LAB MANUAL

SESSION: 2020-21

SUBJECT CODE: KCE 352
SURVEYING AND GEOMATIC LAB
BRANCH –CIVIL ENGINEERING
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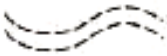
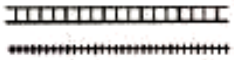
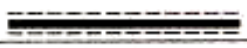
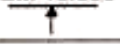
LAB INSTRUCTOR- MR. SHARIQUE SIDDIQUE

INDEX

LIST OF EXPERIMENTS

EXPERIMENT NO- 1

OBJECTIVE: To prepare conventional symbol chart based on the study of different types of topographical maps.

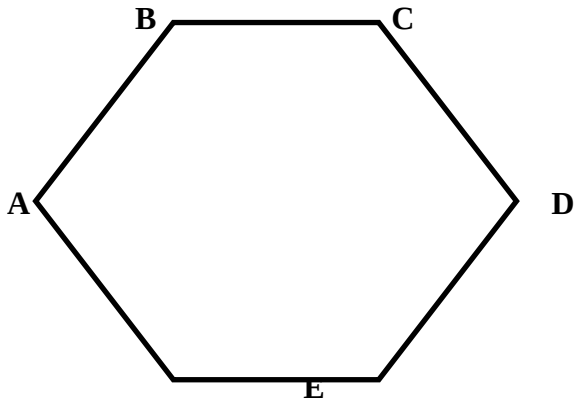
1. Triangulation Station. 	2. Traverse station 	3. Tie station. 	4. Chain line.
5. Wood fencing.	6. Pipe railing.	7. Wire fencing.	8. Demarcated property boundary.
9. Undermarcated property boundary.	10. Compound wall. 	11. Stream. 	12. River. 
13. Cart track. 	14. Canal. 	15. Railway line. 	16. Railway double line. 
17. Unmetalled road. 	18. Metalled road. 	19. Pucca building. 	20. Katcha building 
21. Hedge	22. Trees. 	23. Woods. 	24. Orchard. 
25. Cultivated land. 	26. Swamps. 	27. Culvert. 	28. Bridge. 
29. Embankment. 	30. Cutting. 	31. Railway bridge. 	32. Temple. 
33. Mosque. 	34. Church. 	35. Pond or lake. 	36. North line. 
37. Gates. 	38. Well. 	39. Bench mark. BM 15.000 	40. Pucca drain.
41. Katcha drain.	42. Electric line.	43. Shed.	44. Gate and wall.
45. Pasture.	46. Cemetry	47. Foot path.	48. Lawn.

EXPERIMENT NO- 2

OBJECTIVE: To measure the bearings of a closed traverse by prismatic compass and to adjust the traverse by graphical method.

INSTRUMENTS: Prismatic compass, chain, ranging rods.

SKETCH:



PROCEDURE:

» Fix the closed traverse A B C D E&F.
» Set up the compass at the station 'A'.
» Perform the temporary adjustments.
» Sight the object at 'B' and note down the FB of line AB and measure the distance.
» Sight the object at F and note down the BB of EA.
» Sight the instrument to station 'B' performs all the temporary adjustments.
» Sight the object at 'A' and take the 'BB' of 'AB'.
» Take 'FB' of 'BC' and measure the length of 'BC'.
» Check whether the difference of 'FB' and 'BB' is 180º or not, at all stations.
» Continue the same process all at other stations.

TABULAR FORM FOR CLOSED TRAVERSE:-

Sr. No.	Line	Length	F.B	B.B	INCLUDED ANGLE	Remarks

FORMULA: Included angle = B.B of previous line – F.B of next line.

CHECK: The sum of the included angles should be equals to (2n-4) x 90º (Where 'n' is number of sides of the)

EXPERIMENT NO- 3

OBJECTIVE: To find out reduced levels of given points using Auto/dumpy level.

