Kallam Haranadhareddy Institute of Technology
Chowdavaram, Guntur Dt, Amaravathi, Andhra Pradesh
Affiliated to JNTUK, Approved by AICTE, New Delhi
KHIT
NAAC
CGPA:3.2

SURVEYING LAB MANUAL

ACADEMIC YEAR 2019-20

Name of the student: .....

Regd .No.....

Department of : .....

KHIT
Kallam Haranadhareddy Institute of Technology
Chowdavaram, Guntur Dt. Amaravathi, Andhra Pradesh
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Regd. No.

CERTIFICATE

This is to certify that this is the Bonafied work done by Mr./.Miss.....bearingRollNo.....of..... .....B.Tech., In ..... For the laboratory Course ..... during the Academic Year 20....20.....

No.of Experiments Recorded:.....

Marks Awarded: .....

Signature of the staff Member In-charge

Date: .....

Signature of Head of the Dept.

Date: .....

Signatures:

1. External Examiner .....

2. Internal Examiner.....

Kallam Haranadhareddy Institute of Technology

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SURVEYING FIELD WORK –I LAB MANUAL

NAME :

REGD. NO. :

CLASS :

YEAR :

TABLE OF CONTENTS:

EXP NO:-1 **DATE:-**

CHAIN SURVEY OF ROAD PROFILE WITH OFFSETS IN CASE OF ROAD WIDENING

AIM:

The extension of existing road profile using offset method.

APPARATUS:

1. Chain,
2. Arrows,
3. Ranging rods,
4. Tape,
5. Cross staff

PRINCIPLE:

Surveying is an art of determining the relative positions of various points on, above or below the surface of the earth by means of direct or indirect measurement of distance, direction and elevation. The principles of surveying are:

(i) Working from whole to part.

(ii) (ii)To locate a new station by at least two measurements (angular, linear) from fixed reference points.

Chain surveying is the type of surveying in which only linear measurements are made in the field. The main principle of chain surveying or chain triangulation is to provide a framework consist of number of well-conditioned triangles or nearly equilateral triangles. It is used to find the area of the field.

THEORY:

A. Chain:

The chain is composed of 100 or 150 pieces of galvanized mild steel wire, 4mm in diameter called links .The ends of each link are bent into a loop and connected together by means of three oval rings. The ends of the chain are provided with handles for dragging the chain on the ground, each wire with a swivel joint so that the chain can be turned without twisting. The length of the chain is measured from the outside of one handle to the outside of another handle.

(i). Metric chain (20m &30m)

(ii). Non-Metric chain

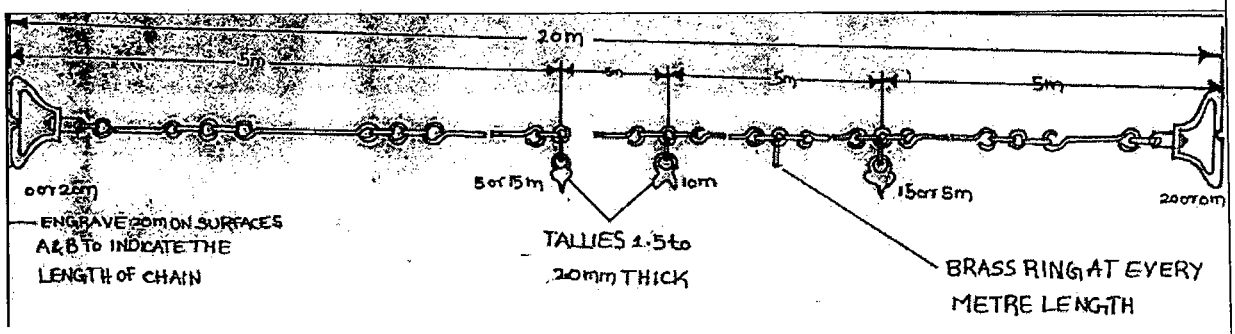
(a).Gunter"s chain or Surveyor"s chain (66ft.)

(b). Engineer"s chain (100ft.)

(c). Revenue chain (33ft.)

(i) Metric Chain:

Metric chains are made in lengths 20m and 30m. Tallies are fixed at every five-meter length and brass rings are provided at every meter length except where tallies are attached



B. Tapes:

The following are the various types of tapes

i) Cloth tape
ii) Metallic tape
iii) Steel tape
iv) Invar tape

Among the above, metallic tapes are widely used in surveying. A metallic tape is made of varnished strip of waterproof line interwoven with small brass, copper or bronze wires. These are light in weight and flexible and are made 2m, 5m 10m, 20m, 30m, and 50m.

