MALLA REDDY ENGINEERING COLLEGE

Maisammaguda, Dhulapally, (Post via Kompally), Secunderabad 500100
(Approved by AICTE,New Delhi and Affiliated to JNTUH,Hyderabad,India)

DEPARTMENT
OF
CIVIL ENGINEERING

SURVEYING LAB(MR-18)

Observation

NAME OF THE CANDIDATE : ____________________________

ROLL NUMBER : ____________________________

YEAR / SEMESTER : ____________________________

Signature of Faculty (1st person) **Signature of Faculty (2nd person)**

JULY 2019

LAB CODE

1. Students should report to the labs concerned as per the timetable.
2. Students who turn up late to the labs will in no case be permitted to perform the experiment scheduled for the day.
3. After completion of the experiment, certification of the staff in-charge concerned in the observation book is necessary.
4. Students should bring a notebook of about 100 pages and should enter the readings/observations/results into the notebook while performing the experiment.
5. The record of observations along with the detailed experimental procedure of the experiment performed in the immediate previous session should be submitted and certified by the staff member in-charge.
6. Not more than three students in a group are permitted to perform the experiment on a set up.
7. The group-wise division made in the beginning should be adhered to, and no mix up of student among different groups will be permitted later.
8. The components required pertaining to the experiment should be collected from Lab- in-charge after duly filling in the requisition form.
9. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
10. Any damage of the equipment or burnout of components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year.
11. Students should be present in the labs for the total scheduled duration.
12. Students are expected to prepare thoroughly to perform the experiment before coming to Laboratory.
13. Procedure sheets/data sheets provided to the students' groups should be maintained neatly and are to be returned after the experiment.
14. DRESS CODE:

    Boys - Formal white shirt neatly tucked in, and white trousers, white / black / brown / tan shoes and belt, I-cards worn round neck

    Girls - Formal white Sal war Kames, white / black / brown / tan shoes, I- cards worn round neck

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S.NO.	NAME OF THE EXPERIMENT	DATE OF EXPERIMENT	SIGNATURE

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<tr><td>2018-19 Onwards (MR-18)</td><td colspan="1">MALLA REDDY ENGINEERING COLLEGE (Autonomous)</td><td colspan="3">B.Tech. III Semester</td></tr>
<tr><td>Code: 80108</td><td rowspan="2">SURVEYING LAB</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Credits: 1.5</td><td>-</td><td>-</td><td>3</td></tr>
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Prerequisite: NIL

Course Objective: To impart the practical knowledge in the field, it is essential to introduce in curriculum. Drawing of Plans and Maps and determining the area are pre requisites before taking up any Civil Engineering works.

List of Experiments:

1. Survey of an area by chain survey (closed traverse) & Plotting
2. Surveying of a given area by prismatic compass (closed traverse) and plotting after adjustment.
3. Radiation method, intersection methods by plane Table survey
4. Fly leveling (differential leveling)
5. An exercise of L.S and C.S and plotting
6. Two exercises on contouring.
7. Measurement of horizontal angles by method of repetition and reiteration.
8. Heights and distance using Principles of tacheometric surveying (Two Exercises)
9. State-out using total station
10. Determine of area using total station
11. Determination of remote height using total station
12. Distance, gradient, Diff, height between to inaccessible points using total stations.

Course Outcomes

At the end of the course, students will be able to

1. Discuss the relative precision expected from pacing, taping, and electronic distance measurement techniques
2. Calculate the errors, standard deviations, standard errors of the mean, accuracy ratio or relative precision of a set of measurements in terms used by the surveyor
3. Determine the earth's curvature effect, by comparing the difference between a horizontal plane and a level (curved) surface on the earth
4. Distinguish between plan view, profile view and cross-sections as used in route surveying and demonstrate understanding of cross-sectioning to attain earthwork data.
5. Determine latitudes and departures for all segments of a closed loop traverse check for closure error, and express the results in the form of the standard accuracy ratio, i.e. accuracy ratio.

CO- PO–PSO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COS	Programme Outcomes(POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	3	3	3	1	2				2	2		2	3		
CO 2	3	3	3	1	2				2	2		2	3		
CO 3	3	3	3	2	2				2	2		2	3		
CO 4	3	3	3	3	2				2	2		2	3		
CO 5	3	3	3	3	2				2	2		2	3		

EXPERIMENT NO - 1

Aim : Survey of an area by chain survey

Equipment : Two chains 20m or 30m, Arrows, Ranging rods. Cross staff or optical square, Plumb bob

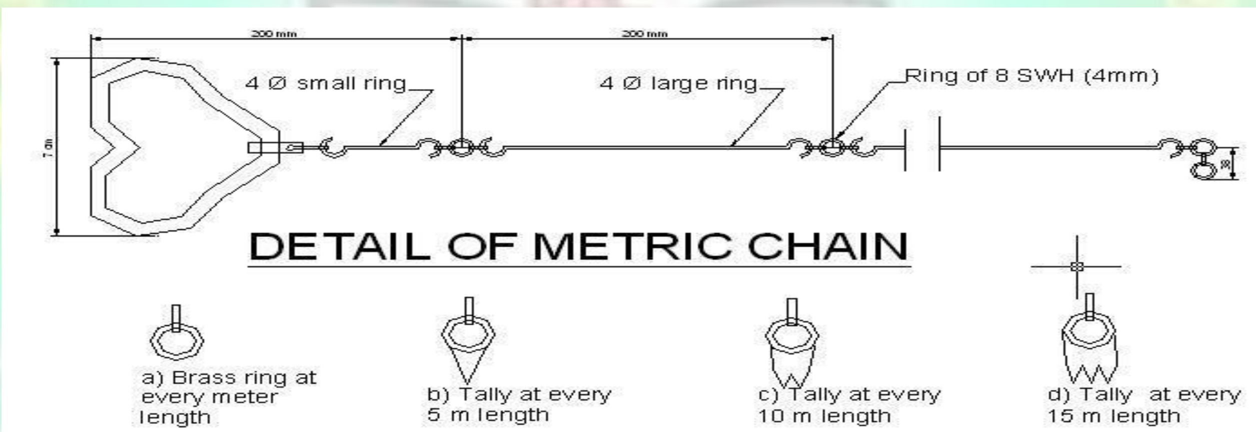
Theory

By the various methods of determining distance the most accurate and common method is the method of measuring distance with a chain or tape is called Chaining. For work of ordinary precision a chain is used. But where great accuracy is required a steel tape is invariably used.

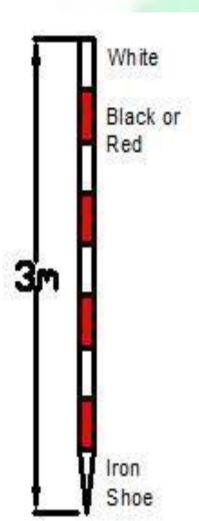
The term chaining was originally applied to measure Distance with a chain. The term chaining is used to denote measuring distance with chain or tape, In the process of chaining, The survey party consists of a leader (the surveyor at the forward end of the chain) a follower (the surveyor at the rare end of the chain and an assistant to establish intermediate points).

The chain is composed of 100 or150 pieces of galvanized mild steel were 4mm in diameter called links. The end of each link is bent into a loop and connected together by means of three oval rings which afford flexibility

Figure:



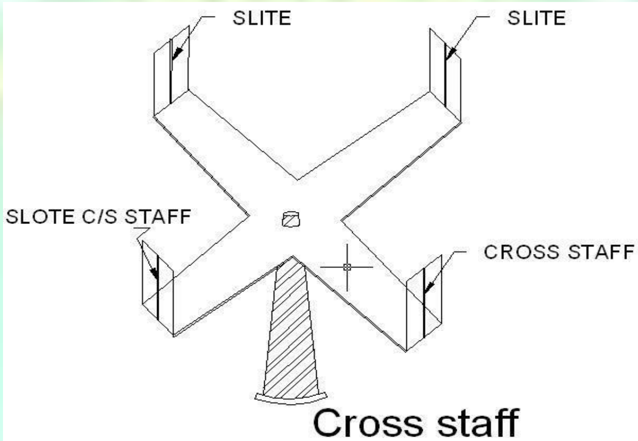
Ranging Rods:



The ranging rods are used for marking the positions of Stations conspicuously and for ranging the lines. Io order to make these visible at a distance, they are painted alternately black and white, or red and white or red White and black successively. The adjustment of the chain should as far as possible be affected symmetrically on either side of the middle so as that the position of central tag remains unaltered. In measuring the length of survey line also called as chain line. It is necessary that the chain should be laid out on the ground in a straight line between the end stations.

Cross-Staff

Cross-Staff is the simplest instrument used for setting out perpendicular i.e taking offsets from a chain line. it is easier and quicker method ,but not very accurate .if great accuracy is desired ,the work should be carried out by the theodolite.



The object of cross staff survey is to located the boundaries of field or plot and to find out its area .

In this method a base line in the centre of the area is selected. Chaining along this line is done and the offsets of the points lying on the boundaries of the plot are taken at different chainages by using a cross staff and tape on either side of the chain line and recorded against the chainages in the field note book as already discussed .The offsets length are written on the left hand side or right hand side of the line as per position until whole of the area is surveyed.

The plot is then divided into triangles and trapezoids because it is easy to find out the area of triangle and trapezoids. The area of the field is computed by the following formulae.

1. The area of a right angle triangle is equal to the base multiplied by half the perpendicular
2. The area of a trapezoid is equal to the base multiplied by half the sum of the Perpendicular.

Procedure:

To start the cross staff survey ,a chain line is run through the centre of the area to be surveyed .it is divided into right angled triangles and trapezoids .The perpendicular to the boundary are taken in order of their chainages.

