12 |

**Group: - “C”**

**Date: -2079/05/03**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STN** | **CHAINAGE** | | | | **BS** | **IS** | **FS** | **RISE** | **FALL** | **R. L** | **REMARKS** |
| **LEFT** | **CENTER** | | **RIGHT** |
|  |  |  | |  |  | 1.875 |  |  |  |  | 2 |
|  |  |  | |  |  | 2.111 |  |  |  |  | 4 |
|  |  |  | |  |  | 2.084 |  |  |  |  | 6 |
|  |  |  | |  |  | 1.806 |  |  |  |  | 8 |
|  |  |  | |  |  | 1.758 |  |  |  |  | EC |
|  |  |  | |  |  | 1.737 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.701 |  |  |  |  | 4 |
|  |  |  | |  |  | 1.662 |  |  |  |  | 6 |
|  |  |  | |  |  | 1.644 |  |  |  |  | 8 |
|  |  | |  |  |  | 1.534 |  |  |  |  | 10 |
|  |  | |  |  |  | 1.766 |  |  |  |  | 2 |
|  |  | |  |  | 1.110 |  | 1.633 |  |  |  | 4(CA) |
|  |  | |  |  |  | 1.372 |  |  |  |  | BC |
|  |  | |  |  |  | 1.487 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.407 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.362 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.255 |  |  |  |  | 4 |
|  |  | |  |  |  | 2.286 |  |  |  |  | 6 |
|  |  | |  |  |  | 2.653 |  |  |  |  | 2(GAP) |
|  |  | |  |  | 2.892 |  | 2.824 |  |  |  | 2(CA) |
|  |  | |  |  |  | 1.320 |  |  |  |  | EC |
|  |  | |  |  |  | 1.291 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.251 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.209 |  |  |  |  | 2 |

**Group: - “C”**

**Date: -2079/05/02**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STN** | **CHAINAGE** | | | | **BS** | **IS** | **FS** | **RISE** | **FALL** | **R. L** | **REMARKS** |
| **LEFT** | **CENTER** | | **RIGHT** |
|  |  |  | |  |  | 1.196 |  |  |  |  | 4 |
|  |  |  | |  |  | 1.322 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.206 |  |  |  |  | 4 |
|  |  |  | |  | 0.825 |  | 1.090 |  |  |  | 6(CA) |
|  |  |  | |  | 1.056 |  | 2.405 |  |  |  | 2 |
|  |  |  | |  |  | 1.181 |  |  |  |  | AP |
|  |  |  | |  |  | 1.241 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.202 |  |  |  |  | 4 |
|  |  |  | |  |  | 1.332 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.421 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.447 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.556 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.545 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.599 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.633 |  |  |  |  | 6 |
|  |  | |  |  |  | 1.189 |  |  |  |  | BC |
|  |  | |  |  |  | 1.157 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.156 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.294 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.101 |  |  |  |  | GAP |
|  |  | |  |  |  | 1.099 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.215 |  |  |  |  | 4 |

**Group: - “C”**

**Date: -2079/05/02**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STN** | **CHAINAGE** | | | | **BS** | **IS** | **FS** | **RISE** | **FALL** | **R. L** | **REMA4RKS** |
| **LEFT** | **CENTER** | | **RIGHT** |
|  |  |  | |  |  | 1.474 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.491 |  |  |  |  | 4 |
|  |  |  | |  |  | 1.541 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.419 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.389 |  |  |  |  | 4 |
|  |  |  | |  |  | 1.489 |  |  |  |  | GAP |
|  |  |  | |  |  | 1.586 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.446 |  |  |  |  | 2 |
|  |  |  | |  |  | 1.484 |  |  |  |  | BC |
|  |  |  | |  |  | 1.451 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.357 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.503 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.505 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.354 |  |  |  |  | AP |
|  |  | |  |  |  | 1.289 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.242 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.347 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.386 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.339 |  |  |  |  | 2 |
|  |  | |  |  | 2.819 |  | 1.246 |  |  |  | 4 |
|  |  | |  |  |  | 1.549 |  |  |  |  | EC |
|  |  | |  |  |  | 1.664 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.674 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.629 |  |  |  |  | 2 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STN** | **CHAINAGE** | | | | **BS** | **IS** | **FS** | **RISE** | **FALL** | **R. L** | **REMARKS** |
| **LEFT** | **CENTER** | | **RIGHT** |
|  |  | |  |  |  | 1.535 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.476 |  |  |  |  | GAP |
|  |  | |  |  |  | 1.498 |  |  |  |  | 2 |
|  |  | |  |  |  | 1.485 |  |  |  |  | 4 |
|  |  | |  |  |  | 1.461 |  |  |  |  | 2 |
|  |  | |  |  |  |  | 1.504 |  |  |  | 4 |