APPARATUS: Dumpy level, leveling staff

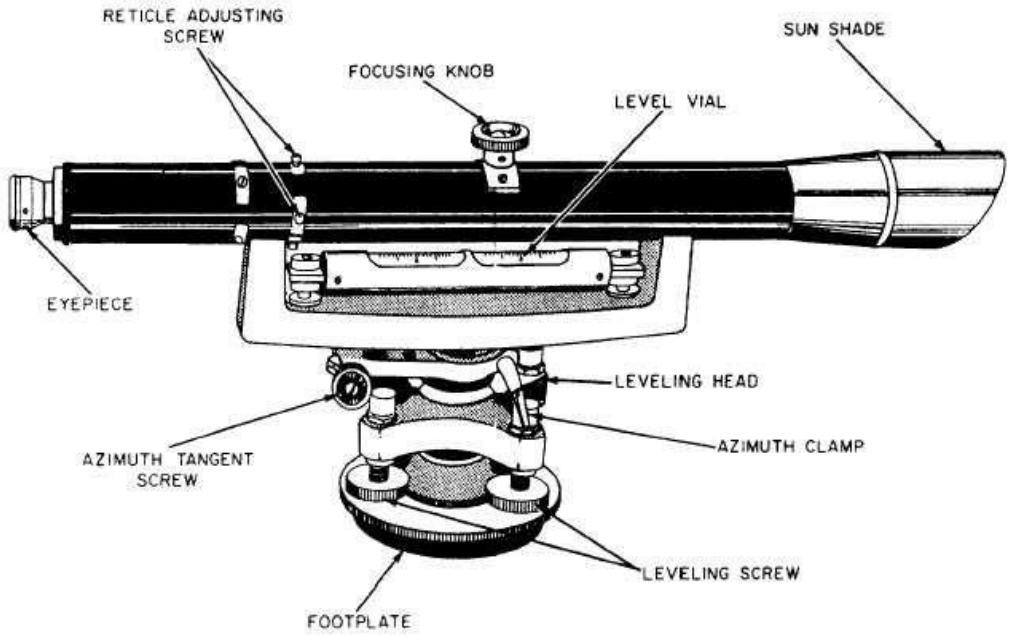


Fig. Dumpy Level

THEORY:

Levelling: The art of determining and representing the relative height or elevation of different object/points on the surface of earth is called leveling. It deals with measurement in vertical plane. By leveling operation, the relative position of two points is known whether the points are near or far off. Similarly, the point at different elevation with respect to a given datum can be established by leveling.

LEVELLING INSTRUMENTS:- The instrument which are directly used for leveling operation are:-Level, Leveling staffLevel: - An instrument which is used for observing staff reading on leveling staff kept over different points after creating a line of sight is called a level.

Dumpy Level: The difference in elevation between the point then can worked out. A level essentiallyconsists of the following points:

1) Leveling Heads
2) Limb plate
3) Telescope
4) Bubble tube
5) Tripod stand

Telescope consists of two tubes, one slide into the other and fitted with lens and diaphragm having cross hairs. it creates a line of sight by which the reading on the staff is taken The essential parts of a telescope are1) body 2) object glass 3)Eye-piece 4) Diaphragm 5) Ray shade 6) The rack and pinion arrangement 7) Focusing screw 8) Diaphragm screw.

Dumpy level: The dumpy level is simple, compact and stable instrument. The telescope is rigidly fixed toitssupports. Hence it cannot be rotated about its longitudinal axis or cannot be removed from its support. The name dumpy is because of its compact and stable construction. The axis of telescope is perpendicular to the vertical axis of the level. The level tube is permanently placed so that its axis lies in the same vertical plane of the telescope but it is adjustable by means of captain head not at one end. The ray shade is provided to protect the object glass. A clamp and slow motion screw are provided in modern level to control the movement of spindle, about the vertical axis. The telescope has magnifying power of about thirty diameters. The level tube is graduated to 2mm divisions and it has normally a sensitiveness of 20seconds of are per graduation. The telescope may be internally focusing or external Focusing type.

