Department:Civil Semester:III

Subject:Surveying Practical-II Subject code:317

LAB MANUAL

INTRODUCTION

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 verniear.

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.

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 tribranch 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) Clamps and tangent screws

There are two clamps and associated tangent screws with the plate. These screws facilitate the motion of the instruments in horizontal plane. Lower clamp screw locks or releases the lower plate. When this screw is unlocked both upper and lower plates move together. The associated lower tangent screw allows small motion of the plate in locked position.

The upper clamp screw locks or releases the upper vernier plate. When this clamp is released the lower plate does not move but the upper vernier plate moves with the instrument. This causes the change in the reading. The upper tangent screw allows the fine adjustment

9) Vertical circle clamp and tangent screw (11):

Clamping the vertical circle restrict the movement of telescope in vertical plane.

10) Altitude level (2):

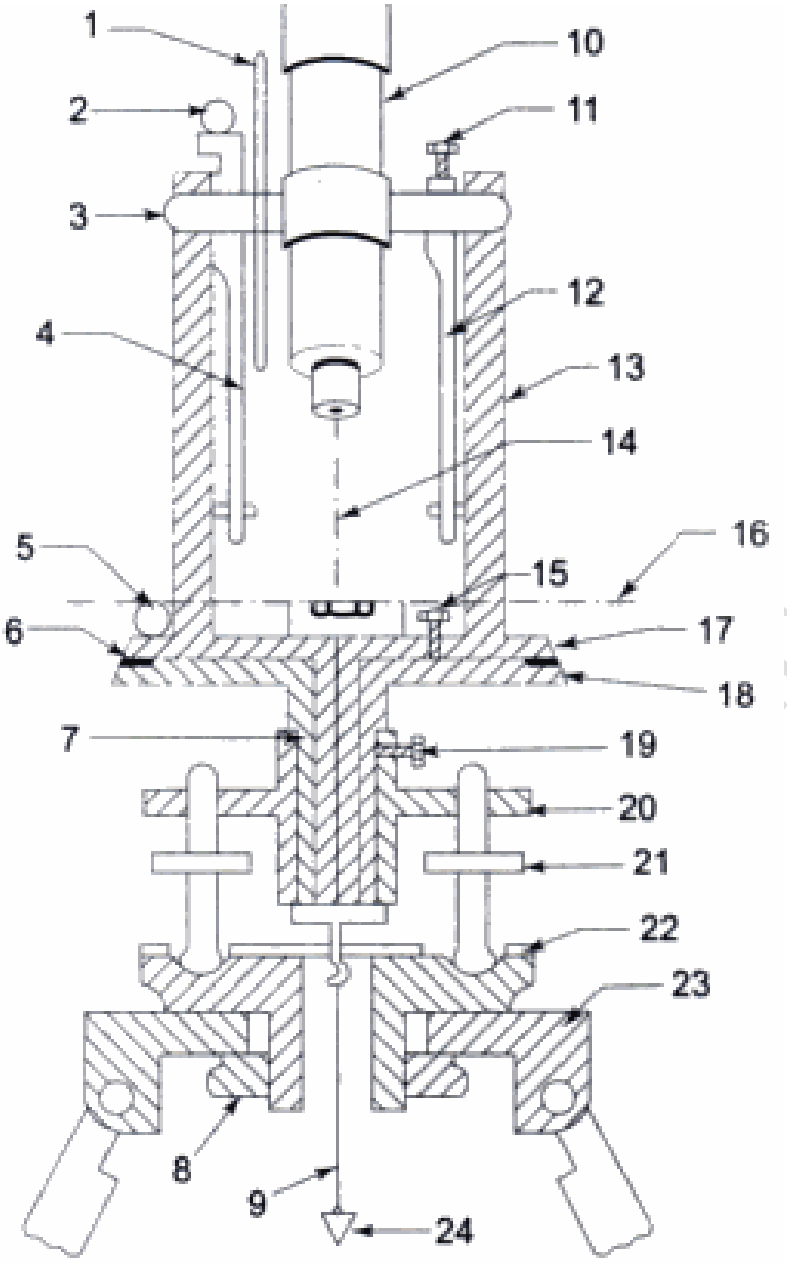
A highly sensitive bubble is used for levelling particularly when taking the vertical angle observations

11)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.