C. Arrows:

Arrows are made of good quality hardened steel wire of 4 mm diameter. The arrows are made 400 mm in length, are pointed at one and the other end is bent into a loop or circle.

D. Ranging Rods:

Ranging rods are used to range some intermediate points in the survey line. The length of the ranging rod is either 2m or 3m. They are shod at bottom with a heavy iron point. Ranging rods are divided into equal parts 0.2m long and they are painted alternately black and white or red and white or red, white and black. When they are at considerable distance, red and white or white and yellow flags about 25 cm square should be fastened at the top.

E. Cross staff:

The simplest instrument used for setting out a right angle.

PROCEDURE:

1. Take the chain and unfold it carefully without crossing the chain each other.
2. Measure the width of the road profile at different points on road and mark the center of the road.
3. With the help of cross staff at the center of the road, prepare offsets on both sides of the road.
4. Repeat the same process at various points on the center line joining ranging rods.
5. Measure the distance between end ranging rods and note down it.
6. Prepare the road profile using obtained data.
7. Now fold the chain carefully without twisting of the chain.

OBSERVATIONS:

Width of the road =
Length of the road =
Mid-point of the road =

CALCULATIONS:

RESULT:

The extension of existing road profile using offset method is _____

EXP NO:-2 DATE:-

SURVEY IN AN AREA BY CHAIN SURVEY (CLOSED CIRCUIT)

AIM:

To survey an open field by chain survey in order to calculate an area of the field

APPARATUS:

1. Metric Chain
2. Ranging rods
3. Arrows
4. Cross Staff
5. Pegs
6. Tape

PROCEDURE:

Ranging a line:
It is the process of establishing a number of intermediate points on a survey line joining two stations in the field, so that all the points on the line are in alignment and the length between stations may be measured accurately.
Two ranging rods are erected vertically at the end stations by two surveyors who are standing behind ranging rods. One of the surveyors from one of the end stations directs the assistant to hold the ranging rod vertically to establish an intermediate point and move the rod either to the left or right until the ranging rod is in alignment with the end stations. Finally, when the ranging is correct, the assistant is directed to fix the ranging rod at that point.

Taking offsets:
The perpendicular distance measured right or left of the chain line to locate the details like corners, boundaries, culverts, etc is known as offset.
Offsets can be taken by two ways: 1. By Tape and
2. by Cross-Staff.

By Tape:

The leader holds the zero end of the tape at the point where the offset is to be taken and the follower swings off the tape in an arc across the chain line to left and right. The minimum reading of tape on the chain line gives the position of the foot of the perpendicular from the required point.

By Cross-Staff:

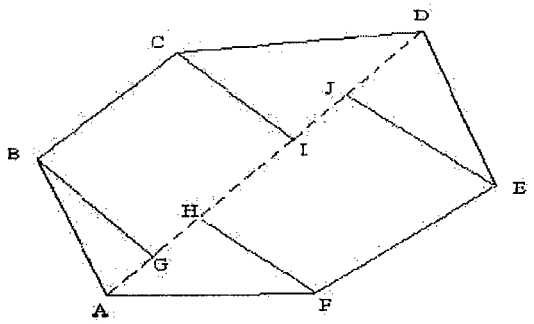
The Cross-Staff is held vertically on the chain line approximately near the point where the offset is likely to fall. The Cross-Staff is turned until the signal at one end of the chain line is viewed through one pair of slits. The surveyor then takes a round and views through the other pair of silts. If the point to which the offset is to be taken is seen, the point below the instrument is the required foot of the offset. On the other

hand, if the point is not seen, the surveyor moves along the chain line, without twisting the Cross- Staff, till the point appears.

Procedure for surveying the given open field (Closed Traverse):

1. ABCDEF is the required closed traverse open field to be surveyed for calculating the area as shown in Fig 1.
2. From the station A the length of all the opposite corners such as AC, AD and AE are measured with a chain and the longest distance is considered for laying off the main chain line.
3. In this case AD is the longest and a chain line running from A to D is laid.
4. Offsets to corner points B, C, E and F are now laid from the chain line AD either by tape or cross-staff and their foot of offsets are G, I, J, H respectively.
5. All the offset lengths GB, HF, IC and JE are measured either by chain or tape depending on the length of offsets.
6. The distances between all the points AG, GH, HI, IJ and JD are also measured along the chain line.

FIGURE:



Survey of an Open Field (Closed Traverse)

OBSERVATIONS:

S.NO	Name of figure	Chainage (m)	Base (m)	Offsets (m)	Mean (m)	Area (m2)

CALCULATIONS:

PRECAUTIONS:

1. Chainages must be marked against the working edge of the offset scale.

2. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet.