Adjustment of the level

The level needs two type of adjustment

1) Temporary adjustment and
2) Permanent adjustment

Temporary adjustments of dumpy level

These adjustments are performed at each set-up the level before taking any observation.

A) Setting up the level: - this includes

1) Fixing the instrument in the tripod: - the tripod legs are well spread on the ground with tripod head nearly level and at convenient height. Fix up the level on the tripod.
2) Leg adjustment:- Bring all the foot screws of the level in the centre of their run .Fix any two legs firmly into the ground by pressing them with hand and move the third leg to leg to right or left until the main bubble is roughly in the centre. Finally the legs are fixed after centering approximately both bubbles. This operation will save the time required for leveling.

B) Leveling: - Leveling is done with the help of foot screws and bubbles. The purpose of leveling is to make the vertical axis truly vertical. The method of leveling the instrument depends upon whether there are three foot screws or four foot screws. In all modern instruments three foot screws are provided and this method only is described.

1) Place the telescope parallel to pair of foot screws.
2) Hold these two foot screw between the thumb and first finger of each hand and turn them uniformly so that the thumbs move either toward each other until the bubble is in centre.
3) Turn the telescope through 90°so that it lies over the third foot screw.
4) Turn this foot screw only until the bubble is centered.
5) Bring the telescope back to its original position without reversing the eye piece and object glass ends.
6) Again bring the bubble to the centre of its run and repeat these operation until the bubble remains in the centre of its run in both positions which are at right angle to each other.

7) Now rotate the instrument through 180°, the bubble should remain in centre provided the instrument is in adjustment: if not, it needs permanent adjustment.

C) Focusing the eye piece:- To focus the eye piece, hold a white paper in front of the object glass ,and move the eye piece in or out till the cross hairs are distinctly seen. Care should be taken that the eye piece is not wholly taken out ,sometimes graduation are provided at the eye piece and that one can always remember the particular graduation position to suit his eyes ,This will save much time of focusing the eye piece.

(D) Focusing the object glass: - Direct the telescope to the leveling staff and on looking through the telescope, turn the focusing screw until the image appears clears and sharp. The image is thus formed inside the plane of cross hairs, Parallax, if any is removed by exact focusing. It may be noted that parallax is completely eliminated when there is no change in staff reading after moving the eye up and down. Reduced Levels the system of working out the reduced level of the points from staff reading taken in the field is called as reduced level (R.L) of a points is the elevation of the point with reference to the same datum. There are two systems of reduced levels

1) The plane of collimation system (H.I. method)
2) The Rise and fall system

1) <u>The plane of collimation system (H.I. method)</u>

In this system, the R.L. of plane of collimation (H.I) is found out for every set-up of the level and then the reduced levels of the points are worked out with the respective plane of collimation as described below.

1) Determine the R.L. of plane of collimation for the first set up of the level by adding B.S. to the R.L. of B.M. i.e. (R.L of plane of collimation= R.L. of B.M. +B.S.)

2) Obtained the R.L. of the intermediate points and first change point by subtracting the staff readings (I.S. and F.S. from the R.L. of plane of collimation (H.I). (R.L. of a point=R.L of plane of collimation H.I.-I.S or F.S)

3) When the instrument is shifted and set up at new position a new plane of collimation is determined by addition of B.S. to the R.L of change point. Thus the levels from two set-ups of the instruments can be correlated by means of B.S. and F.S. taken on C.P.

4) Find out the R.L.s of the successive points and the second C.P. by subtracting their staff readings from this plane of collimation R.L.

5) Repeat the procedure until all the R.Ls are worked out.