A cross staff or optical square is used to set out perpendicular offsets which are usually more than 15m Care should be taken that no offset is overlooked before the chain is removed .The chainages of the points of intersection of the chain line and the boundaries should be recorded .The length of the boundary line may be measured by direct measurement to check the accuracy of field work. After the field work is over, the survey is plotted to some convenient scale. The figure thus formed by the boundary lines is divided in the tabular from as given below

Observation Table;-

S.No.	Figure	Chainage in meter	Base in (meter)	Offset in (meter)	Mean offset	Area in m^2		Remarks
						+Ve	-Ve	
1	2	3	4	5	6	7	8	9

RESULT:

Area of polygon by chain & staff method is found to be__________________square meter.

EXPERIMENT NO - 2

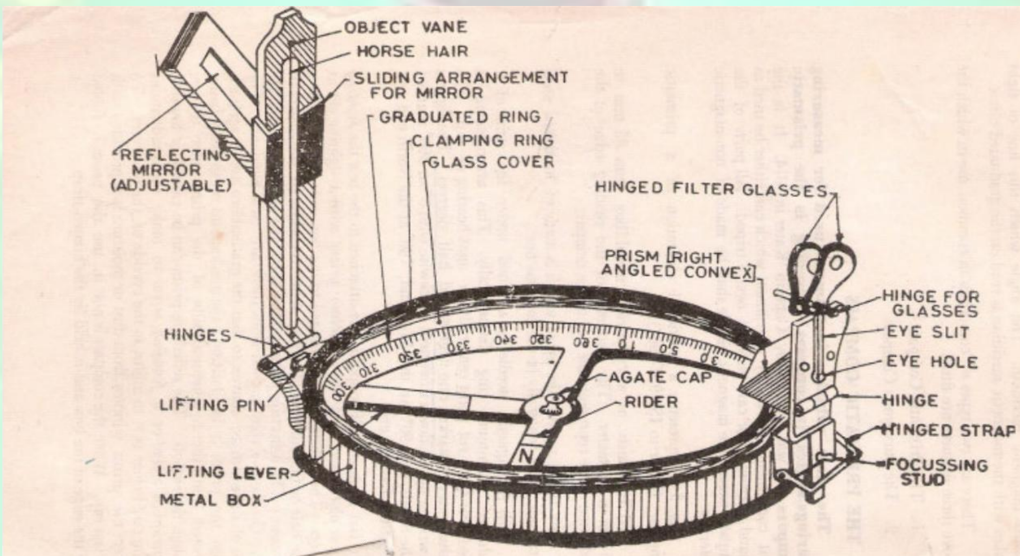
Aim : Survey of given area by Prismatic compass (closed traverse) and plotting after adjustments

Equipment : Prismatic compass, ranging rod, chain, tape, peg Tripod stand , small pieces of stones.

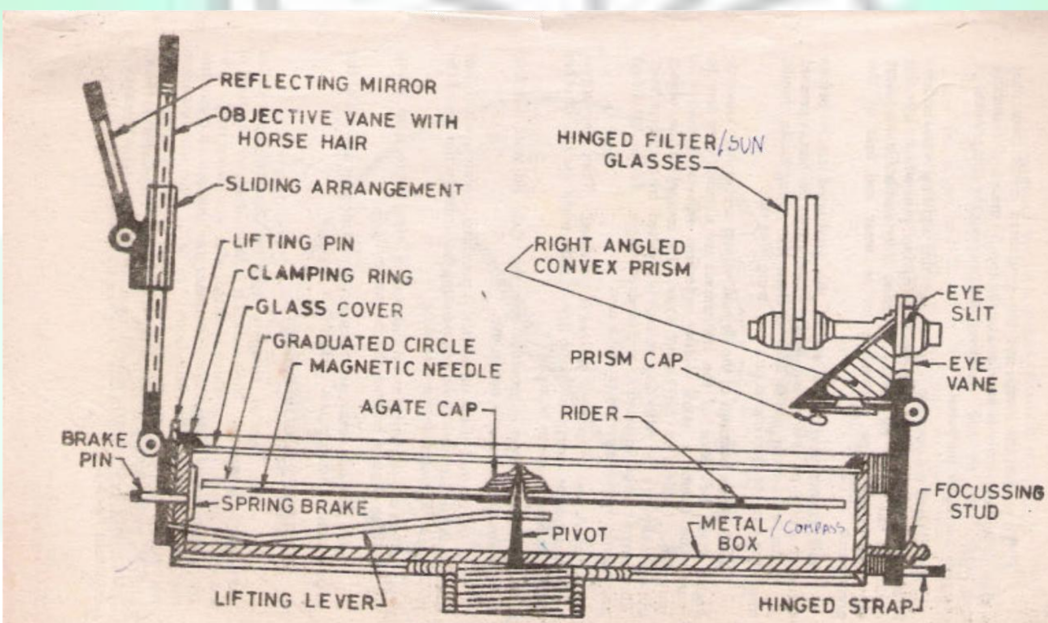
Theory : The important parts of compass are:-

- ✓ A box with graduated circle.
- ✓ A magnetic needle
- ✓ A line of sight

When the line of sight is pointed to point, the magnetic needle of compass points towards north (Magnetic meridian) the angle which this line of sight makes with the magnetic meridian is read on graduated circle. It is known as magnetic bearing of the line.



THE PRISMATIC COMPASS SHOWING ITS VARIOUS PARTS



THE PRISMATIC COMPASS IN SECTION

Fig. 3.1 (a)

There are two types of compasses:-

1. Prismatic compass
2. Surveyor's compass.

Prismatic Compass:-

Prismatic compass is very valuable instrument. It is usually used for rough survey for measuring bearing and survey lines. The least count of prismatic compass is 30 min.

It consists of circular box of 10cm-12 cm dia. of non magnetic material. Pivot is fixed at the centre of box and is made up of hard steel with a Sharp pivot. graduated aluminum is attached to the needle. It is graduated in clockwise direction from 00 to 3600.the figures are written in inverted. Zero Is written at south end and 180 at north end and 270 at the east. Diametrically opposite are fixed to the box. The sighting vane consists of a hinged metal frame in the centre of which is stretched a vertical Horse hair fine silk thread of which is stretched a vertical hair. it presses against a lifting pin which lift the needle of the pivot and holds it against the glass lid. Thus preventing the wear of the pivot point to damp the oscillations of the needle when about to take reading and to bring to rest quickly, a light spring is brought lifted inside the box. The face of the prism can be folded out the edge of the box when North end is used Sometime the sighting vanes is provided with a hinge mirror Which can be placed upward or downwards on the frame and can be also Sided along it is required. The mirror can be made inclined at any angle so that Objects which are too high or too low can be sighted directly by reflecting.

Bearing of Lines: A bearing of a line is a horizontal angle made by the survey line with some reference direction or meridian. Meridian may be

1) A true meridian
2) A magnetic meridian
3) An arbitrary or assumed meridian

True meridian: The true geographical meridian passing through a point is a line of intersection of earth's surface by a plane containing north south pole and given point. They are not parallel to each other at different places.

Magnetic meridian: The direction indicates by a free suspended and a properly balanced magnetic needle Free from all other attractive forces. The direction of magnetic meridian can be established with the help of Magnetic compass.

Arbitrary meridian: Any direction is assumed to be the Reference meridian to carry out small survey.

Whole Circle Bearing:

In whole circle bearing system, the bearing of a line is always measured clockwise from the north point of the reference meridian towards the line right round the circle. The angle thus measured between the reference meridian and the line is called Whole circle bearing of the line. Angles measured will have value between 0 to 360 degrees.

Conversion of W.C.B. in R.B

Case	WCB between	R.B.	QUADRANT
1	0^0 TO90^0	WCB	N-E
2	90^0 TO -180^0	180-WCB	S-E
3	180^0 TO -270^0	WCB-180^0	S-W
4	270^0 TO 360^0	360-WCB	N-W

Reduced bearing (R.B):

In this system of bearing of a line is measured clockwise or anticlockwise from north or south direction whichever is nearer to the line towards east or west. The concept of reduced bearing facilitates computations in traverse surveying.

Conversion of R.B in W.C.B

Case	R.B in quadrant	Rule of W.C.B.	W.C.B between
1	N-E	WCB=R.B	0^0 TO90^0
2	S-E	WCB =180-R.B	90^0 TO -180^0
3	S-W	WCB =R.B+180	180^0 TO -270^0
4	N-W	WCB =360-R.B	270^0 TO 360^0

Adjustment of the Prismatic Compass

The compass may be held in hand but for better results it should be fitted at the top of tripod having ball and socket arrangement. The adjustment of a compass is done in the following three steps.

1) **Centering:** The compass fitted over the tripod Is lifted bodily and placed approximately on the station peg by spreading the leg of a tripod equally, The centre of the compass is checked by dropping a small piece of stone from the centre of the bottom of the compass so that it falls on the top of the station peg. A plumb bob may be used to judge the centering either bt attaching it with a hook providing at the bottom or otherwise by holding it by hand.
2) **Leveling:** After the compass is centred, it is leveled by means of ball and soket arrangement so that the graduated circle may swing freely.It can be checked roughly by placing a round pencil on the top of the compass, when the pencil does not move, that is roughly the horizontal position.
3) **Focusing the prism:** The prism attached is moved up and down so that grauation on the graduated circle should become sharp and clear.

Local Attraction:

Sometimes .the magnetic needle does not point towards magnetic North or South. The reason being that the needle may be under the influence of external attractive forces which are produced due to magnetic substances thus the deflection of the needle from its original position, due to the presence of some magnetic substances is known as local attraction. To detect local attraction at a particular place, fore and back bearing of each line are taken. Then difference comes out to be 180° there is no local attraction at either station. On the other hand of the difference is other than 180°, the bearing may be rechecked to find out the discrepancy may not be due to the presence of iron substance near to the compass. If the difference still remains the local attraction exists at on or both the stations.

