LAB MANUAL

FOR

SURVEYING LAB II

Year.............

Name: .................................................................

Roll No. ......................................................... Reg No. .................................................

Semester ...................................................... Dept......................................................
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Experiment No- 1

Aim: - To measure the horizontal angles by reiteration method.

Instruments used:-Theodolite, ranging rods and arrows.

Theory:-

Reiteration is a method of measuring horizontal angles with high precision. It is less tedious and is generally preferred when there are several angles to be measured at a station. Several angles are measured successively and finally the horizon is closed. Closing the horizon is the process of measuring the angles around a point to obtain a check on their sum which should be equal to 360°.

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 should be 360°. 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.
**OBSERVATIONS AND CALCULATIONS**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Sighted to</th>
<th>Face left Swing right</th>
<th>Face right swing left</th>
<th>Average Horizontal Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Downloaded from Official website of Ammini College of Engineering, Palakkad
http://ammini.edu.in/content.aspx?pageid=362
Result:- The following horizontal angles are measured:
Experiment No-2

Aim: - To measure the horizontal angle AOB by repetition method.

Instruments used: - Theodolite, ranging rods and arrows.

Theory:

The method of repetition is used to measure a horizontal angle to a finer degree of accuracy. By this method, an angle is measured two or more times by allowing the vernier to remain clamped each time at the end of each measurement instead of setting it back at zero when sighting at the previous station. Thus an angle reading is mechanically added several times depending upon the number of repetitions. The average horizontal angle is then obtained by dividing the final reading by the number of repetitions. For very accurate work the method of repetition is used.

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.
### OBSERVATIONS AND CALCULATIONS

<table>
<thead>
<tr>
<th>Instrument 1st Sighted to</th>
<th>Face left Swing right</th>
<th>Face right swing left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Repeat the whole process by turning the telescope in anticlockwise direction.
2. Take the average of face left and face right observation to give the horizontal angle AOB.

Result:-

The horizontal angle AOB =
# Observation and Calculation

<table>
<thead>
<tr>
<th>Peg. No.</th>
<th>Distance</th>
<th>Staff readings</th>
<th>$s = A - B$</th>
<th>$D = ks + C$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bottom A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5m</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>10m</td>
<td></td>
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<tr>
<td>3</td>
<td>15m</td>
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Experiment No- 3

DETERMINATION OF TACHEOMETRIC CONSTANTS

Aim:- To determine the multiplying constant and additive constant of the given theodolite.

Instruments used:- Theodolite, arrows, pegs and ranging rods.

Procedure:-

1. Stretch the chain in the field and drive pegs at 5m, 10m, & 15m interval.
2. Set the theodolite at the zero end and do the temporary adjustments.
3. Keep the staff on the pegs and observe the corresponding staff intercepts with horizontal site.
4. Substitute the values of distance ($D$) and staff intercept ($s$) for different points in the equation $D = ks + C$, where $k$ & $s$ are the tacheometric constants. $k$ is the multiplying constant & $C$ is the additive constant.
5. Solve the successive pairs of equations to get the value of $k$ & $C$ and find out the average of these values.

Result:-

Multiplying constant, $k = $

Additive constant, $C = $
# OBSERVATIONS AND CALCULATIONS

<table>
<thead>
<tr>
<th>Instrument Station</th>
<th>Staff Station</th>
<th>Distance</th>
<th>Horizontal angle</th>
<th>Stadia Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Top</td>
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**Face left**

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**Face right**

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**Experiment No- 4**

**Aim:** To determine the horizontal distance and level difference between two inaccessible points A & B using stadia tacheometry method.

**Instruments used:** Theodolite, levelling staff, pegs and ranging rods.

**Procedure:**

1. Select a station point O and set the theodolite at the point and do the temporary adjustments.
2. Keep the theodolite at face right position and make the vernier A at $0^\circ 0' 0''$ using lower and upper clamping screws.
3. Loosen the lower clamp and bisect the staff at A and accurate bisection is done with lower tangent screws.
4. Note the stadia readings at A and calculate the stadia intercept ‘s’
5. Lower the telescope and bisect the junction of the peg and nail and note the vertical circle reading.
6. Loosen the upper clamp and turn the telescope clockwise towards the staff at B and accurate bisection is done with upper tangent screw. Note the vernier scale reading to get the horizontal angle AOB.
7. Note the stadia readings at B and calculate the stadia intercept ‘s’.
8. Lower the telescope and bisect the junction of the peg and nail and note the vertical circle reading at B.
9. Adjust the telescope for left face and repeat the steps 3 to 8.
10. Close the horizone on each face to check the error.
11. From the equation $D = ks + C$, Calculate the distances from O to A & B.
12. Calculate the level difference between A & B using the formula $V_1 \pm V_2$.