3. Each triangle must be verified by measuring the check lines

RESULT:

The total Area of the given Open Field by Chain Survey = ...sq.m

EXP NO: - 3 DATE:-

DISTANCE BETWEEN TWO INACCESSIBLE POINTS BY USING COMPASS

AIM:

To find the horizontal distance between two inaccessible points.

INSTRUMENTS/APPARATUS:

Prismatic compass, stand, chain, tape, ranging rods, pegs, plumb bob, hammer, field-book, pencils, eraser.

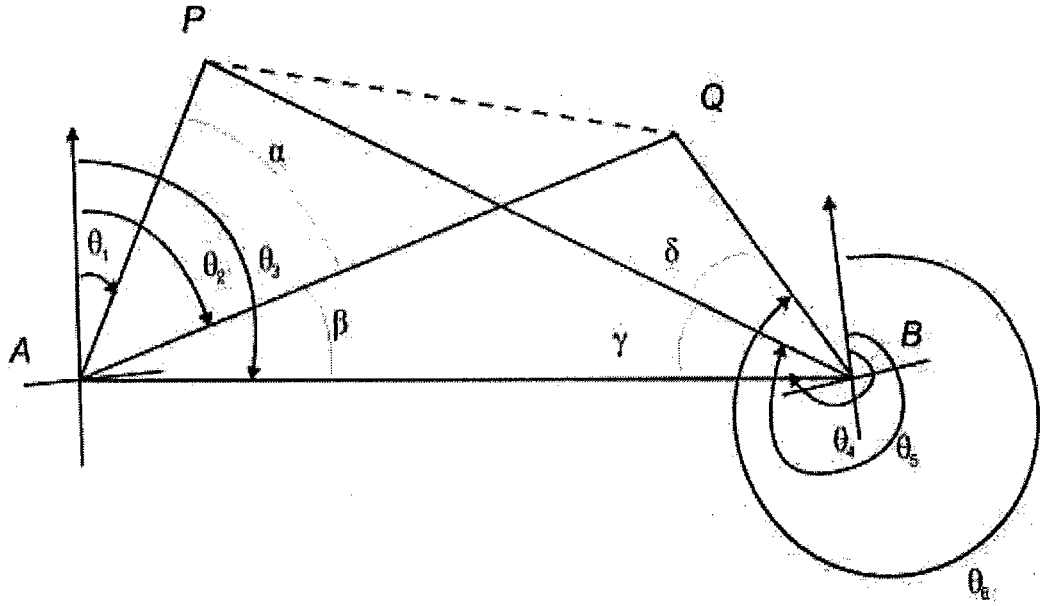
PRINCIPLE:

Prismatic compass is an instrument based on the principle that a freely suspended or pivoted Magnetic needle point in the direction of magnetic meridian. The bearings of lines are Obtained in the WCB system.

PROCEDURE:

It is required find the distance between two points P and Q. Both P and Q are inaccessible.

1. Select two stations A and B on the ground such that line AB is nearly parallel to line PQ.
2. Measure the distance AB.
3. Centre the prismatic compass over station A and observe the bearings of lines AP, AQ and AB and record them as $\theta 1$, $\theta 2$ and $\theta 3$ Thus angles α and β can be obtained.
4. Centre the prismatic compass over station B and observe the bearings of lines BA, BP and BQ and record them as $\theta 4$, $\theta 5$ and $\theta 6$. Thus angles γ and δ can be obtained.



Distance between two inaccessible points – compass survey

Observations and Calculations:

1) $\alpha = \theta_2 - \theta_1$; $\beta = \theta_3 - \theta_2$; $\gamma = \theta_5 - \theta_4$; $\delta = \theta_6 - \theta_5$

2) $$PB = \frac{AB}{Sin180 - (\alpha + \beta + \gamma)} * Sin(\alpha + \beta)$$

3) $$QB = \frac{AB}{Sin180 - (\beta + \gamma + \delta)} * Sin\ \beta$$

4) $$PQ = (PB^2 + QB^2 - 2*PB*QB*Cos\ \delta)^{1/2}$$

Result:

Distance between inaccessible points PQ is = _____

EXP NO: - 4 DATE:-

AREA OF THE GIVEN BOUNDARY USING COMPASS

AIM:

To determine the area of given boundary using prismatic compass.