Elimination of Local attraction:

In this method, the bearing of the other lines are corrected and calculated on the basis of the a line which has the difference between its fore bearing and back bearing equal to 180°. The magnetic of the error is formed due to local attraction by drawing a sketch of observed and correct bearing of the line at each station. The error will be negative when the observed bearing is less than the corrected one and the correction will be positive and vice versa.

If however, there is no such line in which the difference of fore bearing and back bearing is equal to 180°, the correction should be made from the mean value of the bearing of that line in which the difference between the fore and the back bearing is the least. If the bearings are observed in quadrant system, the correction should be applied in proper direction by drawing a neat sketch roughly.

PROCEDURE:

1. Four ranging rods are fixed at different points i.e. A, B, C, D, E etc. such that it should be mutually visible and may be measured easily.
2. Measure the distance between them.
3. At point A the prismatic compass is set on the tripod Stand, centering and leveling is then properly done.
4. The ranging rod at B is ranged through sighting slits and objective vane attached with horse hair and reading on prismatic compass is noted down.

5. It is fore bearing of line AB. Then the prismatic compass is fixed at B and ranging rod at C. AND A is sighted. And reading is taken as forbearing of BC and back bearing Of AB.
6. Repeat the same procedure at the stations C, D etc.

Observation Table:

S.no.	Line	Observed bearing	Local attraction	error	Correction	Corrected bearing	Included angle
A	AB						
	AE						
B	BA						
	BC						
C	CB						
	CD						
D	DC						
	DE						
E	ED						
	EA						

Sample Calculation: Error = observed bearing –corrected bearing

Check = $(2n-4) \times 90^0$

RESULT: The prismatic compass is studied and bearing of lines of traverse are Observed, the correction due to local attraction at affected station is done and corrected bearings are written in tabular form.

EXPERIMENT NO - 3

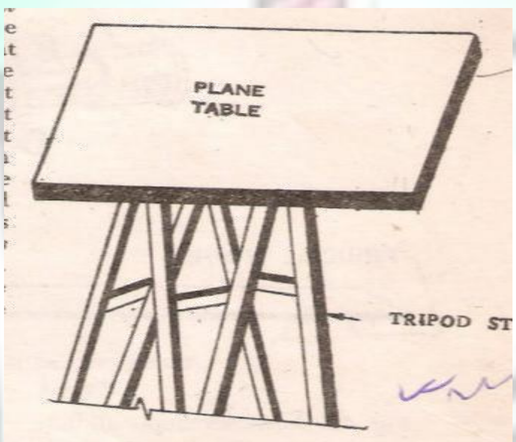
Aim : Radiation and Intersection method by Plane Table Survey

Apparatus : Plane table with tripod, Alidade, Trough compass, Sprit level, Plumbing fork or U-frame, Plumb bob, Tape, chain, pegs, ranging rods, etc.

Theory

Plane table surveying: the system of surveying in which field observation and plotting work i.e. both are done simultaneously is called plane table surveying.

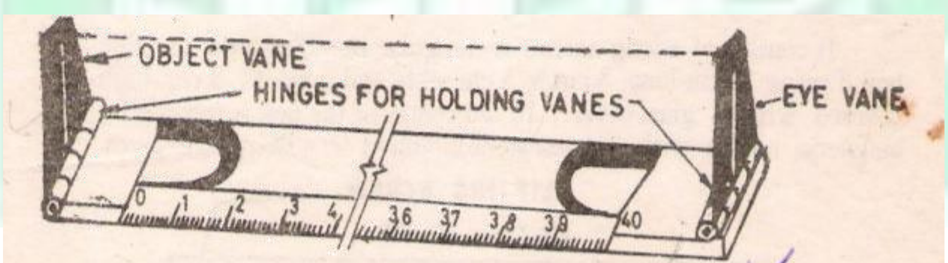
The plane Table: The drawing board made of well seasoned wood such as teak or pine which is used for the purpose of plotting is called plane table. It is available in sizes 500x400x15mm, 600x5000x15mm and 750x600x20mm.The top surface of board is perfectly plane and to the underneath it is fitted with a leveling head or ball and socket arrangement. The table is mounted on a tripod by means of a central screw with a wing nut or in such a manner so that the board can be revolved; leveled and clamped in any position.



PLANE TABLE WITH TRIPOD

Alidade: The tool or instrument which consists of metal (usually of brass) or wooden (well seasoned) rule 40cm to 60cm long, 3cmto5cm wide and fitted with two vanes at the ends is called an alidade.

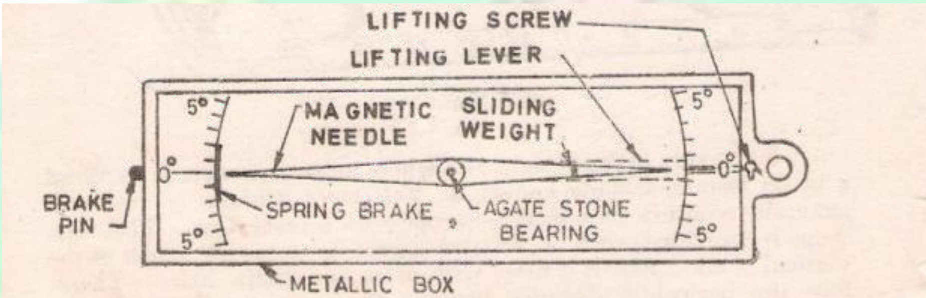
The beveled graduated edge is known as the fiducial edge. Such an alidade is known as plain alidade.



PLAIN ALIDADE

Trough Compass:

The compass which is used to mark the direction of the magnetic meridian on the plane table is called trough compass. It consist of a long narrow rectangular non magnetic metallic box 8cm to 15cm long,3cm to 5cm wide and 2cm to 3cm high on the covered with a glass cover. it the centre of the box is provided a magnetic needle with a agate stone mounted on the sharp steel pivot. At the end the through compass graduated scales are with zero degree at the centre and up to 5° on either side of the zero line.A counter weight is also used for North end of the needle to represent North and is also used for balancing the dip of the needle.

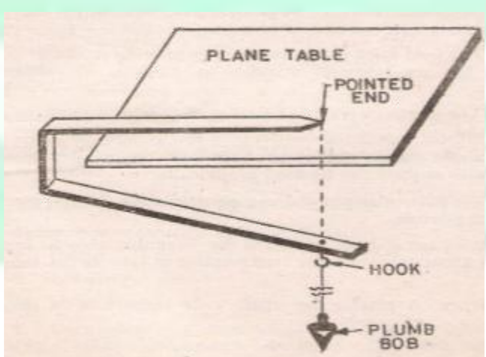


TROUGH COMPASS
Fig 4.4

Sprit Level: A small sprit level circular or rectangular is required for seeing if the table is properly level. The level must have flat base so that it can be placed on the table.

Plumbing fork or U-frame: The plumbing fork to which is attached a plumb bob ,used for centering the plane table over the station occupied by the plane table. it is also meant for transforming the ground point on to sheet so that both the points should be in the same vertical line

It consists of two light metal arms as shown in fig. approximately of equal lengths. A hook for suspending a plumb bob is provided at the lower arm immediately below the end point of the upper arm. The upper arm is placed on the plane table while the lower arm with a plumb bob is moved below the table for centering over the ground station mark, thus in the exact position the pointed end of the upper arm will give the corresponding position on the paper.

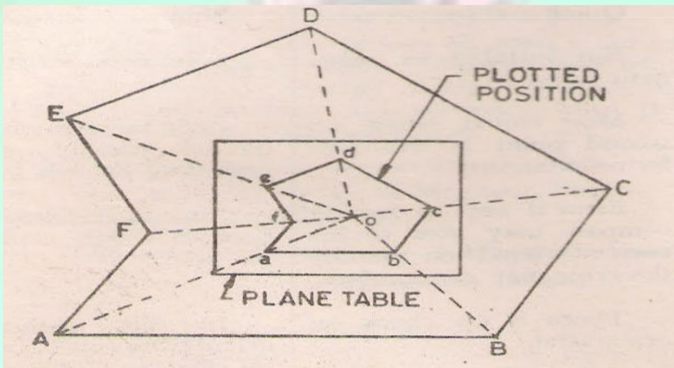


PLUMBING FORK
Fig. 4.5

Radiation Method:

When from a single set of plane table on instrument station different details are located on the sheet, the method is known as radiation method In this method the rays are drawn from the instrument station to the point to be located, then the distances are measured from the instruments station to the point and the position of the each point is plotted on the sheet using a suitable scale.

The method is most suited for surveying small areas which can be controlled by single setting. It can also be used in combination with other method. This method can be applied for locating distant points if the distances are obtained Tacheometrically with the help of the telescope alidade.



RADIATION METHOD

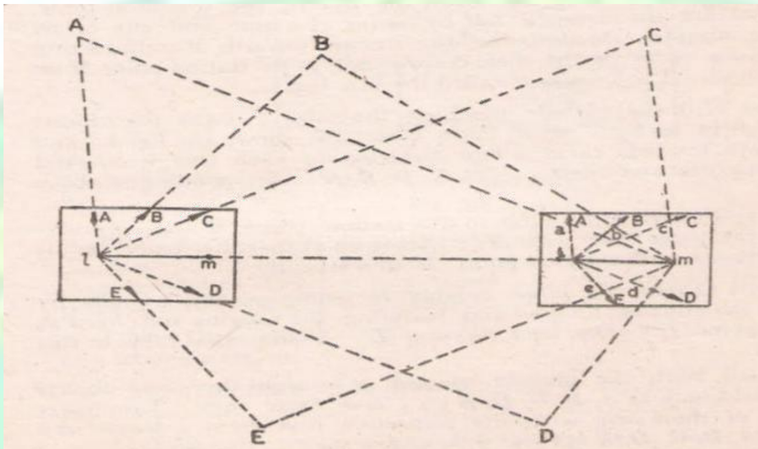
Procedure:

1. Select the position of the table where it is be set so that all the points to be located are visible from it. Let 'O' be the position of such a point on the ground.
2. Set the plane table over this point and level it. Draw the North line in the top corner of sheet by means of trough compass at the table.
3. Now transfer the position of the point 'O' on the ground to the sheet by means of the plumbing fork. The point 'O' will represent point 'o' will represent point 'O' on the ground.
4. With the alidade touching the point 'o' (may be represented by fixing a pin), sight the point A in the field. Draw the ray along the fiducial edge. Measure the distance of this point from the instrument station by means of tape and plot the point 'a' corresponding to point 'A' in the field to scale in the sheet.
5. Similarly sight other points such as B, C, D, E etc. and measure their distances from the instrument station. Plot them to scale to get their position on the sheet such as b, c, d etc. on the sheet.