Where $V_1 = OA \tan \alpha_1$

$V_2 = OB \tan \alpha_2$

$\alpha_1$ & $\alpha_2$ are the vertical angles taken to the points A & B respectively.
Result:-

Horizontal distance AB =

Level difference between A & B =
Experiment No- 5

**Aim:** To find the horizontal distance and level difference between two inaccessible points A and B by tangential tacheometry method.

**Instruments used:** Theodolite with tripod, plumb bob, ranging rod, staff peg etc.

**Theory:**

In this method, the horizontal and vertical distances from the instrument to the staff station are computed from the observed vertical angles to the vanes fixed at a constant distance apart upon the staff. The stadia hairs are therefore not used and the vane is bisected every time with the axial hair. Thus the two vertical angles are to be measured—one corresponding to each vane.

There may be three cases of the vertical angles:-

(i) Both angles are angles of elevation.

(ii) Both angles are angles of depression.

(iii) One angle of elevation and the other of depression.

**Case 1: Both angles are angles of elevation.**

\[ s + V = D \tan \alpha_1 \] \hspace{1cm} (1)

\[ V = D \tan \alpha_2 \] \hspace{1cm} (2)

Where \( s = \) staff intercept

\( V = \) height of lower vane from horizontal

\( D = \) horizontal distance of point from instrument station

Solving above equations (1) and (2) and equating D,

\[
\frac{s + v}{\tan \alpha_1} = \frac{v}{\tan \alpha_2}
\]

solving for \( V \) we have,

\[
V = \frac{s \tan \alpha_2}{tan \alpha_1 - \tan \alpha_2} \hspace{1cm} (A)
\]

substituting value of \( V \) in equation (2) the horizontal distance \( D \) can be calculated by

\[
D = \frac{V}{\tan \alpha_2}
\]
Case 2: Both angles are angles of depression.

(V-s) = D \tan \alpha_1 \quad \text{(3)}

V = D \tan \alpha_2 \quad \text{(4)}

Equating D from (3) and (4) we get

\[
\frac{V-s}{\tan \alpha_1} = D = \frac{V_s}{\tan \alpha_2}
\]

from the above equation,

\[
V = \frac{s \tan \alpha_2}{\tan \alpha_2 - \tan \alpha_1} \quad \text{(B)}
\]

Case 3: One angle of elevation and other angle of depression.

\[
V = D \tan \alpha_2 \quad \text{(5)}
\]

\[
s - V = D \tan \alpha_1 \quad \text{(6)}
\]

and adding (5) and (6) we get

\[
s = D \tan \alpha_2 + D \tan \alpha_1
\]

therefore

\[
D = s \cos \alpha_1 \cdot \cos \alpha_2 / \sin(\alpha_1 + \alpha_2)
\]

and

\[
V = D \tan \alpha_2 = \frac{s \tan \alpha_2}{\tan \alpha_2 + \tan \alpha_1} \quad \text{(C)}
\]

Procedure:

- The instrument is set at O such that both P and Q are visible.
- P is a point on the retaining wall/wall/building/mound (as the case may be). A rod is fixed at P with two vanes A1 and B1 which are at 0.25 m and 1.5 m from the bottom of the rod respectively.
- Another point Q is given where a rod, with two vanes A2 and B2 at 0.5 m and 2 m from bottom of the rod respectively, is fixed.
- By using upper clamp set vernier readings to zero in vertical scale and horizontal scale. The RL of P is assumed to be ______.
- Keep the levelling staff at P. Take a horizontal reading to staff.
- Loose the vertical clamp and sight the two vanes. Note the vertical angles as $\alpha_1$ and $\alpha_2$ respectively.
- Take readings with both faces.
- Loose the upper clamp and sight the staff at Q. Read the horizontal angle and note this angle as $\alpha$. 

Loose the vertical clamp and sight the vanes A2 and B2 and note the vertical angles as \( \alpha_1 \) and \( \alpha_2 \) respectively.

The horizontal distance between the two points is given by:

\[ D = \sqrt{D_1^2 + D_2^2 - 2D_1D_2 \cos \alpha} \]

- \( D_1 \) = horizontal distance of points P from O
- \( D_2 \) = horizontal distance of points Q from O
- \( \alpha \) = horizontal angle between P and Q

**Result:**

Horizontal distance between the two inaccessible points P and Q = ________

Level Difference between P and Q = ________
**Experiment No- 6**

**Aim:** To plot an open traverse using theodolite.

**Instruments used:** Theodolite with tripod, compass, plumb bob, ranging rod, tape, pegs etc

**Theory:**
Theodolite traversing:

Method I: Traversing by method of included angles.