INSTRUMENTS/APPARATUS:

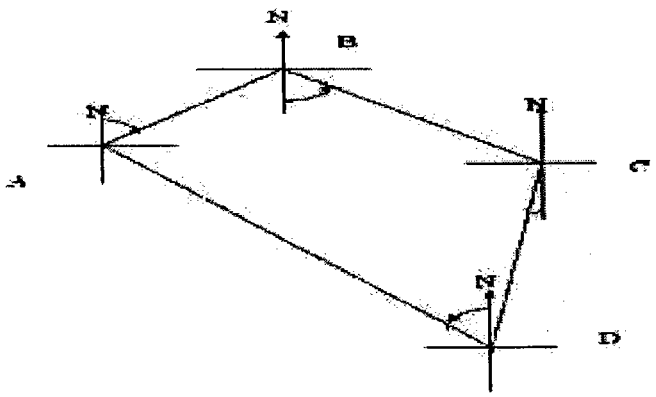
Prismatic compass, stand, chain, tape, ranging rods, pegs, plumb bob, hammer, field-book, pencils, eraser.

PROCEDURE:-

Closed traverse is generally run around a structure .It is defined as A series of connected lines whose directions and lengths are determined precisely.

Following procedure is adopted to run a closed compass traverse.

- Let us say we have to run a closed compass traverse ABCDEA.
- Set the prismatic compass at point A. center it and level it.
- Take bearings of traverse lines AB and AE.
- Shift the compass to point B center it and level it. Take the bearings BC and BA.
- Link-wise complete the traverse as shown in fig (a).
- Measure the length of traverse line AB, BC, CD, DE, and EA.
- Record the observation in tabular columns.
- Care must be taken to see that the stations are not affected by local attractions. If they are affected corrections to local attractions should be applied first and then the traverse should be plotted with corrected bearings.
- Simplest method of plotting is angle and distance method with a protractor. If Last point is falling short by some distance in meeting the first point then it means that there is a closing error.



OBSERVATION & CALCULATIONS

LINE	FORE BEARING	BACK BEARING	LENGTH (M)

RESULT:-

The bearings and lengthS of given boundary is to be shown on a Drawing sheetand area of the given boundary Is_____

EXP NO:-5 DATE:-

AREA OF A GIVEN BOUNDARY BY THE METHOD OF RADIATION

AIM: To draw the position in plan of the given points by radiation method.

INSTRUMENTS/APPARATUS:

Plane table and its accessories –
Tripod,
Alidade,
Trough compass,
Plumbing fork,
Spirit level,
Drawing sheet,
Chain, tape, ranging rods, pegs,
Hammer and field-book.
Cello- tape, pencil, eraser and dusting cloth).

PRINCIPLE:

Plane table is a surveying instrument that can be used to prepare a map or plan of an area directly in the field without the direct measurement of any angles. Radiation is one of the methods employed in plane table survey. This method is generally employed for locating the details.

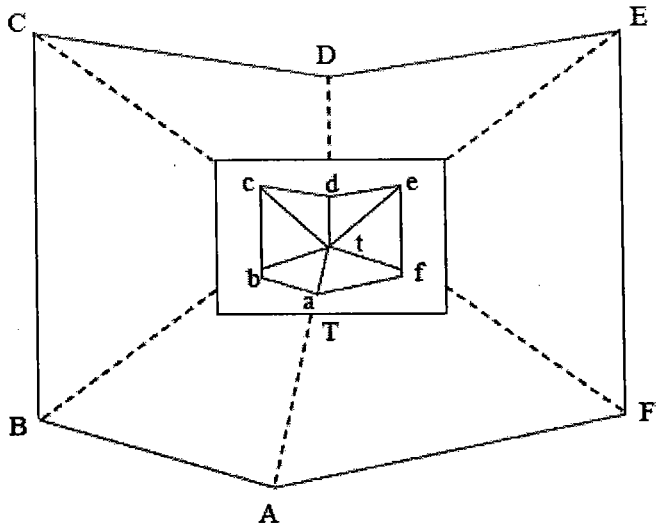
In this method, a ray is drawn from the instrument station towards the point. The distance is measured between the instrument station and the point. The point is located by plotting to some scale the distance so measured. This method is more suitable for small distances. One instrument station can cover several points to be detailed.

PROCEDURE:

1. Select a point *'T'* on the ground so that all points to be located are visible from it.
2. Set up the table at *'T'*, level it, and do centring.
3. Transfer the point *'T'* on to the drawing sheet by means of plumbing fork so that it is exactly over station *'T'* on the ground and name it *'t'*.
4. Mark the direction of the magnetic meridian on the drawing sheet by means of trough compass.
5. Centring the alidade on *'t'* BISECT the points *A, B, C, D, E* and *F* one after the other and draw the rays along the fiducially edge.
6. Measure the distances *TA, TB, TC, TD, TE* and *TF* on the ground and plot their distances to some scale along the corresponding rays and thus get the position of points *a, b, c, d, e,* and *f* on the

drawing sheet. (upper case letters are used to represent stations on ground and lower case letters are used to represent stations on drawing sheet)

7. Join *a,b,c,d,e* and *f* on the drawing sheet.



Radiation method – plane table

OBSERVATIONS AND CALCULATIONS:

1. Measure the distance AB, BC, CD, DE, EF and FA on the ground.
2. Scale the distance ab, bc, cd, de, ef and fa on the drawing sheet.