Intersection method:

When the location of an object is obtained on the sheet of paper by the intersection of the rays drawn after sighting at the object from two plane table stations (previously plotted), it is called intersection method.

The method is suitable when the distance between the point and the instrument station is either too large or cannot be measured accurately due to some field conditions as in case of mountainous country. It is also employed for filling up details, locating distant and inaccessible object, locating the broken boundaries as in the case of rivers etc. The method can also be used for checking of plotted points. The line joining the two instrument stations is known as the base line. No linear measurement other than the base line is made.



INTERSECTION METHOD

Procedure:

1. Select two points L and M in such a way so that all the points to be plotted are visible from them. Now set the table at station, point L in such a position so that the sheet should cover all the points. Level the table and clamp it.
2. Draw the north line in the top corner of sheet by means of trough compass
3. Now transfer the position of station point L on the sheet as ‘l’ with the help of plumbing fork so that it is vertically above the instrument station.
4. With the alidade pivoted about ‘l’ sight the ranging rod fixed at station point M and draw the line in the direction of M. Now measure the distance LM by means of the tape and cut off lm to some suitable scale along the ray drawn toward M; thus fixing the position of ‘m’ on the sheet corresponding to station point M on the ground. The line lm is called the base line.
5. With the alidade touching the point ’l’ sight the objects in the field such as A,B,C,D,E etc. as shown in figure and draw the rays towards them. Th direction of each line is marked with an arrow and a letter A, B, C, D. E etc. corresponding to above details.
6. Now shift the table to the station point M and approximately set it in the line with ML. Set it up so that the point ‘m’ is vertically above the station point ‘M’ and level it.
7. Orient the table roughly by compass, then finally by placing the alidade along ml and bisecting the ranging rod fixed at station point ‘L’ i.e. by back sighting ‘L’. Clamp the table in this position.
8. With the alidade centered at m sight the same object in the field such as A, B, C, D, E etc; and draw rays. The intersection of these rays with the respective rays from l locate the object A, B, C, D, E etc; as a , b, c, d, e etc; on the sheet.

EXPERIMENT NO - 4

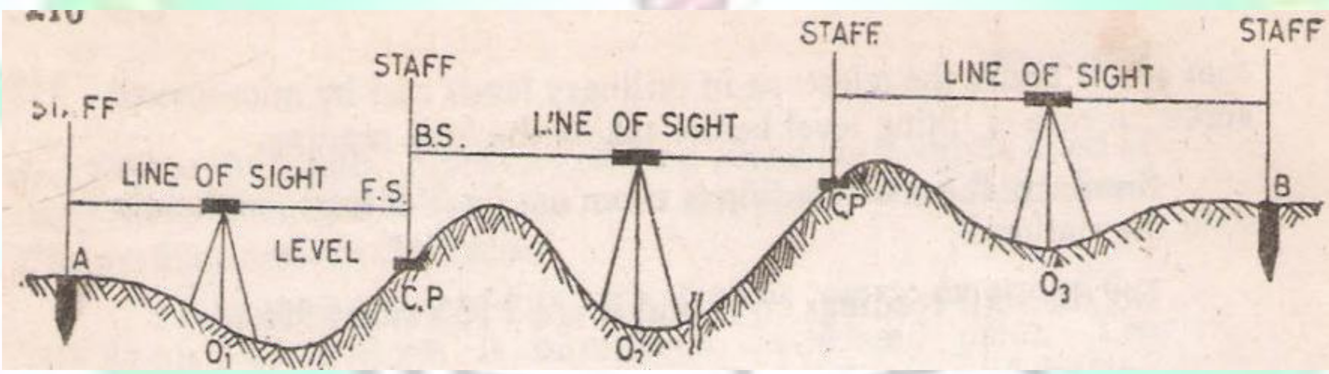
Aim : Fixing bench mark with respect to temporary bench mark with dumpy level by fly leveling

Apparatus **:** Dumpy level, leveling staff, tripod stand, arrows, pegs

Theory:

Fly leveling: It is a very approximate from of levelling in which distances are not measured and sights are taken as large as possible. In this method a line of levels is run to determine approximately reduced levels of the points carried out with more rapidly and less precision.

Check leveling: The main purpose of this type of leveling is to check the values of the reduced levels of the bench marks already fixed. In this method only back sight and foresight are taken. There is no need of intermediate sights. However great care has to be taken for selecting the change points and for taking reading on the change points because the accuracy of leveling depends upon these



PROCEDURE:

1. Let A and B the two points as shown in figure They are too for apart .The position of each set up of level should be so selected that the staff kept on the two points is visible through the telescope.
2. Let O1, O2, O3 be the positions of the level to be setup. Choose the change points 1,2 etc. on a stable ground so that the position of the level should be midway between the two staff reading to avoid error due to imperfect adjustment of the level.
3. Now setup the level at O1 take the reading on the staff kept vertically on A with bubble central. This will be a back sight and R.L of the A is is to assumed or say known. Record these values in the same line in the level book.
4. Now select the position of C.P (1) so that the distance of it from O1 is approximately equal to that O1A
5. With the bubble in the centre take the reading of the staff held vertically over the change point. This will be a fore sight and book this value in the level book on the next line in the column provided.

6. Now shift the level to O2 and set up it there carefully, with the bubble in the centre take reading on the staff kept vertically as the fore sight over C.P(1). This will be a back sight, book it in the same line as the fore sight already recorded in the column provided.
7. Select another CP (2) on the stable ground as before so that station O2 is approximately midway between C.P (1) and C.P(2).
8. With the bubble central, take the reading on the staff kept vertically over the CP2.This will be fore sight and book it in the level book page in next line.
9. Repeat the process until the point B.M reached .The last reading will be a foresight
10. Now find out the reduced levels by height of instrument method or by rise and fall method.

Observation Table:

Station	Readings			Height of instrument	Reduced Levels	Remarks
	B.S.	I.S	F.S			

RESULT:

The difference of level between the point be equal to R.L of the last point minus the R.L at the B.M is found to be ____________________

EXPERIMENT NO - 5

Aim **:** L-Section and cross section of the road (one full size drawing sheet each for L- section and cross section)

Apparatus : Dumpy level, leveling staff, ranging rod, tape etc.

Theory:

Profile leveling: The process of determining elevations at points at short measured intervals along a fixed line is called Longitudinal or profile leveling.

Cross sectioning: It is a method of leveling to know the nature of Ground on either side of the centerline of the proposed route. Levels are taken at right angles to the proposed Direction of the road end at suitable distances and leveling is carried out along this cross Section.

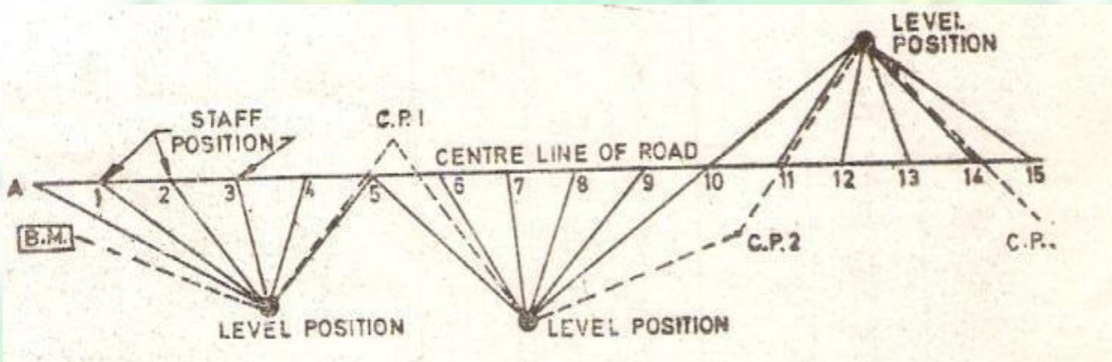
During location and construction of highways, Rail tracks sewers and canals strakes or other marks are placed at various aligned points and the undulation of the ground surface along a predetermined line is adjoined. The line of section may be single straight lines changing directions.