Trasit theodolite and parts:

1.Vertical Circle
2.Altitude bubble
3.Horizontal axes
4.Vernier Arm
5.Plate bubble
6.Graduated Arc
7.Levelling 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.Tribrach
21.Foot screw
22.Trivet
23.Tripod top
24.Plumb bob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Important Definition

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.

Temporary adjustments of theodolite

Centering:

This involves setting the theodolite exactly over the station mark or on the station peg.It is done by the following steps.

1)The plub bob is suspended from a small hook attached to the vertical axis of the theodolite.

2)The instrument is placed over the station mark with the telescope at a convenient height and with the tripod legs set well apart.

3)Two legs of the tripod are set firmly into the ground and the third leg is moved radially to bring the plumb bob exactly over the station mark.Then the third leg is also pushed into the ground.

4)If the instrument has a shifting head ,the instrument is roughly centered over the station mark and then by means of the shifting head ,the plumb bob is brought exactly over the station mark.

Levelling:

Having centered and approximately leveled the instrument is accurately leveled with reference to the plate level by means of leveling (or foot)screws.So that the vertical axis is made truly vertical,to lead the instrument.

(a) Loosen all the clamps and turn the instrument about either of its axis until the longer plate level is parallel to the pair of foot screws,the other plate level will then be parallel to the line joining the third screw and the mid point of the line joining the first pair
(b) Bring the long bubble to the centre of its run by turning both screws equally either both inwards or both outwards.
(c) Similarly bring to the other bubble to the center of its run by turning third leveling screw or the other pair of leveling screws.
(d) Repeat the process until finally both bubbles are exactly centered.

If the vertical angles are to be measured the instrument should be levelled with reference to the altitude level fixed on the index arm. To do this,

a)First level the instrument by the plate levels.Then turn the telescope.So that the altitutde level is parallel to the line joining a pair of foot screws.Bring the bubble to the center of its run by means of these srews.

b)Turn the telescopr through 90° and bring the bubble exactly to the mid position by the third leveling screw.Repeat until the bubble remains central in these two positions.

Focussing:

This is done in two steps.

1)Focussing the eyepiece for distinct version of the cross hairs at diaphragm.
2)Focussing the object glass for bringing the center of the object on the plane of the diagram.

(1)Focussing the eyepiece:

Point the telescope towards the sky or hold a sheet of white paper infront of the object glass ,and move the eyepiece in and out until the cross hairs are seen quite distinctly and clearly (appear sharp and black)

(2) Focussing the object glass:

There will be an apparent movement of the image relatively to the cross hairs when the observer moves his eyes.The apparent movement being called the parallax.To eliminate it ,direct the telescope towards the object and turn the telescope towards the object and turn the focusing screw until the image appears clear and sharp.

EXPERIMENTS

Exp.No: 1 Date:

Repetition method of measuring Horizontal angles (Repitition method)

Aim:

To determine the horizontal angle by repetition method.

Apparatus Required:

Theodolite with tripod,peg,ranging rod ,plub-bob

Procedure:-

1) Let LOM is the horizontal angle to be measured as shown in fig. O is the station point fixed on the ground by a peg. Set up the theodolite over the peg 'o' and level it .

2) Set the horizontal graduated circle vernier A to read zero or 360° by upper clamp screw and slow motion screw. Clamp the telescope to bisect the bottom shoe of the flag fixed at point 'L' and tighten the lower clamp. Exactly intersect the centre of the bottom shoe by means of lower slow motion screw. Check that the face of the theodolite should be left and the telescope in normal position.

3) Check the reading of the vernier A to see that no slip has occurred .Also see that the plate levels are in the centre of their run. Read the vernier B also.

4) Release the upper clamp screw and turn the theodolite clockwise. Biset the flag bottom shoe fixed at point M by a telescope. Tighten the upper clamp screw and bisect the shoe exactly by means of upper slow motion screw.

5) Note the reading on both the vernier to get the approximate value of the angle LOM.