RESULT:

Compare the ground and plan distances between the stations A, B, C, D, E and F.

EXP NO:-6 DATE:-

FINDING THE AREA OF A GIVEN BOUNDARY BY THE METHOD OF INTERSECTION

AIM:

To draw the position in plan of the given points by intersection method.

INSTRUMENTS/APPARATUS:

Plane table and its accessories –
Tripod,
Alidade,
Trough compass,
Plumbing fork,
Spirit level,
Drawing sheet,
Chain, tape, ranging rods, pegs,
Hammer and field-book.
Cello- tape, pencil, eraser and dusting cloth).

PRINCIPLE:

Plane table is a surveying instrument that can be used to prepare a map or plan of an area directly in the field without the direct measurement of any angles. Intersection is one of the methods employed in plane table survey. This method is generally employed for locating the details.

In this method the location of an object is determined by sighting at the object from two plane table stations and drawing the rays. The intersection of these rays will give the position of the object. Therefore in this method it is essential to have at least two plane table stations. The distance between the two plane table stations is measured and plotted on the sheet to some scale. The line joining the two plane table stations is known as the base line. No linear
measurement other than that of the base line is made in this method of surveying.

This method is preferred when the distance between the point and the plane table station is either too large or cannot be measured accurately due to some field conditions.

PROCEDURE:

It is required to plot the position of ground points PQRS (shown in figure given below) on the drawing sheet. The line AB is a base line measured on the ground. It is represented by the line ab on the board drawn to scale. The position of the base line AB is chosen such that it is in the middle of the boundary formed by PQRS.

1. Set up the plane table over A and orient the plane table by laying the alidade along the drawn line ab and rotate the board until B is sighted from A through the alidade (Now the line ab is aligned with line AB on the ground).

2. Pivot the alidade at 'a' and sight to the points P, Q, R & S and draw the rays. These rays represent the lines of sight to these features.
3. Shift the table to B. Plumb point b on the board over B on the ground.
4. By laying the alidade along the drawn line ba rotate the board until A is sighted and clamp the board (Now the line ab is aligned with line AB on the ground)
5. Mark the direction of the magnetic meridian on the drawing sheet by means of trough compass.
6. Pivot the alidade at 'b' and sight to the points P, Q, R & S and draw the rays (The rays from B will intersect those drawn from A, thus establishing the positions p, q, r and s on the board).
7. Join the point's p, q, r & s on the drawing sheet.

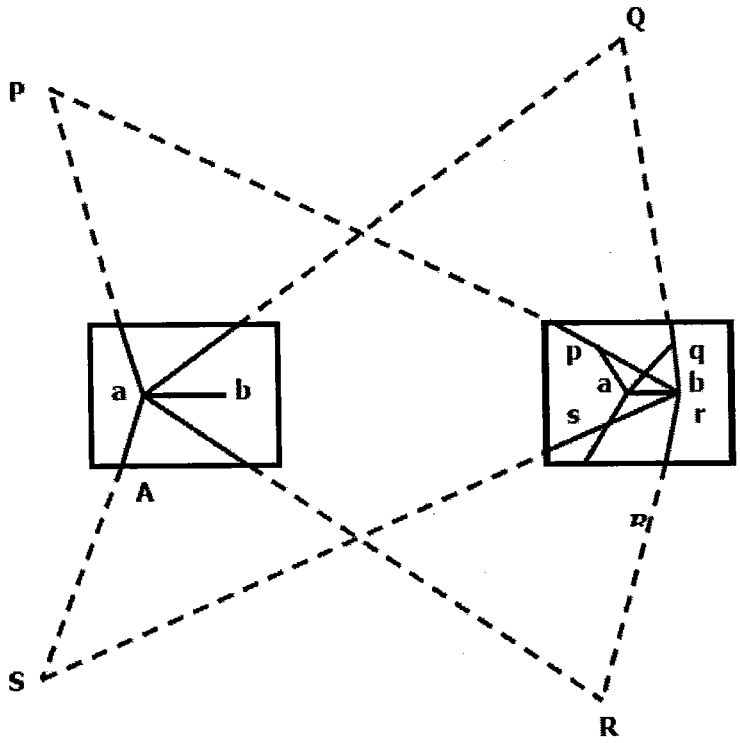


Fig: Intersection method – plane table

OBSERVATIONS AND CALCULATIONS:

1. Measure the distance PQ, QR, RS and SP on the ground.
2. Scale the distance pq, qr, rs and sp on the drawing sheet.

RESULT:

Compare the ground and plan distances between the stations P, Q, R and S.