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**BRIDGE SURVEY**

**Group: - “C” Date: -2079/05/04**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| INST | SIGHTED TO | FACE | HORIZONTAL ANGLE | | | | | | | | | REMARKS |
| SET 00 | | | | | | | | |
| Hor.circle Reading | | | Horizontal Angle | | | Mean horizontal angle | | |
| D | M | S | D | M | S | D | M | S |
| A | D | L | 0 | 0 | 0 | 108 | 48 | 19 | 108 | 48 | 36.5 |  |
| R | 180 | 0 | 28 |
| B | L | 108 | 48 | 18 | 108 | 48 | 55 |
| R | 228 | 49 | 23 |
| A | B | L | 0 | 0 | 0 | 27 | 18 | 51 | 27 | 19 | 43.5 |  |
| R | 180 | 0 | 06 |
| C | L | 27 | 18 | 51 | 27 | 20 | 36 |
| R | 207 | 20 | 42 |
| B | A | L | 0 | 0 | 0 | 25 | 41 | 17 | 25 | 42 | 10 |  |
| R | 179 | 58 | 53 |
| D | L | 25 | 41 | 17 | 25 | 43 | 3 |
| R | 205 | 41 | 56 |
| B | C | L | 0 | 0 | 0 | 103 | 23 | 37 | 103 | 23 | 48 |  |
| R | 179 | 59 | 0 |
| A | L | 103 | 23 | 37 | 103 | 23 | 59 |
| R | 283 | 22 | 59 |
| C | A | L | 00 | 00 | 00 | 49 | 18 | 15 | 49 | 16 | 27.5 |  |
| R | 180 | 01 | 30 |
| B | L | 49 | 18 | 15 | 49 | 14 | 46 |
| R | 229 | 16 | 10 |
| D | B | L | 00 | 00 | 00 | 45 | 29 | 33 | 45 | 29 | 13 |  |
| R | 180 | 01 | 40 |
| A | L | 45 | 29 | 33 | 45 | 28 | 53 |
| R | 225 | 30 | 33 |

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**BRIDGE SURVEY (Error Correction Sheet)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| INST | SIGHTED TO | FACE | HORIZONTAL ANGLE | | | | | | | | | | | | | | | REMARKS | |
| SET 00 | | | | | | | | | | | | | | |
| Hor.circle Reading | | | Horizontal Angle | | | Mean horizontal angle | | | Correction of Error | | | Correction | | |
| D | M | S | D | M | S | D | M | S | D | M | S | D | M | S |  |
| A | D | L | 0 | 0 | 0 | 108 | 48 | 19 | 108 | 48 | 36.5 | 108 | 48 | 36.67 | 00 | 00 | 0.17 |  |
| R | 180 | 0 | 28 |
| B | L | 108 | 48 | 18 | 108 | 48 | 55 |
| R | 228 | 49 | 23 |
| D | B | L | 00 | 00 | 00 | 45 | 29 | 33 | 45 | 29 | 13 | 45 | 29 | 13.17 | 00 | 00 | 0.17 |  |
| R | 180 | 01 | 40 |
| A | L | 45 | 29 | 33 | 45 | 28 | 53 |
| R | 225 | 30 | 33 |
| B | A | L | 0 | 0 | 0 | 25 | 41 | 17 | 25 | 42 | 10 | 25 | 42 | 1.17 | 00 | 00 | 0.17 |  |
| R | 179 | 58 | 53 |
| D | L | 25 | 41 | 17 | 25 | 43 | 3 |
| R | 205 | 41 | 56 |
| A | B | L | 0 | 0 | 0 | 27 | 18 | 51 | 27 | 19 | 43.5 | 27 | 19 | 43.83 | 00 | 00 | 0.33 |  |
| R | 180 | 0 | 06 |
| C | L | 27 | 18 | 51 | 27 | 20 | 36 |
| B | C | L | 0 | 0 | 0 | 103 | 23 | 37 | 103 | 23 | 48 | 103 | 23 | 48.33 | 00 | 00 | 0.33 |  |
| R | 179 | 59 | 0 |
| A | L | 103 | 23 | 37 | 103 | 23 | 59 |
| R | 283 | 22 | 59 |
| C | A | L | 00 | 00 | 00 | 49 | 18 | 15 | 49 | 16 | 27.5 | 49 | 16 | 27.83 | 00 | 00 | 0.33 |  |
| R | 180 | 01 | 30 |
| B | L | 49 | 18 | 15 | 49 | 14 | 46 |
| R | 229 | 16 | 10 |