6) Release the lower clamp screw and rotate the theodolite anticlockwise ai azimuth.Bisect again the bottom shoe of the flag at 'L' and tighten the lower clamp screw. By means of slow motion screw bisect exactly the centre of the shoe.

7) Release now the upper clamp screw and rotate the theodolite clockwise. Bisect the bottom shoe of the flag fixed at M and tighten the upper clamp screw. By

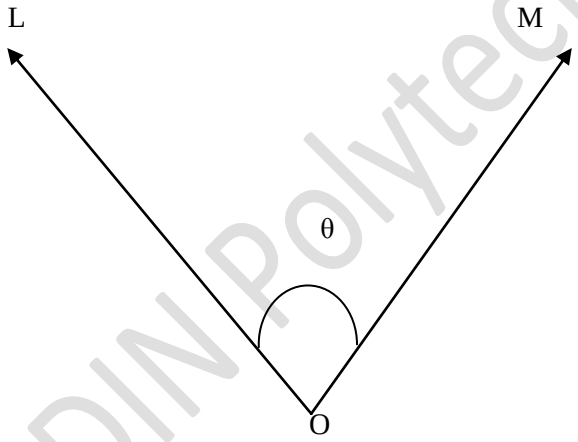
means of slow motion screw bisect exactly the centre of the shoe. The vernier readings will be now twice the of the angles.

8) Repeat the process until the angle is repeated the required number of times (usually 3). Add 360° for every complete revaluation to the final reading and divided the total angle by number of repetitions to get the value of angle LOM.

9) Change the face of the theodolite the telescope will now be inverted. Rrpeat the whole process exactly in the above manner and obtain value of angle LOM.

10) The average horizontal angle is then obtained by taking the average of the two angles obtained with face left and face right.

11) Usually three repetitions face left and three with face right should be taken and the mean angle should be calculated.



Result:

The horizontal angle ,<LOM =

Intrument at	sight to	face- left									swing-right face- right										
		A			B		MEAN			No.of repetition	Horizontal angle			A			B		MEAN			No.of repetition
		o	′	″	′	″	o	′	″		o	′	″	o	′	″	′	″	o	′	″	
o	L									1												1
	M																					
	L									2												2
	M																					
	L									3												3
	M																					

Exp.No: 2 Date:

Measurement of Horizontal angle by Reiteration method

Aim

To measure horizontal angle by reiteration method

Instruments used

Theodolite with tripod , peg, plumb bob ,ranging rod.

Procedure

1)set up the theodolite over the station O with face left.

2)set up the vernier A to zero by means of upper clamb and upper tangent screw

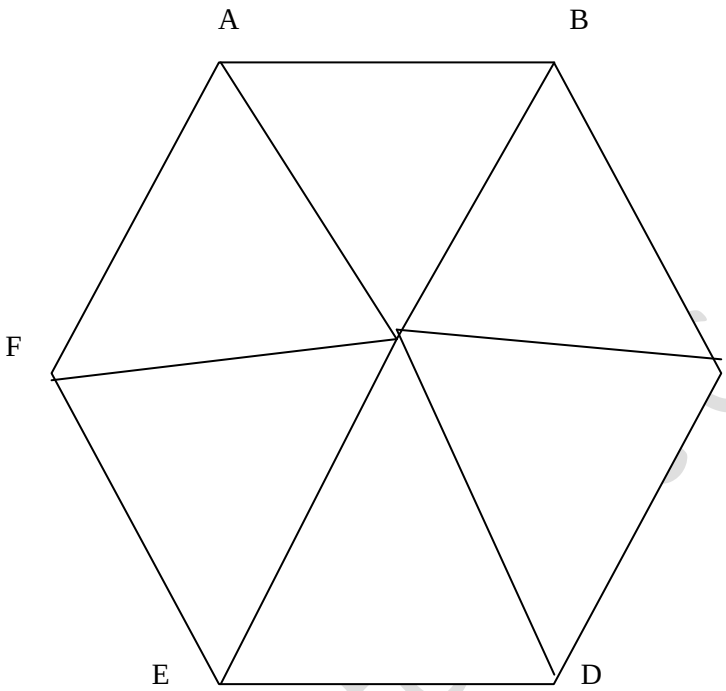
3) direct the telescope to stationA and bisect it accurately by using lower tangent screw,note vernier reading

4)loosen the upper clamp and turn the telescope clockwise until B is bisected . Tight the upper clamp and bisect B exactly by using upper tangent screw.Read both vernier.The mean of two vernier give value of <AOB.