EXP NO:-7 DATE:-

TWO POINT PROBLEM BY THE PLANE TABLE SURVEY

AIM:

To locate the position on the plan, of the station occupied by the plane table by means of observations to two well defined points whose positions have been previously plotted on the plan

INSTRUMENTS/APPARATUS:

Plane table and its accessories –

Tripod,
Alidade,
Trough compass,
Plumbing fork,
Spirit level,
Drawing sheet,
Chain, tape, ranging rods, pegs,
Hammer and field-book.
Cello- tape, pencil, eraser and dusting cloth).

PRINCIPLE:

Plane table is a surveying instrument that can be used to prepare a map or plan of an area directly in the field without the direct measurement of any angles. In the process sometimes a technique called 'resection' is employed.

Resection is the process of determining the plotted position of the station occupied by the plane table, by means of sights taken towards known points, location of which have been plotted.

In two-point problem the position of occupied station on the drawing sheet is obtained by means of observations to two well defined points whose positions have been previously plotted on the plan.

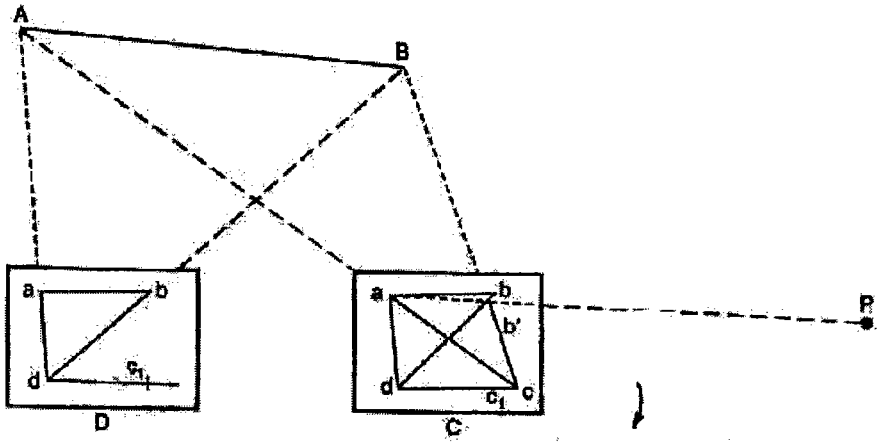


Fig: Two-point problem – plane table

PROCEDURE:

Let us take two points *A* and *B*, the plotted positions of which are known (*a, b*). Let *C* be the point to be plotted. Therefore the whole problem is to orient the table at *C*.

1. Choose an auxiliary point D near C. While choosing D take care that angle CAD and angle CBD are not very acute.
2. Place the table at D. By eye judgment orient the table at D such that ab is nearly parallel to AB. Clamp the table.
3. Keep the alidade at a and sight A and draw back a resector. Similarly keep the alidade at b and sight B and draw back a resector. The two rays resect at d1. (Here we are not naming it as d because it is not exactly d, since the orientation is by eye judgment and therefore not a correct orientation).
4. Transfer the point d1 to the ground and drive a peg.
5. Keep the alidade at d1 and sight C. Draw the ray. Mark a point c1 on the ray by estimation to represent the distance DC.
6. Shift the table to C, orient it by taking backsight to D and centre it with reference to c1. (Thus the orientation is same as it was at D).
7. Keep the alidade pivoted at a and sight it to A. Draw the ray to intersect with the previously drawn d1c1 in c2. (Thus c2 is the point representing the station C with reference to the approximate orientation made at D).
8. Pivot the alidade about c2 and sight B. Draw the ray to intersect with the ray d1b in b1.(Thus b1 is the approximate representation of B with reference to the approximateorientation made at D).
9. The angle between ab and ab1 is the error in orientation and must be corrected for. Keep the alidade along ab1 and fix a pole at P on the ground in line with ab1 at a great distance.
10. Keep the alidade along ab, rotate the table till P is bisected. Clamp the table. The table is thus correctly oriented.
11. Draw a resector from a to A and another from b to B, the intersection of which will give the position C occupied by the table. Thus name the point as c.

Observations and Calculations:

1. Measure the distance *CA* and *CB* on the ground.
2. Scale the distance *ca* and *cb* on the drawing sheet.

Result:

Compare the ground distances *CA* and *CB* with corresponding plan distances *ca* and *cb*.

EXP NO:-8 DATE:-

Fly leveling: Height of the instrument Method

AIM:

To find the reduced levels of the given stations by differential leveling by Height of instrument method.