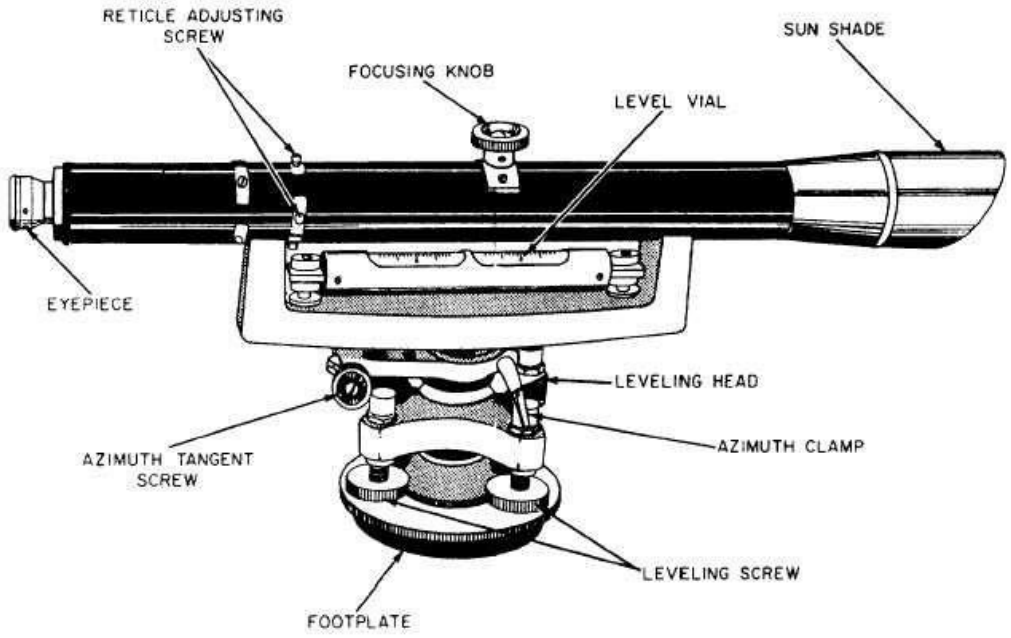
Observation table:-

STATION	**Reading**			**Height of instrument**	**Reduced Level**	**Remarks**
	B.S	**I.S.**	**F.S.**			

EXPERIMENT NO- 4

OBJECTIVE: To perform fly leveling with Auto/tilting level.

APPARATUS: Dumpy level, leveling staff



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Observation table:-

STATION	**Reading**			**Height of instrument**	**Reduced Level**	**Remarks**
	B.S	**I.S.**	**F.S.**			

EXPERIMENT NO- 5

OBJECTIVE: To study parts of a Vernier theodolite and measurement of horizontal and vertical angle.