5) Similarly bisect C and D.Read both vernier at each bisection toget <AOC and <COD……etc

6)Finally close the horizon by sighting station A.

7)The vernier A should now 360°.If not,note reading and find error.If the error be small it is equally distributed among the several observed angle if large the reading should be discarded and new set taken.



Result:

<AOB =

<BOC=

<COD=

<DOE=

<EOF=

<FOA=

Intrument at	sight to	face- left swing-right												face- right swing-left												h
		A			B		MEAN			Horizontal angle				A			B		MEAN			Horizontal angle				
		o	′	″	′	″	o	′	″	o	′	″		o	′	″	′	″	o	′	″	o	′	″		c
o	L																									
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Exp.No: 3 Date:

Determination of horizontal distance between two inaccessible points with theodolite

Aim:

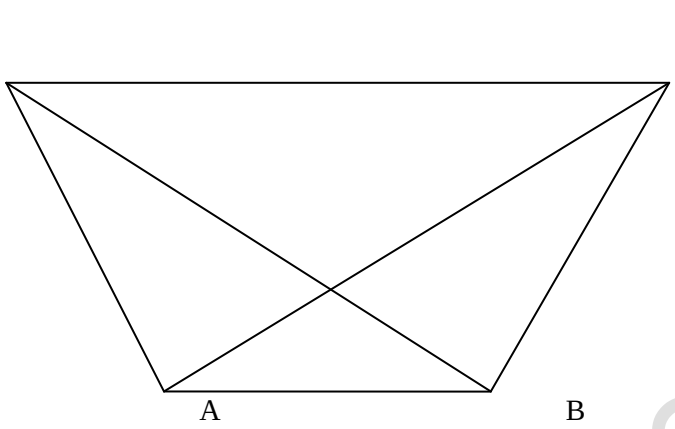
To determination of horizontal distance between two inaccessible points with theodolite

Apparatus:-

Theodolite with tripod , three ranging rods,peg,tape

Procedure:

1)Select a base line AB=…….m approximate parallel to PQ.
2) Set up the instrument over the station A and do all temporary adjustments.
3)Setup the zero of vernier A by using upper clamp by releasing the lower clamping screw ,turn the telescope towards P.Exact bisection is done by using its tangent screw.
4)Release the upper clamping screw and turn the telescope towards Q.Exact bisection is done by using its tangent screw
5)Read both verniers .The mean of two readings gives the angle PAQ
6)Unclamping upper plate and bisect station B and read both vernier and which give the angle PAB.
7)Change the face and then also take the angle PAQ and PAB by method of repetition.
8)The average value of angle get from both face given the actual value of PAQ and PAB.
9)Similarly setup the instrument over B and take the value of angle ABP and ABQ.
10)Consider triangle ABP and AQB .Apply sine rule an ddetermine the distance AP and AQ.
11)Applying cosine rule to triangle APQ and calculate the inaccessible distance PQ.



Intrument at	sight to	face- left								swing- right Horizontal angle			face- right								
		A			B		MEAN						A			B		MEAN			
		o	′	″	′	″	o	′	″	o	′	″	o	′	″	′	″	o	′		″
A	P																				
	Q																				
	B																				
B	A																				
	P																				
	Q																				

Result:

The inaccessible distance PQ = ……..m

Exp.No: 4 Date:

TRAVERSE SURVEY

Aim

To prepare Gale's traverse table of a closed traverse ABCDE.

Instuments used:

Theodolite with tripod , three ranging rods,peg,tape

Procedure:

1)setup the instrument over the station point A and bearing of the line AB is observed.

2)The angle EAB is then measured by taking backsight on preceeding station E and forward station B

3)The mean of two vernier reading gives the angle EAB

4)The theodolite is then moved to successive station and included angles are measured and line AB,BC etc are measured by tape.