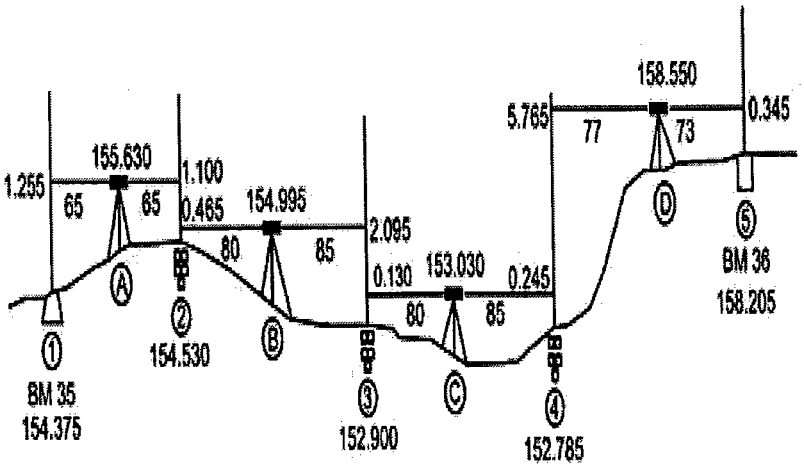
APPARATUS:

Dumpy level, leveling staff, tripod.

PRINCIPLE:

In order to find difference of level between two points on the ground, it is necessary to establish a level surface above the two points and measure the vertical distance from it to the points. The difference between these measurements will give the difference in level between the points. It is possible to get a horizontal surface from the line of sight of a telescope adjusted into the horizontal position. This is done by any Leveling instrument.

Therefore by setting up a Leveling instrument at a suitable location on the ground it is possible to obtain difference between levels of two points. Automatic level is a very convenient Leveling instrument. When the difference in level between two points cannot be obtained by one set-up of Leveling instrument, it is necessary to repeat the process. This process of using a series of several set-ups of leveling instrument to find the level difference between two distantly placed points is called fly leveling.



PROCEDURE:

1. Instrument level is setup at convenient positions near first point (say A).
2. Temporary adjustments should be done,(setting up, levelling up, elimination of a parallax) are performed.
3. First sight of B.M (point of known elevation) is taken and reading is entered in back Sight column.
4. Then second reading is taken by keeping levelling staff on first point as entered in Intermediate sight column.
5. If distance is large instrument is shifted, the instrument becomes turning point (or) changing point.
6. After setting up instrument at new position, performing temporary adjustment and Take back sight as turning point.
7. Thus turning point will have both back sight and fore sight readings.
8. Link wise the process is repeated till last point (say B) is reached. The above procedure is shown in fig. Readings are entered in a tabular form is given below and Reduced levels are calculate either by height of instrument method.

HEIGHT OF INSTRUMENT METHOD:

ST. NOS	B.S (M)	I.S (M)	F.S (M)	H.I (M)	R.L	REMARKS
	∑B.S		∑F.S			

ARITHMETIC CHECK:

Σ B.S - ΣF.S = ΣRISE – ΣFALL = LAST RL - FIRST R.L

RESULT:

Difference of elevation between two given points is _____

EXP NO:-9 DATE:-

FLY LEVELING: RISE AND FALL METHOD

AIM:

To find the reduced levels of the given stations by differential leveling by Rise and fall method.

APPARATUS:

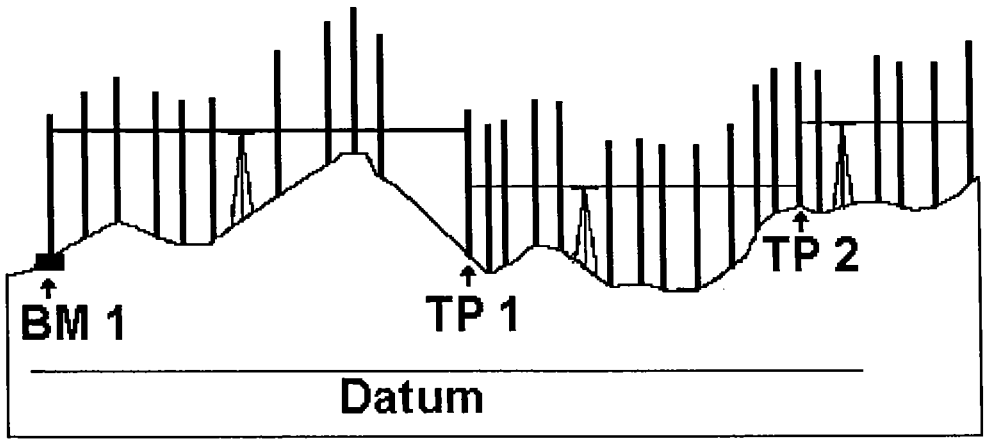
Dumpy level, leveling staff, tripod, plumb bob, tape.