APPARATUS:- Theodolite, three ranging rods,

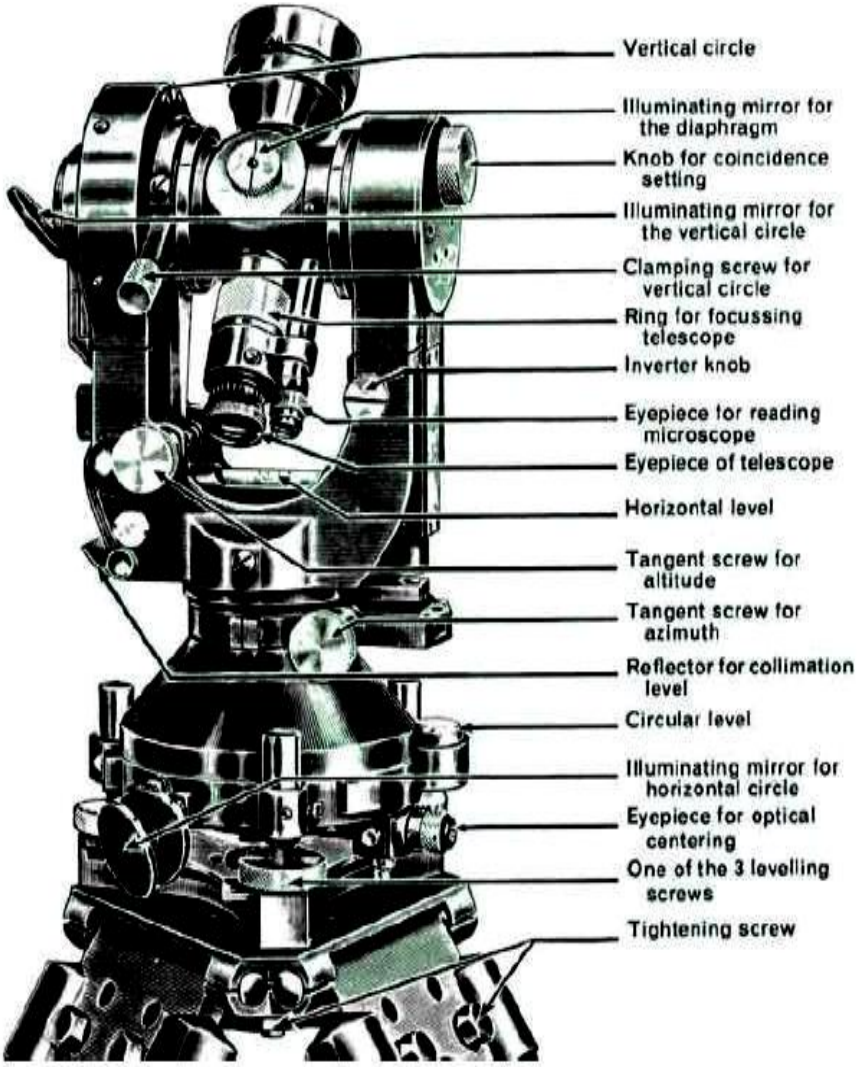


Fig. Vernier Theodolite

THEORY: Theodolite is an instrument designed for the measurement of horizontal and vertical angle. It ismost precise method it is also used for laying of horizontal angles locating points on line prolonging thesurvey line establishing the gradient, determination of difference in the elevation setting out curve.Theodolites are of two types - transit and non transit. Transit theodolite is commonly used nowadays.In transit theodolitetelescope can be revolved a complete revolution about its horizontal axis in a vertical plane. A transit theodoliteconsists of essential part.

1) Leveling head: It supports the main working parts of the instrument and screws on a tripod. The headcomprises of two parts
   a) A leveling foot screws for leveling the instrument i.e. for marking vertical axis truly vertical.

b) A movable head or centering arrangement for centering the vertical axis accurately over a station point
.

2) A lower level circular horizontal metal plate: It carries a circular graduated arc. The lower plate is attached to a vertical metal spindle (outer axis) which works in vertical bearing and a form a part of leveling head. It may be graduated in degree and half degree or a degree 1/3 of degrees .the upper plate carries an index and vernier or micrometer towards fine reading on gradated horizontal circle .the upper plate carries standard use of for supporting the telescope and the spirit level used for leveling the instrument.3) A telescope: The telescope is pivoted between the standard at right angles to the horizontal axis . It can be rotated about its horizontal axis in a vertical plane. The telescope is provided with the focusing screw ,Clamping screw and tangent screw

.

4) A circular graduated are carried on vertical circle: It is attached to the horizontal axis of the telescope, it is usually divided into 4 quadrants, but in some instruments it is graduated continuously from 0-360^0.Thegraduation in each quadrant are numbered from 0-900 in opposite direction. The subdivisions of vertical circle are similar to those of vertical circle.