5)Sum up all included angle according to the interior or exterior angle is measured .It is compared with (2n-4)90 .Where n is the no.of sides of traverse.

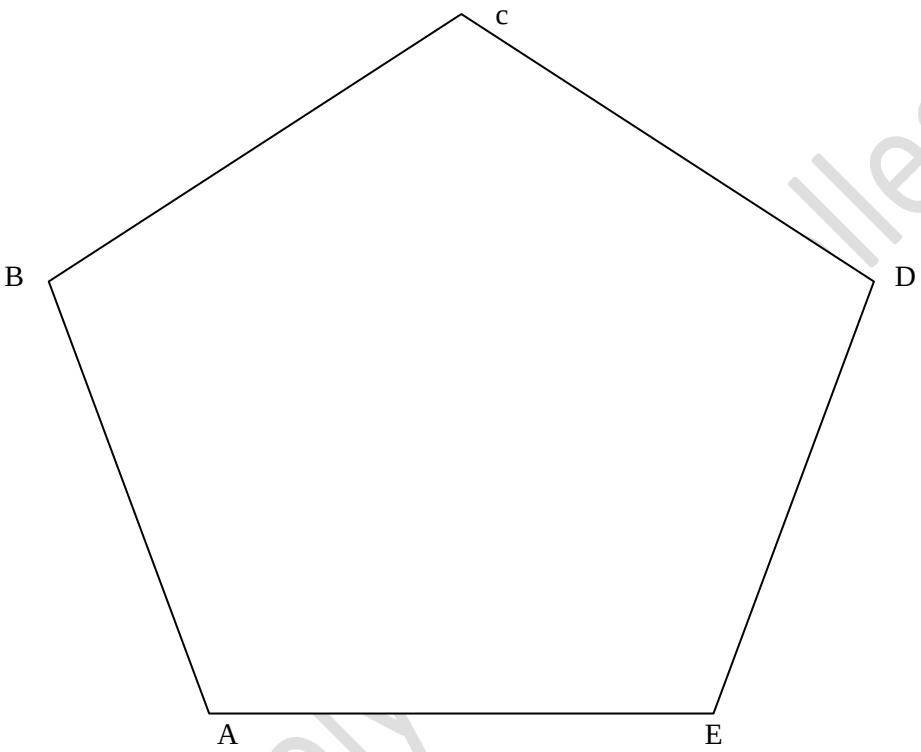
6)If not ,apply necessary correction to the angles so that the sum of corrected angles will exactly equal to (2n-4)90

7)Calculate wholecircle bearing ,deduce the bearing of the line and determine the quadrant in which the line lie.

8)Add all northing and all southing and find the difference between sums.Similarly obtain difference between sum of easting and sum of westing.

9)Apply necessary correction to the latitude and departure so that the sum of northing equals yhat of southing and sum of easting equals that of westing.

10)From the corrected consecutive constants ,obtain the independent co-ordinates of the line so that they areall positive ,the whole of the traverse thus lying in the first quadrant.



Result:Gale's Traverse table prepared

Exp.No: 5 Date:

HEIGHT AND DISTANCES

Aim:

To measure elevation and depression angles

Instruments used:

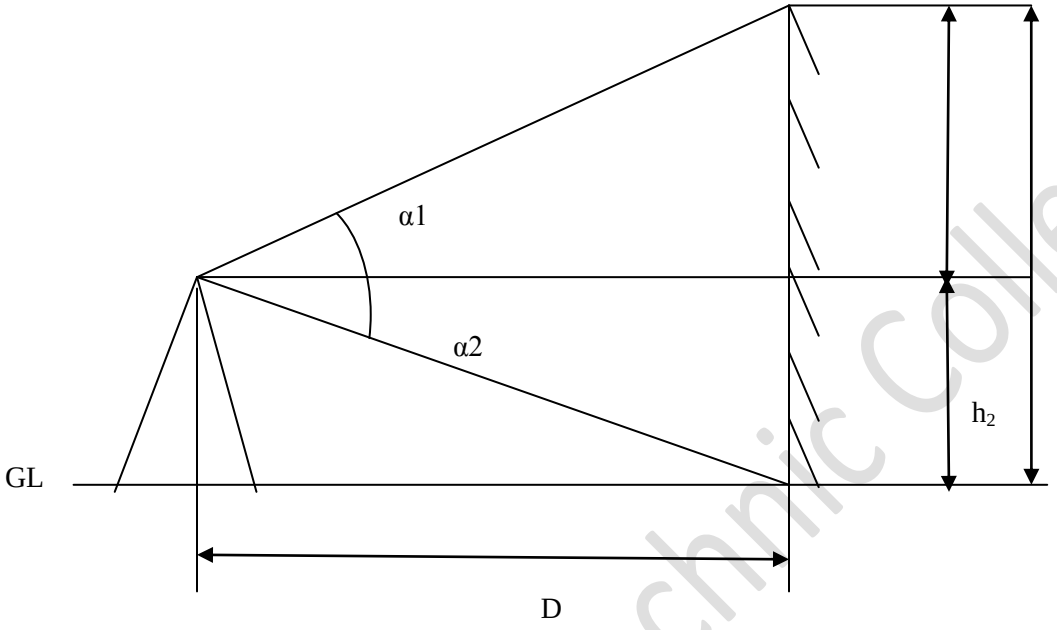
Theodolite with tripod,peg, leveling staff,ranging rod tape.

Procedure:

1) Set up the theodolite at a convenient distance from the object and measure the horizontal distance between them accurately by using steel or invar tape.let this distance be d meters .then set up and center the instrument over a and level it accurately with reference to the altitude bubble .
2) Set the zero of the vertical vernier exactly to the vertical circle clamp and tangent screw.
3) Loosen the vertical circle clamp and bisect the telescope towards the top of the object. when it is sight approximately clamp the vertical circle.bisect the object exactly by turning the tangent screw.
4) Read both verniers .the mean of two readings give the value of required angle α_1
5) Now loosen the vertical clamp and bisect the bottom of given object exactly by using vertical tangent screw. the mean of two readings give the value of required angle α_2
6) Change the face of the instrument and repeat it.

Result

Height of the given object=……m



Observation:

H=h1+h2

D=……m

h_1=Dtan α1

h_2=Dtan α2

H=Dtan α1+ Dtan α2

Exp.No: 6 Date:

TO FIND THE REDUCED LEVEL OF BASE INACCESSIBLE POINT

Aim:

To find the distance and RL of base inaccessible point .

Apparatus :

Theodolite with tripod,leveling staff,peg,mallet,tape

Procedure:

1)Setup the instrument at P and level it accurately with respect to the altitude bubble

2)Direct the telescope towards Q and bisect it accurately,Clamp both the plate.Read the vertical angle $\alpha 1$.

3)Transit the telescope so that the line of sight is reversed .Mark the 2^{nd} instrument station R on the ground .Measure the distance RP accurately.

4)With the vertical vernier set to the zero reading and the altitude bubble in the center of its run,take the reading on the staff kept at nearby the BM.

5)Shift the instrument to R and bset up the theodolite there.Measure the vertical angle α2 to Q with both face observation.

6)With the vertical vernier set to the zero reading and altitude bubble in the center of its run,take the reading on the staff kept at nearby the BM.