Levels are taken at right angles to the proposed Direction of the road end at suitable distances and leveling is carried out along this cross section. Cross section are the sections run at right Angles to the centerline and on the either side of it for the purpose They are taken at each 10,m station on the centerline. The length of Cross section depends upon the nature of the work if cross sections are Short they are set square out by edge. If long they are set out by the Optical square, box sextant or theodolite. They are serially numbered from the beginning of the Centerline and are taken simultaneously with the longitudinal section they may be taken at the hand level, level, Abney level or theodolite

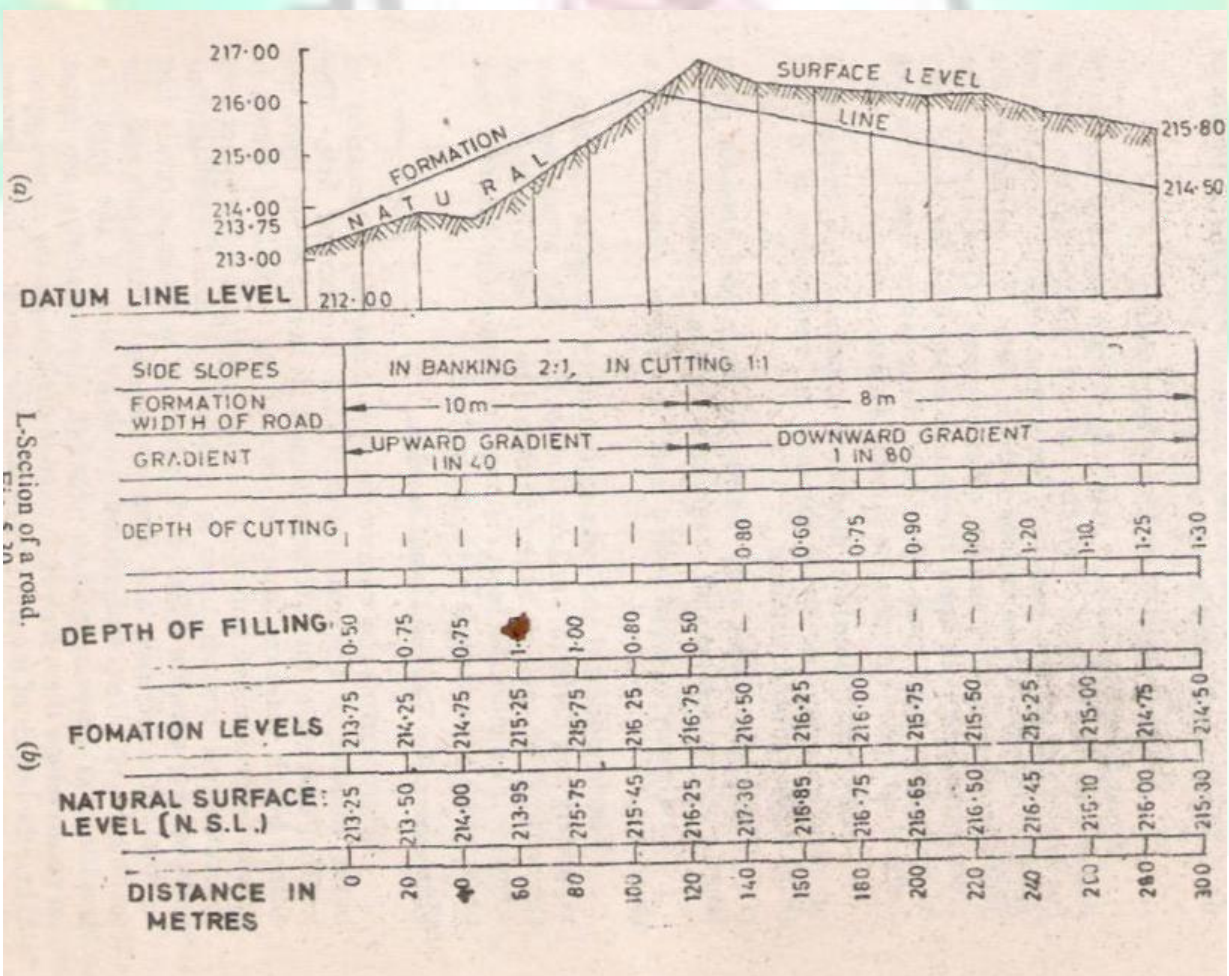
Procedure:

Let ABC be the line of section set out on the ground and marked with pegs driven at equal interval (say 20m to 30m) as in the figure. The level is set up generally on one side of the profile to avoid too short sight on the points near the instrument and care is taken to set up the level approximately midway between two change points. The leveling is strated from the bench mark of known value. From each set up staff reading are taken on pegs already fixed at the desired interval and also at significant points where abrout changes of slope etc. occur. All these readings are recorded as intermediate slight against the respective chainages along the line in the level book. Other data of the level book is also filled up before starting the work. When the length of sight is beyond the power of the telescope (usually it is 100m) ,the foresight on the change point is taken. The level is then is then shifted and setup in an advanced position and a back sight is taken on the change point. The change point may or may not lie in the line of section. Chaining and reading are then continued as before, till the whole line of section is completed.

The work is to be checked in the progress of leveling by taking reading on other bench marks, on the way or on bench marks fixed by differential leveling. The fore and back bearing of the section line should be taken and recorded. Next sketches of the bench mark, change points, and other feature such as nallah, a road, canal, etc. crossing the section line be drawn and fully described in the remarks column of the level-book. The procedure and corresponding reading and values are represented on the page of a level-book for a part of road project.



Plotting the Longitudinal section



LEVEL BOOK

Whenever leveling operation is carried out the staff reading taken in the field is entered in the note book called a Level-Book. Each page of it has the following columns which help in booking of reading and reduction of levels.

Name of work survey for:-							Page No:-	
Levelling from --------------------------------								
Instrument No--				Conducted by:-				
Station	Distance In meters	Staff Reading			Height of Instrument or		Reduced Level	Remarks
		(B.S)	(I.S)	Fore (F.S)	Rise	Fall		

EXPERIMENT NO- 6

Aim : Contour plan of given area (one full size drawing sheet)

Apparatus : Dumpy level, prismatic compass, chain 20m, 30m, metallic Tape, Ranging rod, Leveling staff, pegs line.

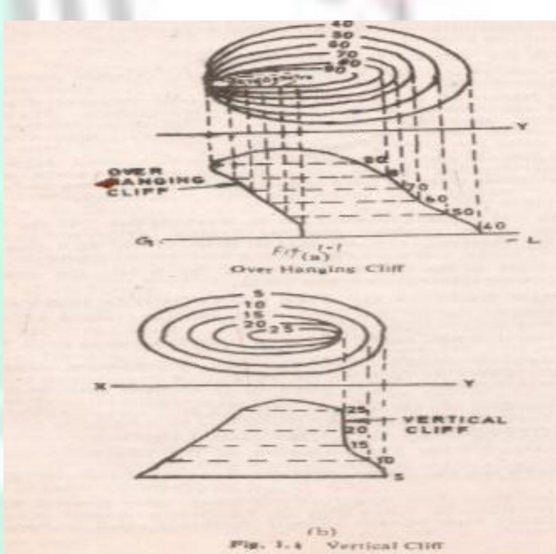
Theory:

Contouring: The elevation and depression the undulations of the surface of the ground are shown as map by interaction of level surface with by means of contour line. a contour may be defined as the line of intersection of a level surface with the surface of the ground.

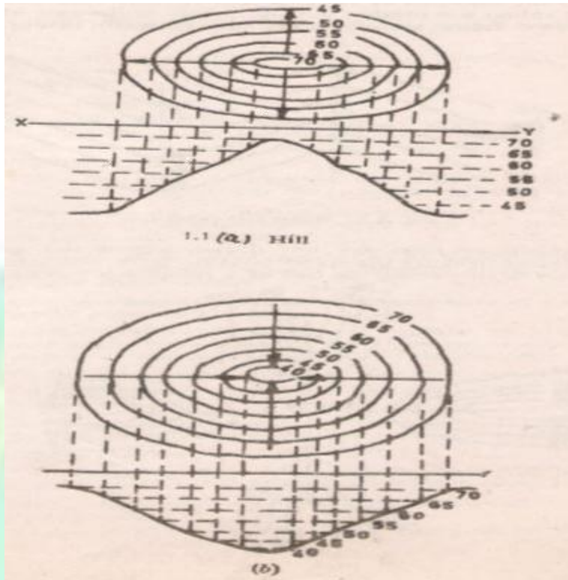
Characteristics of Counter Lines

The following are the Characteristics of the contours/ contour lines.

1) All points on the same contour line will have the same elevation.
2) Contour lines close together represent steep ground, while uniform slope is indicated when they are uniformly spaced. A series of straight, parallel and equally spaced contours show a plane or flat surface.
3) Contour lines of different elevation cannot merge or cross one another on the map, expect in the case of an overhanging cliff. A vertical cliff is indicated when several contours coincide [see fig 1.1 (a) and (b)]



4) A contour line must close upon itself either within or without the limits of the map.
5) Series of closed contour lines on the map either represent a hill or a depression according as the higher or lower values are inside them as shown in figs [1.2(a) and (b)]



1.1 (a) Hill

(b)

6) A contour will not stop in the middle of the plan. It will either close or go out of the plan.

7) Ridge or water shad and valley lines are the lines joining the top most or the bottom most points of hill and valley respectively, cross the contours at right angles. A ridge line is shown when the higher values are inside the loop, while in the case of a valley line, the lower values are inside the loop as shown in fig (1.3)

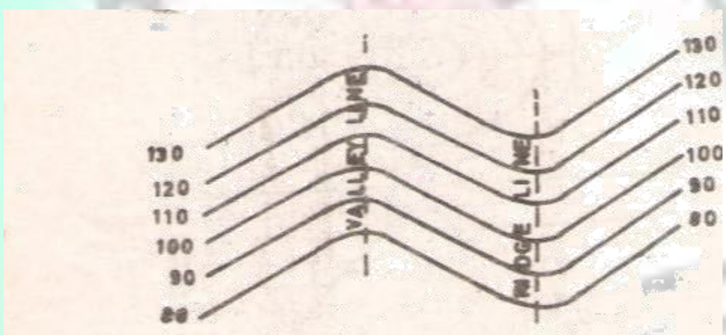


Fig. 1.3. Ridge and valley line

8) Contour lines are not drawn across the water in the stream or river because the water level in the it is not constant; but contours are drawn along the bed of a river or a stream.

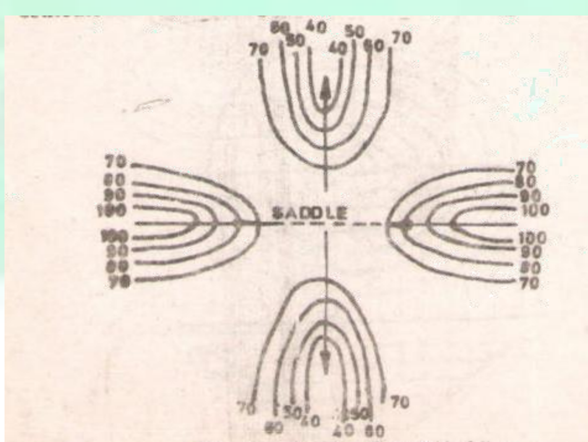


Fig. 1.4. Saddle and water shed line.