MESURMENT OF VERTICAL ANGLE

A vertical angle is the angle between the inclined line of sight to an object and the horizontal. It may be an angle of elevation or on angle of depression according as the point is above or below the horizontal plane passing through the turn on axis of the instrument. To measure angle of elevation or depression LOM shownin fig. proceed as follows:

1) Set up the theodolite at station point O and level it accurately with reference to the altitude level.
2) Set vertical vernier C and D exactly to zero by using the vertical circle clamp and tangent screw, while the altitude level should remain in the centre of its run. Also the face of the theodolite should be left.
3) Release the vertical circle clamp screw and rotate the telescope in vertical plane so as to bisect the object M. tighten the vertical circle clamp and exactly bisect the object by slow motion screw.
4) Read both verniers C and D. the mean of the tow readings gives the value of the required angle.
5) Similar observation may be made with other face. The average of the tow values thus obtained gives the value of the required angle which is free from instrumental errors.
6) Similarly the angle of depression can be measured following the above steps.

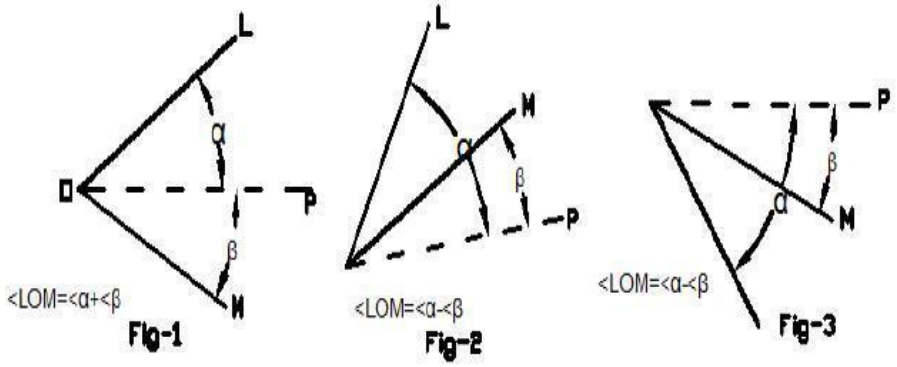
To measure the vertical angle between two points L and M

Sometimes it is required to measure vertical angle between two points L and M. There can be three possibilities.

(a) One point is above the line of sight and the other is below the line of sight then angle LOM as shown in fig will be equal to (<P +<Q)

(b) Both the points are above the line of sight. Then the angle LOM= <P -<Q

(c) Both the points are below the line of sight, then the angle LOM= <P -<Q (Refer Fig. 3)



To measure the angle between two points L and M proceed as follows:

1) Set the theodolite at station point O and accurately level it.
2) Bisect the flag at L as explained already and take the reading on the vernier C and D. Calculate the mean angle.
3) Bisect the flag at M as before and take the reading on the vernier C and D.
Calculate the mean angle.
3)The sum or difference of these angles will give the value of the vertical angle between points L and M

Result: -……..

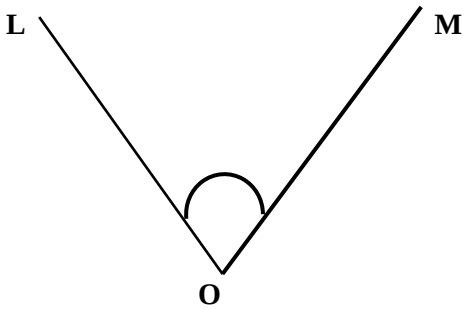
EXPERIMENT NO- 6

OBJECTIVE: Tomeasure horizontal angle between two objects by repetition /reiteration method.

Apparatus Required: Theodolite with tripod, peg, ranging rod, plumb-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. Bisect 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 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. Repeat 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 =……

EXPERIMENT NO- 7

OBJECTIVE: To determine the height of a vertical structure (like chimney, water tank etc)using trigonometrical levelling by taking observations in single vertical plane