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**BRIDGE SURVEY**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| INST/  HI | SIGHTED TO | ANGLE | | | | | | STADIA READING | | | STADIA INTERSEPT | DISTANCE | | RL OF POINTS | REMARKS |
| Horizontal Angle | | | Vertical Angle | | | T | M | B | S=T-B | Horizontal distance | Vertical Distance |
| D | M | S | D | M | S |
| A/1.393m |  | 104 | 45 | 02 | 357 | 13 | 30 | 2.020 | 1.999 | 1.978 |  |  |  |  | C1 |
|  |  | 103 | 09 | 57 | 357 | 13 | 30 | 1.748 | 1.720 | 1.692 |  |  |  |  | a1 |
|  |  | 108 | 52 | 14 | 357 | 13 | 30 | 0.479 | 0.439 | 0.399 |  |  |  |  | b1 |
|  |  | 100 | 36 | 15 | 355 | 18 | 59 | 0.776 | 0.766 | 0.757 |  |  |  |  | A1 |
|  |  | 267 | 40 | 58 | 3 | 49 | 48 | 1.504 | 1.498 | 1.493 |  |  |  |  | B1 |
|  |  | 162 | 55 | 06 | 4 | 10 | 49 | 1.366 | 1.288 | 1.210 |  |  |  |  | C2 |
|  |  | 154 | 07 | 03 | 4 | 10 | 49 | 1.236 | 1.154 | 1.072 |  |  |  |  | a2 |
|  |  | 149 | 42 | 47 | 4 | 10 | 49 | 0.716 | 0.635 | 0.554 |  |  |  |  | b2 |
|  |  | 171 | 47 | 22 | 4 | 09 | 55 | 1.053 | 0.977 | 0.901 |  |  |  |  | A2 |
|  |  | 177 | 19 | 24 | 7 | 26 | 33 | 1.712 | 1.637 | 1.562 |  |  |  |  | B2 |
|  |  | 177 | 14 | 51 | 8 | 10 | 07 | 0.945 | 0.790 | 0.636 |  |  |  |  | C3 |
|  |  | 175 | 52 | 53 | 8 | 10 | 07 | 1.256 | 1.090 | 0.925 |  |  |  |  | a3 |
|  |  | 171 | 16 | 35 | 8 | 10 | 07 | 0.825 | 0.662 | 0.499 |  |  |  |  | b3 |
|  |  | 180 | 26 | 39 | 9 | 36 | 25 | 1.950 | 1.794 | 1.639 |  |  |  |  | A3 |
|  |  | 182 | 57 | 15 | 12 | 20 | 41 | 2.790 | 2.623 | 2.456 |  |  |  |  | B3 |
|  |  | 168 | 48 | 12 | 9 | 44 | 52 | 1.219 | 1.966 | 0.765 |  |  |  |  | C4 |
|  |  | 171 | 00 | 08 | 10 | 10 | 56 | 2.340 | 2.176 | 1.592 |  |  |  |  | a4 |
|  |  | 173 | 14 | 18 | 10 | 11 | 22 | 2.423 | 3.201 | 1.929 |  |  |  |  | b4 |
|  |  | 175 | 08 | 50 | 11 | 11 | 15 | 3.441 | 2.702 | 2.961 |  |  |  |  | A4 |
|  |  | 175 | 40 | 18 | 11 | 07 | 37 | 2.934 |  | 2.471 |  |  |  |  | B4 |
|  |  | 6 | 25 | 54 | 356 | 42 | 11 | 2.934 |  | 2.417 |  |  |  |  | B’1 |
|  |  | 25 | 14 | 42 | 349 | 58 | 09 | 2.804 |  | 1.904 |  |  |  |  | C’1 |
|  |  | 19 | 52 | 11 | 353 | 13 | 17 | 2.974 |  | 2.814 |  |  |  |  | A’1 |
|  |  | 28 | 44 | 54 | 352 | 11 | 20 | 2.392 |  | 2.202 |  |  |  |  | a’1 |
|  |  | 35 | 18 | 39 | 353 | 00 | 55 | 1.699 |  | 1.502 |  |  |  |  | b’1 |
|  |  | 2 | 38 | 13 | 353 | 02 | 04 | 1.450 |  | 1.015 |  |  |  |  | B’2 |
|  |  | 8 | 49 | 18 | 351 | 43 | 33 | 2.123 |  | 1.809 |  |  |  |  | A’2 |
|  |  | 16 | 16 | 58 | 351 | 43 | 31 | 3.677 |  | 3.370 |  |  |  |  | C’2 |
|  |  | 19 | 52 | 46 | 351 | 43 | 31 | 3.625 |  | 3.319 |  |  |  |  | a’2 |
|  |  | 20 | 59 | 29 | 351 | 42 | 48 | 2.525 |  | 2.235 |  |  |  |  | b’2 |
|  |  | 1 | 40 | 11 | 351 | 28 | 15 | 1.260 |  | 0.801 |  |  |  |  | B’3 |

**Jana Jagriti Secondary School**

**Ratnanagar Municipality -14, Pithuwa Chitwan**

**BRIDGE SURVEY**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| INST/  HI | SIGHTED TO | ANGLE | | | | | | STADIA READING | | | STADIA INTERSEPT | DISTANCE | | RL OF POINTS | REMARKS |
| Horizontal Angle | | | Vertical Angle | | | T | M | B | S=T-B | Horizontal distance | Vertical Distance |
| D | M | S | D | M | S |
|  |  | 6 | 31 | 34 | 354 | 52 | 01 | 2.927 |  | 2.971 |  |  |  |  | A’3 |
|  |  | 14 | 36 | 58 | 150 | 59 | 04 | 2.494 |  | 2.112 |  |  |  |  | C’3 |
|  |  | 16 | 00 | 34 | 351 | 34 | 51 | 4.099 |  | 3.711 |  |  |  |  | a’3 |
|  |  | 18 | 17 | 16 | 351 | 22 | 48 | 2.401 |  | 1.099 |  |  |  |  | b‘3 |