LOCATING CONTOURS:

a) By cross-section method:

This method is commonly used in rough survey, cross sections are run traverse to the contour line of road, and railway as canal and the point of change of slope (representations) are located. The cross-section line may be inclined at any angle to the centerline if necessary. The spacing of the cross sections depends upon the characteristics of the ground.

By interpolation of contour is meant the process of spacing the contour proportioning between the plotted ground points. Contour may be interpolated by

1) Estimation
2) Arithmetical calculations
3) Graphical method .in all these methods

It is assumed that the slope of the ground between any two random points is uniform.

RESULT: The contour of given land is drawn in the sheet.

EXPERIMENT NO- 7

Aim : Measurement of Horizontal angles by method of Repetition and Reiteration

Apparatus : Theodolite, Ranging rod, pegs etc.

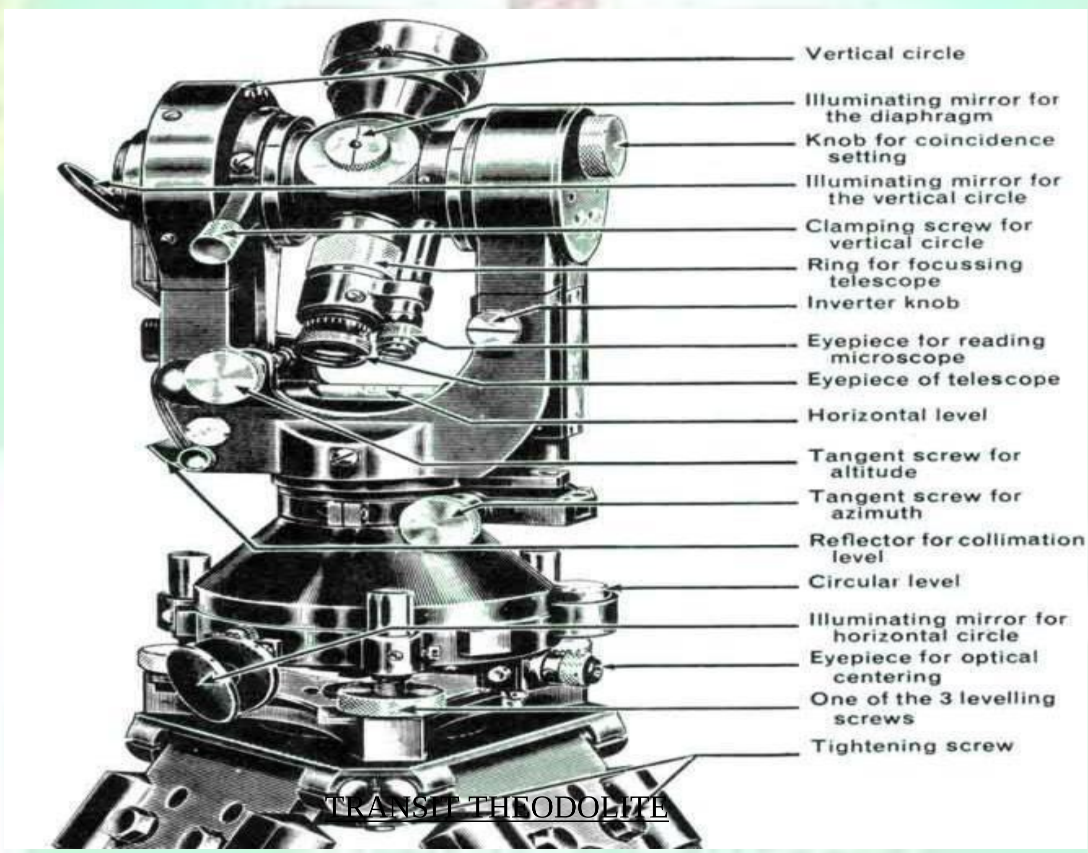
Theory:

Theodolite: The theodolite is the most intricate and accurate instrument used for measurement of horizontal and vertical angles. It consists of telescope by means of which distant objects can be sighted. The telescope has two distinct motions on in the horizontal plane and the other in the vertical plane. The former being measured on a graduated Horizontal vertical circle of two vernier.

Theodolite are primarily classified as

1) Transit theodolite
2) Non-transit theodolite

A theodolite is called transit theodolite when its telescope can be resolved through a complete revolution about its horizontal axis. In a vertical plane the transit type is largely used.



TRANSIT THEODOLITE

Various parts of transit theodolite

1) Telescope: it is an integral part and is mounted on the spindle known as horizontal axis or turn on axis. Telescope is either internal or external focusing type.

2) The leveling head: It may consists of circular plates called as upper and lower Parallel plates. The lower parallel plate has a central aperture through which a plumb bob may be suspended. The upper parallel plate or tri branch is supported by means of four or three leveling screws by which the instrument may be leveled.

3) To lower plate or screw plate: It carries horizontal circle at its leveled screw. It carries a lower clamp screw and tangent screw with the help of which it can be fixed accurately in any desired position.

4) The upper plate or vernier plate: it is attached to inner axis and carries two vernier and at two extremities diametrically opposite.

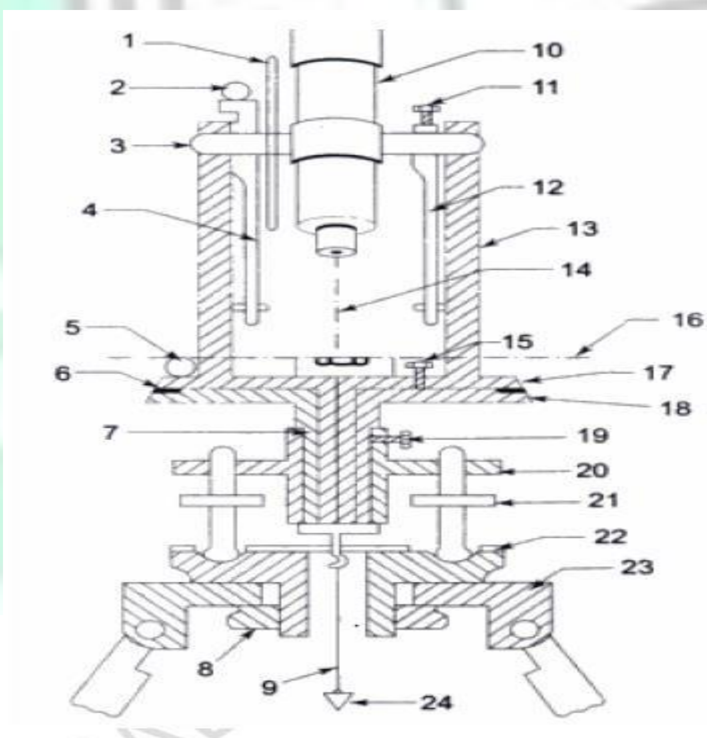
5) Compass: the compass box may be either of circular form or of a rough type. The former is mounted on the vernier plate between the standards while the latter is attached to the underside of the scale or lower plate or screwed to one of the standards. Modern theodolite is fitted with a compass of the tubular type and it is screwed to one of the standards.

6) Vertical circle: the vertical circle is rigidly attached to the telescope and moves with it. It is silvered and it is usually divided into four quadrants

7) Index bar or T-frame: the index bar is T shaped and centered on horizontal axis of the telescope in front of the vertical axis. It carries two vernier of the extremities of its horizontal arms or limbs called the Index arm, the vertical leg called the clip or clipping screws at its lower extremity the index arm and the clipping arm are together known as T-frame

8) Plumb bob: To centre the instrument exactly over a station mark, a plumb bob is suspended from the hook fitted to the bottom of the central vertical axis.

Transit theodolite and parts:



1. Vertical Circle
2. Altitude bubble
3. Horizontal axes
4. Vernier Arm
5. Plate bubble
6. Graduated Arc
7. Leveling Head
8. Clamping Nut
9. Vertical Axis
10. Telescope
11. Vertical circle clamping screw
12. Arm of the vertical circle clamp
13. Standard
14. Line of sight
15. Upper plate clamping screw
16. Axis of plate bubble
17. Upper plate
18. Lower plate
19. Lower plate clamping screw
20. Tri branch
21. Foot screw
22. Trivet
23. Tripod top
24. Plumb bob

Definitions

Face Right: When the vertical circle of a theodolite is on right of the observer, the position is called face right and observation made is called face right observation.

Face Left: When the vertical circle of a theodolite is on left of the observer, the position is called face left and observation made is called face left observation. By taking the mean of both face readings, the collimation error is eliminated.

Telescope Normal: The telescope is said to be normal or direct when its vertical circle is to the left of the observer and bubble is up.

Telescope Inverted: The telescope is said to be inverted when its vertical circle is to the right of the observer and the bubble is down.

Changing face: Revolve the telescope by 180°in vertical plane about horizontal axis.Again revolve the telescope in horizontal plane about vertical axis.

Repetition method of measuring Horizontal angles

When it is required to measure horizontal angles with great accuracy as in the case of traverse, the method of repetition may be adopted. In this method the same angle is added several times by keeping the vernier to remain clamped each time at the end of each measurement instead of setting it back to zero when sighting at the previous station. The corrected horizontal angle is then obtained by dividing the final reading by the number of repetitions. Usually six reading, three with face left and three with face right, are taken The average horizontal angle is then calculated.