APPARATUS:- Theodolite, three ranging rods,

MESURMENT OF VERTICAL ANGLE

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1) Set up the theodolite at station point O and level it accurately with reference to the altitude level.
2) Set vertical vernier C and D exactly to zero by using the vertical circle clamp and tangent screw, while the altitude level should remain in the centre of its run. Also the face of the theodolite should be left.
3) Release the vertical circle clamp screw and rotate the telescope in vertical plane so as to bisect the object M. tighten the vertical circle clamp and exactly bisect the object by slow motion screw.
4) Read both vernier C and D. the mean of the tow readings gives the value of the required angle.
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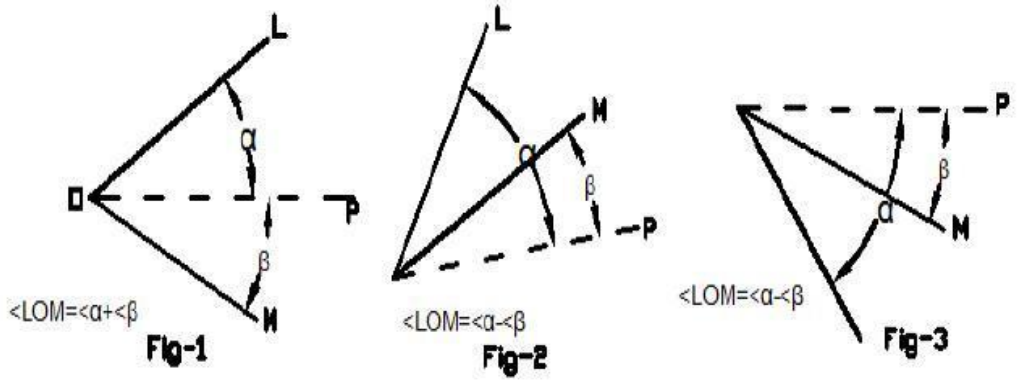

The average value of vertical is found to be----------

Calculation:- Result: The height is……..

EXPERIMENT 8

OBJECTIVE: To study various parts of Electronic Theodolite, Total Station and practice for Measurement of distance, horizontal and vertical angles.

Total Station

A total station is an electronic/optical instrument used in modern surveying. The total station is an electronic theodolite (transit) integrated with an electronic distance meter (EDM) to read slope distances from the instrument to a particular point.

It can perform the following functions:-

- Distance measurement
- Angular measurement
- Data processing
- Digital display of point details
- Sorting of data in an electronic field book

The important features of total station are Key board Control

Digital panel: - The panel displays the values of distance, angle, height and the coordinates of the observed point where the reflector is kept.

Remote height object: - The heights of some inaccessible objects such as towers can be Read directly .The microprocessor provided in the instrument applies the correction for curvature and mean refraction automatically.

Traversing program: - The co-ordinates of the reflector and the angle of bearing of there deflect or can be stored and can be recalled for next set up of the instrument.

Setting out for distance ,direction and height:- Where ever a particular direction and a horizontal distance is to be entered for the purpose of locating the point on the ground, using a target, then the instrument displays the angle through which the theodolite has to be turned and the distance by which the reflector should move.

Automatic level

An automatic level is a special surveying (leveling) instrument which contains an optical compensation which maintains a horizontal line of sight or line of collimation even though the instrument is slightly tilted.

EXPERIMENT NO – 9

OBJECTIVE:-To set out a simple circular curve by Rankin's method

Problem:-Two tangent intersect at a point the defection angle being ____º.Calculate all the data necessary for setting out a simple curve of radius 32.

Instruments used: Theodolite, ranging rods, pegs, arrows etc.

Theory:-A deflection angle to any point on the curve is the angle at Point of Curve (PC) between the tangent and the chord from the P C to that point.

RANKINES METHOD OF DEFLECTION ANGLES

T1V= rear tangent
T1 = Point to curve
= the tangential angles or the angles with each of the successive chordsT1A, AB, BC etc. Makes with the respective tangents to the curve at T1, A, B etc
= Total tangential angles of the deflection angles to the points A, B, C etc
C1, C2, C3 = lengths f the chords T1A, AB, BC etc...
A1A = tangent to the curve at A
= 1719 C minutes
R
For the first chord= tangential angle for the chord AB
Hence, the deflection angle for any chord is equal to the deflection angle for the previous chord plus the tangential angle for that chord.