In running an open traverse LMOP as shown in figure

- Set up the theodolite over station M and level it accurately. Observe the magnetic bearing of line ML. With the help of theodolite measure the horizontal angle LMO. MOP being the included angle.
- Shift the theodolite to each of the station N, O and repeat the process to measure included angles MNO and NOP.
- Also measure the lengths of the lines LM, MN, NO and OP by means of steel tape. Repeat the procedure with the other face.
- The whole work should be carefully recorded in the field note book

Method II: Traversing by method of deflection angles

This method is more suitable for railways, roads, pipelines etc. in which a series of traversing lines makes an angle with the direction of previous line. These angles are called deflection angles.

In measuring deflection angles, having observed the bearing at the starting station 'L',
- Set the theodolite at each of the stations M, N, P, Q etc.
- Bisect the back stations using lower clamp and its tangent screw. The vernier may be set to zero or the initial reading may be taken.
- The theodolite is transited and the forward station is bisected with the upper clamp and its corresponding tangent screw. The vernier is read again. The difference between the first set of reading and the second gives the angle of deflection.
- The angles are measured either towards the right or left and this direction must be carefully noted in the field book. Chaining is done in the usual manner.

Set the theodolite at the point on the curve (T₁) with both plates clamped to zero.
Direct the theodolite to bisect the point of intersection V. The line of sight is thus in the direction of rear tangent.
Release the vernier plate and set angle = deflection angle (here 60°) on the vernier, the line of sight is thus directed along the chord T₁A.

Result:
The open traverse LMNPQ was then plotted.
Experiment No- 7

Aim: To plot a closed traverse using theodolite.

Instruments used: Theodolite with tripod, compass, plumb bob, ranging rod, tape, pegs etc.

Theory:
Theodolite traversing:

A traverse survey is one in which the framework consists of a series of connected lines, the lengths and direction of which are measured with the help of a tape or chain and an angle measuring instrument. When the lines form a circuit which ends at the starting point the traverse is called an open traverse. If the circuit ends elsewhere it is called an open traverse. The close traverse is suitable for wide areas and for locating the boundaries of lakes, forests etc. whereas an open traverse is carried out in long strips of the country as in the case of canal, road, railways etc.

In theodolite traversing theodolite is used for measurement of angles or tape or chain preferably steel tape is used for linear measurements. This method is applied for accurate and precise works.

Traversing by the method of included angles:

In a closed traverse included angles can be measured by running a traverse in clockwise or counterclockwise direction. The common practice is to run a closed traverse in counterclockwise direction but it is always better to adhere to a regular routine of measuring angles. The angle may be measured by the repetition method and the observations should be taken with both the faces and also by reading both the verniers. Then the average value of each angle should be calculated. It will ensure desired degree of accuracy.
Calculations:

\[(2n - 4) \times 90^0 = 540\] (theoretical, since it is a pentagon)

Sum of observed angles = \(A + B + C + D + E\)

\[= \text{___________}\]

Total error =

Total Correction =

Correction for each angle =

Corrected angles =

A =

B =

C =

D =

E =
Procedure:
In running a traverse ABCDE as shown in fig above, set up the theodolite over the station A and level it accurately. Observe the magnetic bearing at the line AE and measure the included angle EAB as usual. Shift the theodolite to each of the successive stations B, C, D, E ... (in the anticlockwise direction) and repeat the process to measure each of the angles ABC, BCD, CDE, DEA. Also measure the length of lines AB, BC, CD and DE by means of the steel tape. The whole work should be recorded carefully in the field note book.

Result:
The closed traverse ABCDE was plotted.
Experiment No- 8

**Aim:** To set out a simple curve by linear method having radius 32 m and an external deflection angle of 60°.

**Instruments used:** Theodolite with tripod, pegs, arrows, plumb bob, cross staff, ranging rod.

**Theory:**
Linear methods are used when:-

- High degree of accuracy is not required
- The curve is short

Linear methods for setting out curve include

1. By ordinates or offsets from long chord.
2. By offsets from tangents (T):
   a) Perpendicular offsets
   b) Radial offsets
Method 1:

By ordinates or offsets from long chord (L)

OFFSETS FROM LONG CHORD

where

\[ R = \text{radius of curve} \]

\[ O_0 = \text{mid ordinate} \]

\[ O_x = \text{ordinate at a distance } x \text{ from mid point of the chord} \]