THEORY:

Differential levelling is the method of direct levelling the object of which is To determine difference in elevations of two points regardless of horizontal position of point with respect to each other, when points are apart it may be necessary to setup The instrument several times.

PROCEDURE:

1. Instrument level is setup at convenient positions near first point (say A).
2. Temporary adjustments should be done,(setting up, levelling up, elimination of a parallax) are performed.
3. First sight of B.M (point of known elevation) is taken and reading is entered in back Sight column.
4. Then second reading is taken by keeping levelling staff on first point as entered in Intermediate sight column.
5. If distance is large instrument is shifted, the instrument becomes turning point (or) changing point.
6. After setting up instrument at new position, performing temporary adjustment and Take back sight as turning point.
7. Thus turning point will have both back sight and fore sight readings.
8. Link wise the process is repeated till last point (say B) is reached. The above procedure is shown in fig in above experiment. Readings are entered in a tabular form is given below and Reduced levels are calculate either by RISE & FALL method.



Rise and fall method:

Station No	B.S	I.S	F.S	RISE	FALL	R.L	REMARKS

ARITHMETIC CHECK:

Σ B.S - ΣF.S=ΣRISE - ΣFALL=LAST RL - FIRST R.L

RESULT:

Difference of elevation between two given points is _____

EXP NO:-10 DATE:-

LONGITUDINAL SECTION AND CROSS SECTIONS OF A GIVEN ROAD PROFILE

AIM:

To plot the longitudinal section and cross section along a proposed alignment of a highway.

EQUIPMENTS:

Automatic Level, tripod, Levelling staff, chain, tape, cross staff, arrows, ranging rods, pegs, Hammer, Levelling book, pencil and eraser.

PRINCIPLE:

Profile Levelling is an operation to determine elevations of points spaced apart at known distances along a given line. The purpose of profile Levelling is to provide data from which a vertical section of the ground surface along a surveyed line can be plotted. Longitudinal sectioning and cross sectioning are examples of profile Levelling.

a) Longitudinal sectioning: to find out the elevations of the points on the ground at fixed intervals along the centre line of proposed sewer lines, pipelines, highways, railways, canals, etc.
b) Cross sectioning: to find out the elevations of the points on the ground at fixed intervals on either side and perpendicular to centre line of proposed highways, canals, etc.

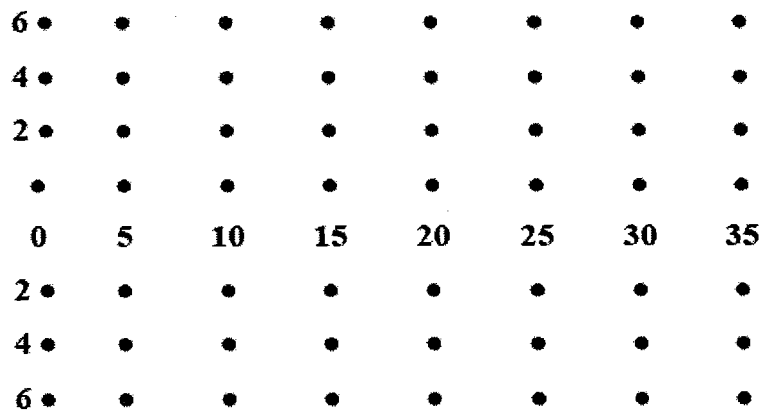


Fig: Longitudinal and cross sectioning

PROCEDURE:

1. Establish points on the ground at fixed interval say 5 m along the proposed centre line of the highway by direct ranging and fix arrows as shown in figure given below.
2. Establish perpendicular lines on either side of the proposed centre line of the highway using cross staff as shown in figure given below.
3. Along the perpendicular lines that are established in the previous step fix arrows on the ground at a fixed interval say 2 m as shown in figure given below.
4. Carry out differential Levelling to find the R.Ls of every arrow point and enter the readings in table.
5. Calculate the R.Ls of all the points.
6. Draw the longitudinal section along the centre line of the proposed highway to a suitable scale.
7. Draw cross section in the transverse direction at each chainage point along the centre line of the proposed highway to a suitable scale.

Observations and Calculations:

TABLE

S. No.	Chainage of centre line	Chainage Left C.S.	Chainage Right C.S.	B.S. (m)	I.S. (m)	F.S. (m)	H.I. (m)	R.L. (m)	Remarks

Height of Instrument = R.L. of B.M. + B.S.

R.L. of each arrow point = H.I. – I.S. or F.S.

RESULT:

Profile of the centre line of the proposed highway and various cross sections along the centre Line of the proposed highway are shown on the graph sheet.