Procedure:

1. Locate P C (T_1_), P.T. (T_2) and P.I. (I).
2. Set up the Theodolite exactly at T_1 and make its temporary adjustments.
3. Set the vernier A to zero and bisect the P I. Clamp the lower plate.
4. Release the upper plate and set the vernier A to read Δ_1. The line of sight is thus directed along T_1A.
5. Hold the zero of the tape at T_1, take a distance (T_1A) and swing the tape with an arrow till it is bisected by the Theodolite. This establishes the first point A on the curve.
6. Set the second deflection angle Δ_2 on the scale so that the line of sight is set along T_1b.

7. With the zero of the tape held at *a and* an arrow at the other end (chord distance =ab), swing the tape about a, till the arrow is bisected by the Theodolite at b. this establishes the second point b on the curve.
8. The same steps are repeated till the last point T_2 is reached.

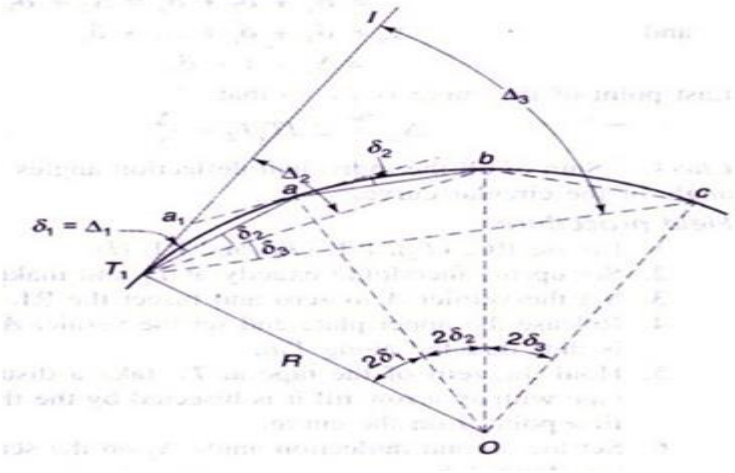

Fig.-Rankine's method of deflection curve

Result: The simple curve was set by Rankin's method of tangential angles.

EXPERIMENT NO – 10

OBJECT: To plot the contour map for a given area by direct method.

Equipments: Dumpy Level, Levelling Staff, Tripod, Staff bubble, Chain or Tape.

Procedure:

1. First, ensure that an appropriate bench mark (BM) is available near the site of the survey. If a B.M is not available, then one should be located near the site by fly levelling.

2. Once a benchmark is available, set up the instrument (level) at a suitable position covering a large part of the area to be surveyed.

3. The area is divided into a number of squares and all grid points are marked (Ref. Fig. 1). Commonly used size of square varies from 5 m × 5 m to 20 m × 20 m.

4. Levels of all grid points are established by leveling.

5. Then **grid square** is plotted on the drawing sheet. Reduced levels of grid points marked and contour lines are drawn by interpolation [Ref. Fig. 1].

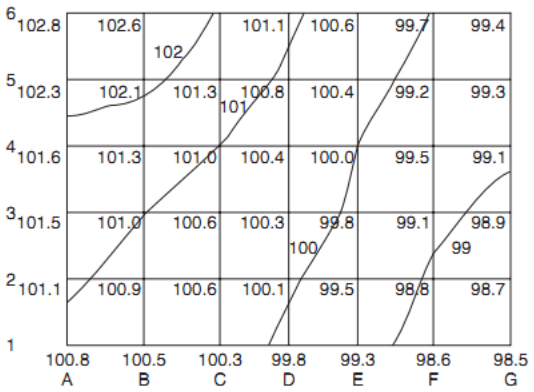

Figure 1: Grid Contouring

Conclusion- Result is----------