Procedure:

1. Select a station point O.
2. Set the theodolite at O and do the temporary adjustments. The telescope is adjusted for right face right swing.
3. Set the vernier A to zero using upper clamp. Loosen the lower clamp, direct the telescope to the station point A and bisect A exactly by using the lower clamp and lower tangent screw.
4. Note the vernier readings (A and B).
5. Loosen the upper clamp and turn the telescope clockwise until the point B is exactly bisected.
6. Note the vernier readings (A and B).
7. The mean of the two vernier readings gives the value of <AOB.
8. Loosen the lower clamp and turn the telescope to station point A and bisected A by using the lower clamp and lower tangent screw.
9. Loosen the upper clamp and turn the telescope clockwise until the point B is exactly bisected. Now the vernier reading is twice the value of the angle.
10. Repeat the process for the required number of times (usually 3).
11. The correct value of the angle AOB is obtained by dividing the final reading by the number of repetition.
12. Adjust the telescope for left face left swing.

		Face left Swing right				Face right swing left				
Instrument at	Sighted to	A	B	Mean	Horizontal Angle	A	B	Mean	Horizontal Angle	Average Horizontal Angle

Reiteration Procedure:

1. Select a station point O.
2. Set the theodolite at O and do the temporary adjustments. The telescope is adjusted for right face right swing.
3. Set the vernier A to zero using upper clamp. Loosen the lower clamp, direct the telescope to the station point A and bisect A exactly by using the lower clamp and lower tangent screw.
4. Note the vernier readings (A and B).
5. Loosen the upper clamp and turn the telescope clockwise until the point B is exactly bisected.
6. Note the vernier readings (A and B).
7. The mean of the two vernier readings gives the value of <AOB.
8. Bisect all the points successively and note the readings of both verniers at each bisection.
9. Finally close the horizon by sighting the station point A. The A vernier The A vernier should be 3600. If not, note the closing error.
10. Adjust the telescope for left face left swing.
11. Repeat the whole process by turning the telescope in anticlockwise direction.
12. Distribute the closing error proportionately the several observed angles.
13. Take the average of face left and face right observations to give the corresponding horizontal angles.

Instrument at	Sighted to	Face left Swing right				Face right swing left				
		A	B	Mean	Horizontal Angle	A	B	Mean	Horizontal Angle	Average Horizontal Angle

RESULT:

Average horizontal angle is found to be

1. By Repetition method ________________
2. By Reiteration method ________________

EXPERIMENT NO- 8

Aim : Determination of elevation of points by Tacheometric surveying

Equipment : Tacheometer, Chain (or) Tape, Pegs and Levelling Staff. Ranging rods

Theory:

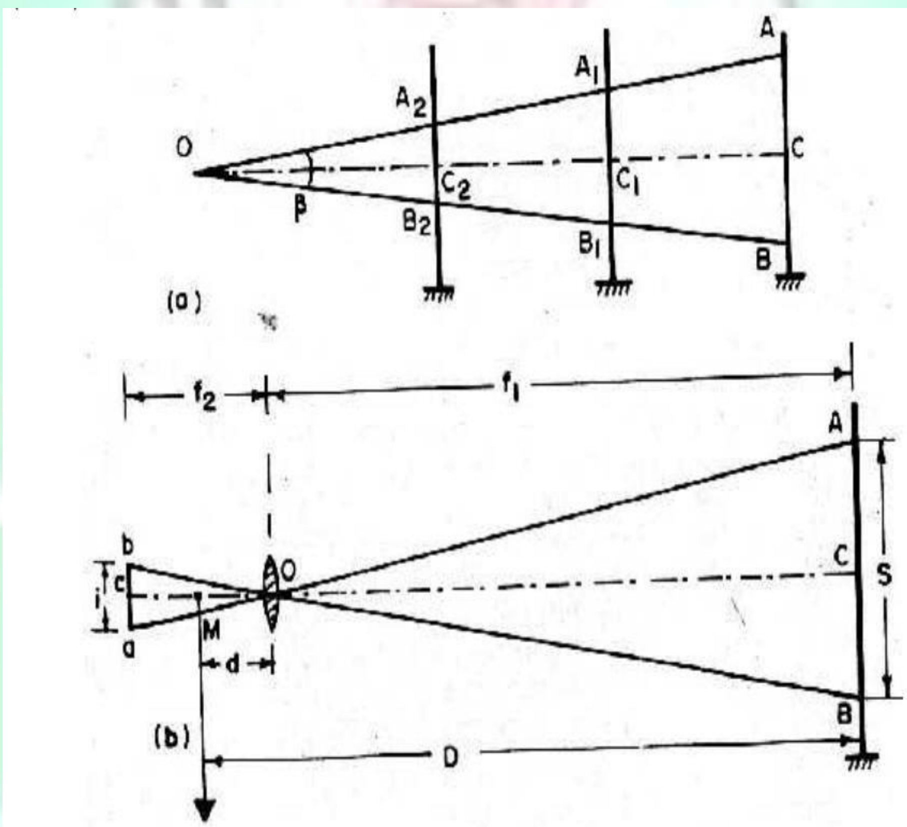
The Tacheometer is an instrument which is generally used to determine the horizontal as well as vertical distance. it can also be used to determine the elevation of various points which cannot be determine by ordinary leveling. When one of the sight is horizontal and staff held vertical then the RLs of staff station can be determined as we determine in ordinary leveling .But if the staff station is below or above the line of collimation then the elevation or depression of such point can be determined by calculating vertical distances from instrument axis to the central hair reading and taking the angle of elevation or depression made by line of sight to the instrument made by line of sight to the instrument axis.

Principle : Distance between two points is given by (Fig)

$$D = \frac{f}{i} \times s + (f + d)$$

Where f/i is called the multiplying constant

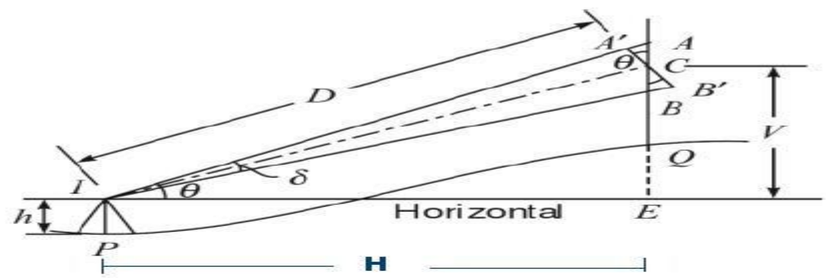
(f + d) is called additive constant



Procedure:

1. Set up the instrument in such a way that all the point should be visible from the instrument station.
2. Carryout the temporary adjustment and set vernier zero reading making line of sight horizontal.
3. Take the first staff reading on Benchmark and determine height of instrument.
4. Then sight the telescope towards the staff station whose R.Ls are to be calculated.
5. Measure the angle on vernier if line of sight is inclined upward or downward and also note the three crosshair readings.
6. Determine the R.Ls of various points by calculating the vertical distance

Case 1:



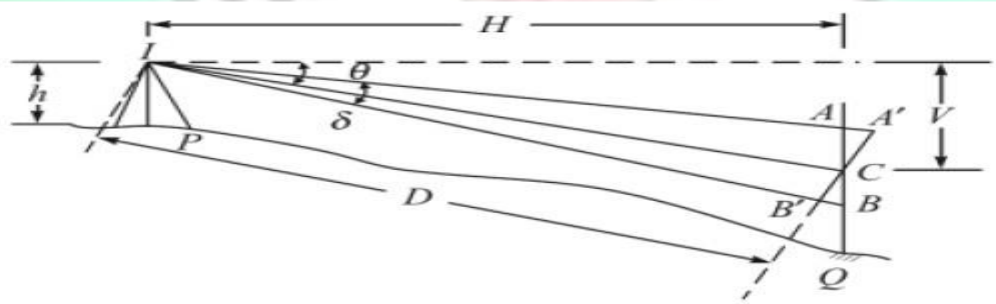
Inclined sight (elevation)

$$H = D\cos\theta = KS\cos^2\theta + C\cos\theta$$

$$V = \frac{1}{2}KS\sin 2\theta + C\sin\theta$$

$$\text{R.L. of } Q = \text{R.L. of } P + h + V - CQ$$

Case 2:



Inclined sight (depression).

$$D = KS\cos\theta + C$$

$$H = D\cos\theta = KS\cos^2\theta + C\cos\theta$$

$$V = D\sin\theta = KS\sin\theta\cos\theta + C\sin\theta$$

$$\text{R.L. of } Q = \text{R.L. of } P + h - V - CQ$$

Result:

EXPERIMENT NO- 9

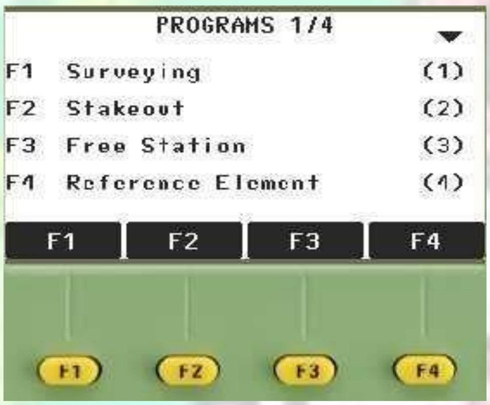
Aim : Setting up Total Station

Equipment **:** Total Station

Theory

Setting up Total Station over a point for the first time (Aligning to North)

1. Switch on the instrument.
2. Press USER key for Laser Beam for centering and leveling.
3. Press MENU.
4. Press F1 (PROGRAMS).



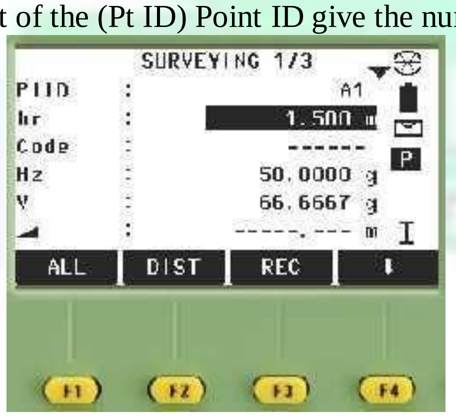
5. Press F1 (SURVEYING).