Intrument at	sight to	face- left									swing-right										face- right										swing-left										
		C			D		MEAN			Horizontal angle			C			D		MEAN			Horizontal angle																				
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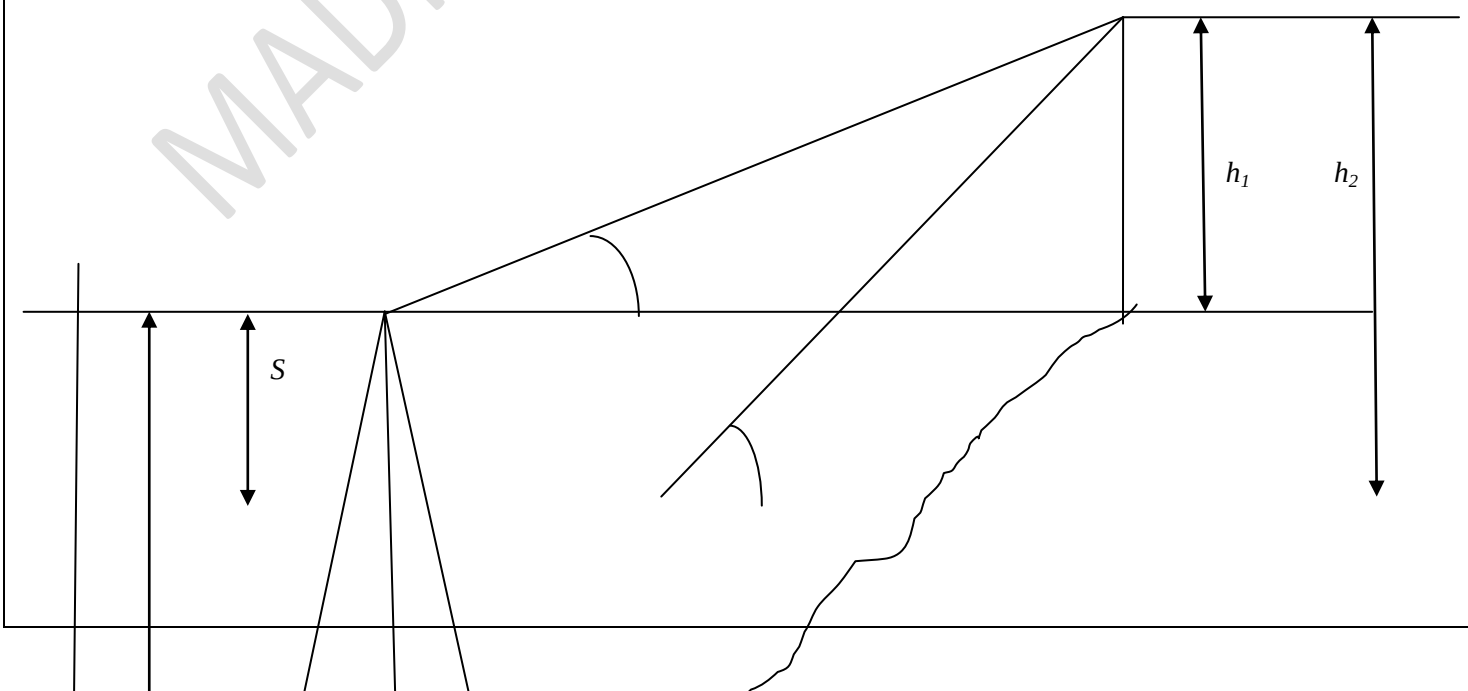

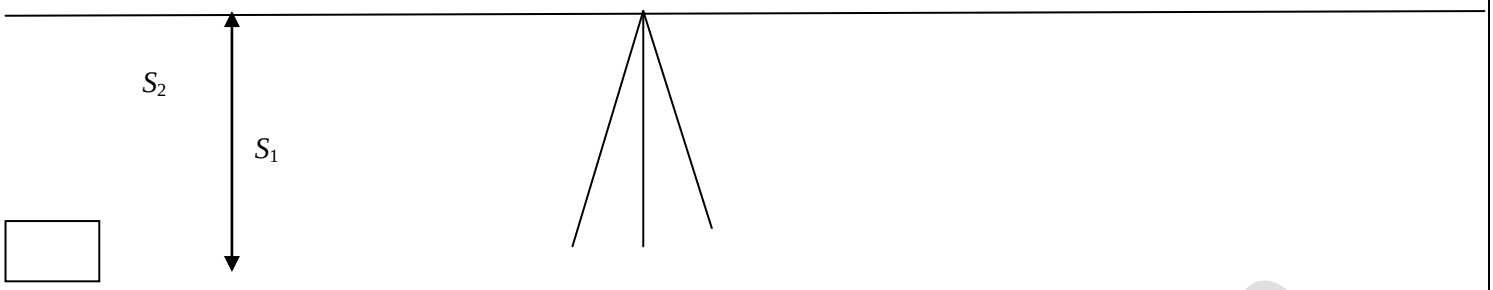

Result:

Distance =

RL of the given point=