6. Press F1 (Set Job).

7. Press F1 (NEW) to give a new job name.
8. To write the name of the job. Press F1 (INPUT) and then using the Function keys F1 to F4 give the name. Then Press Enter.
9. Press F4 (OK)
10. Press F2 (Set Station) to give the station No. Press F1 (INPUT) to give the station number using the Function keys from F1 to F4.
11. Press F2 (FIND).
12. Press F4 (ENH).
13. Enter the Easting, Northing and Elevation for the point and Press F4 (OK)
14. Now in front of hi (Instrument Height) give the height of the instrument.
15. Press F4 (OK)
16. Press F3 (Set Orientation).

17. Press F1 (Manual Angle Setting).
18. Point the instrument in the North direction and Press F1 (Hz=0).
19. Press F3 (REC).
20. Press F4 (START).

21. In front of the (Pt ID) Point ID give the number of the point to shoot.



22. In front of the hr (Reflector height) give the height to which the reflector is opened.

For shifting the station by aligning to the back point (known co-ordinates)

1. Switch on the instrument.
2. Press USER key for Laser Beam for centering and leveling.
3. Press MENU.
4. Press F1 (PROGRAMS).
5. Press F1 (SURVEYING).
6. Press F2 (Set Station) to give the station No.
7. In front of Station: Enter the Station Number where you are standing. Press F1 (INPUT) to give the station number using the Function keys from F1 to F4.
8. Press F2 (FIND).
9. Press F4 (OK).
10. Now Give in front of hi (height of Instrument) and Press F4 (OK).
11. Press F3 (Set Orientation).
12. Press F2 (Coordinates).
13. In front of BS (Back Sight) give the number of the Back Point to which the Instrument is being aligned. By Pressing F1 (INPUT)
14. Press F2 (FIND)
15. Press F4 (OK).
16. Press PAGE.
17. Now Sight the back point and Press F1 (DIST).
18. The value in front of Δ = will give the relative error in station shifting.
19. Press F3 (REC).
20. Now Press F (OK).
21. Press F4 (START)
22. And we can continue with the surveying.
23. To see the Easting, Northing, and Elevation for a Point Press PAGE until you see East, North, Elevation

EXPERIMENT NO- 10

Aim : Determination of area using total station

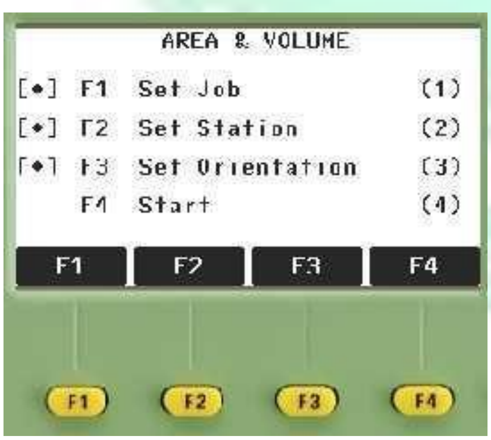
Equipment:

1. Total Station
2. Tripod
3. Prism and Pole
4. Arrows
5. Field Book

Procedure:

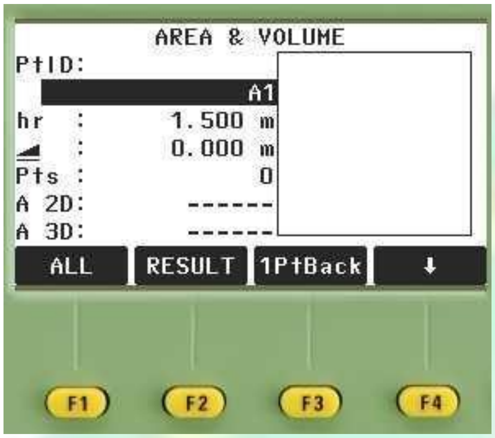
1) Using arrows mark the corners of the land whose area is to be found.
2) Choose a point for the Total station set up such that from this point all the points marked in step 1 are visible and set up the station on this point.
3) Press MENU.
4) Press F1 (Programs).
5) Press PAGE.

6) Press F2 (Area).



7) The First three steps (F1, F2 and F3) for station setup and orientation (refer Step1 and Step 2).

8) Press F4 (Start).



The points whose area is to be found can be either in the memory or can be shot directly in the field.

9) In front of Point ID Enter the number of the first point, then sight the point by keeping the reflector on that point. Press F1 (ALL) or press the trigger.

10) Repeat step 9 for the remaining points in a proper sequence until you have shot all the points. Once you have shot all the point you can see the area displayed on the screen automatically.

Result:

The area of the given piece of land is, A = __________________

Comments/Inference:

Write your comments and observations on the result obtained.

Applications:

In cadastral surveys it is required to make a plan of land showing all its boundaries and also obtain its area. This information about the land is useful for land development and selling and purchase of land.

EXPERIMENT NO- 11

Aim : To determine remote height of a point using Total Station.

Equipment:

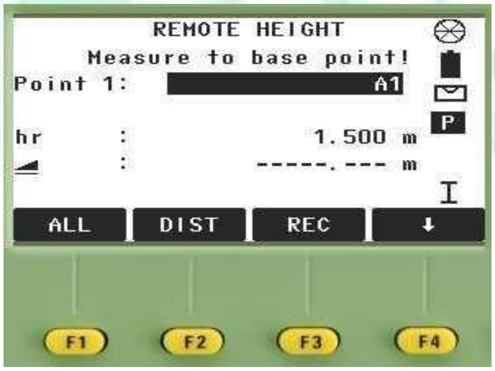
1. Total Station
2. Tripod
3. Prism and Pole
4. Arrows
5. Field Book

Procedure:

The Remote height program is used to find the elevation of the remote points where it is possible to place the prism directly below the point the point whose remote elevation is to be found.

1. Identify the point whose elevation has to found out
2. Choose a point for the Total station set up such that from this point both the point under consideration and its projection on the ground are visible, then set up the station over this point.
3. Press MENU.
4. Press F1 (Programs).
5. Press PAGE button.

6. Press F3 (Remote Height).
7. The First three steps (F1, F2 and F3) for station setup and orientation (refer to Step1 and Step 2).
8. Press F4 (Start).



9. Focus on the required point and turn telescope towards ground and guide prism man for properly placing the prism on the ground.
10. Now put the prism on the base point and Sight it and press F3 (ALL).
11. Now move the telescope and focus the top point whose elevation is to be found.
12. The height value will be displayed on the screen.

Result:

The remote height of a point, h = _____________

Comments/Inference:

Write your comments and observations on the result obtained.

Applications:

In construction of structures like buildings and bridges etc., it is required to find height of some points which are difficult to access.

EXPERIMENT NO- 12

Aim : To obtain the distance, gradient and difference of height between two in accessible points using the Total Station.

Equipment:

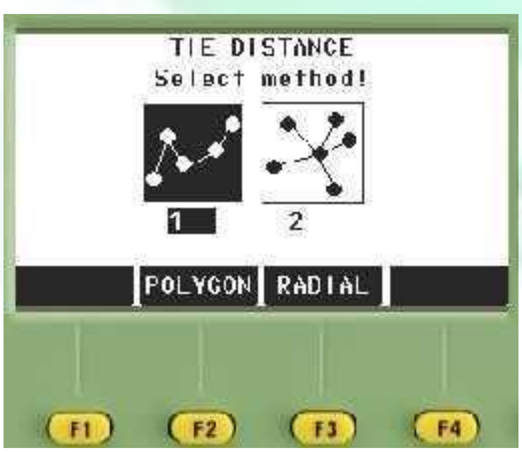
1. Total Station
2. Tripod
3. Prism and Pole
4. Field Book

Procedure:

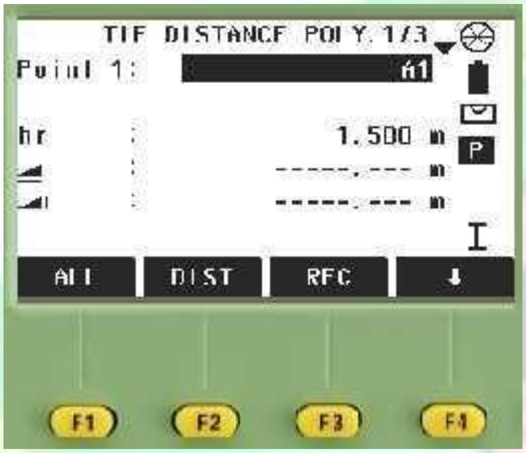
The Tie Distance Program is used to find the horizontal distance between two points by measurement in the field.

1. Identify the two points for measuring the distance.
2. Choose a point for the Total station set up such that from this point the two points marked in step 1 are visible and set up the station on this point.
3. Press MENU.
4. Press PAGE.

5. Press F1 (Tie Distance).
6. The First three steps (F1, F2 and F3) for station setup and orientation (refer to Step1 and Step 2).
7. Press F4 (Start).
8. There are two type of distance Polygonal and Radial.



9. The Polygonal is the point-to-point distance where as the Radial is used for finding the distance from a single point being kept fixed.
10. When the Points are not in memory and you want to operate the program by taking the measurements right in the field,



11. In front of the point enter the number of the point and Press F3 (ALL).
12. In front of the point2 Enter the number of the second point again sight it and press F3 (ALL).
13. Now you can see the results displayed on the screen.

Result:

The distance (d), gradient (s) and difference of height (h) between two in accessible points are,

d =__________, s =__________, h = ________________

Comments/Inference:

Write your comments and observations on the result obtained.

Applications:

In topographical surveys, sometimes features like buildings etc. are not accessible. Therefore a surveyor should be familiar with the technique of obtaining the horizontal distance, difference in height and hence the gradient between two inaccessible points.