T1&T2=Tangent points

\[ L = \text{Length of long chord measured on the ground} \]

Mid ordinate

\[ O_0 = R - \sqrt{R^2 + \left(\frac{L}{2}\right)^2} \]

\[ O_x = \sqrt{R^2 - x^2} - (R - O_0) \]
BY PERPENDICULAR OFFSETS  BY RADIAL OFFSETS

Method 2

By offsets from tangents (T)
Tangent length \( T_1 V = T_2 V = R \tan \frac{\alpha}{2} \)

a) By perpendicular offsets:
\[
DE = O_x = \text{Offset perpendicular to the tangent.}
\]
\[
O_x = R - \sqrt{R^2 - x^2}
\]

b) By Radial offsets
\[
O_x = \text{Radial offset } DE \text{ at any distance } x \text{ along the tangent}
\]
\[
T_1 D = x
\]
\[
O_x = \sqrt{R^2 + x^2} - R
\]

Procedure:

Method 1:

By offset from long chord
Stretch the chain along the long chord \( T_1 T_2 \) (L) given by the formula,
\( L = 2R \sin \frac{\alpha}{2} \).
Mark \( T_1 \) on it which is point of curve
Mark D along the chain line which is midpoint of \( T_1 T_2 \).
From D erect a perpendicular offset equal to the mid–ordinate \( O_0 \). Mark L which is the mid point of the curve.
Divide \( T_1 D \) into intervals of 4m.
Mark these point as \( O_4 \), \( O_6 \), \( O_{12} \), \( O_{16} \).
Erect perpendicular offsets from these points given by the relation
\[
O_x = \sqrt{R^2 - x^2} - (R - O_0)
\]
Repeat the above steps to get the other half of the curve.

a) By perpendicular offsets
  a. Stretch the chain along the tangent \( T_1 V \) given by the relation
     \( T = R \tan \frac{\alpha}{2} \)
  b. Divide the tangents into equal number of possible parts (say 4m interval) and name them as \( O_4 \), \( O_6 \), \( O_{12} \), \( O_{16} \) and \( OT_1 V \).
c. Set perpendicular offsets from these points given by the equation
\[ O_x = R - \sqrt{R^2 - x^2} \] to get points on the curve

d. Repeat the steps 1 to 3 to get the other half of the curve

b) By radial offsets:
   1. Stretch the chain along the tangent \( T_1 V \) given by the relation
      \[ T = R \tan \theta / 2 \]
   2. From \( T_1 \) set out perpendicular and mark the centre of the curve \( O \) by measuring radius of 32 m and fix a ranging rod at \( O \).
   3. From \( O_4 \) sight \( O \) and set out offset given by the equation
      \[ O_x = \sqrt{(R^2 + x^2)} - R. \]
   4. Repeat the steps for all the other points namely \( O_4, O_6, O_{12}, O_{16} \).
   5. Repeat the procedure for the next tangent.

**Results:**

A simple curve of given radius was set out by linear methods.
Experiment No - 9

**Aim**: Setting out of simple circular curve by Rankine method of tangential angle.

**Problem**
Two tangent intersect at a point the defection angle being ____°. 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 P.C between the back tangent and the chord from the P.C to that point.
RANKINES METHOD OF TANGENTIAL ANGLES

T1V = rear tangent
T1 = Point to curve
= the tangential angles or the angles with each of the successive chords
T1A, 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 of the chords T1A, AB, BC etc...

A1A = tangent to the curve at A

\[ = \frac{1719 C}{R} \text{ minutes} \]

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. Set the theodolite at the point of curve T1.
2. With both the plates clamped to zero, direct the theodolite to bisect the point of intersection V. The line of sight is thus in the direction of the rear tangent.
3. Release the vernier plate and set angle 1 on the vernier. The line of sight is thus directed along chord T1A.
4. With zero end of tape pointed at T1 and arrow held at a distance T1A = c along it, swing the tape around T1 till the arrow is bisected by the cross hairs.
5. Thus the first point A is fixed.
6. Set the second deflection angle 2 on the vernier so that the line of sight is directed along chord T1B.
7. With the zero end of the tape pinned at A, and an arrow held at distance AB = C along it, swing the tape around A till the arrow is bisected by the cross hairs, thus fixing the point B.
8. Repeat steps 4 and 5 till last point is reached.

Result: The simple curve was set by Rankine’s method of tangential angles
Experiment No- 10

Aim: To study the modern instruments used in surveying

Electronic Distance Measuring Instruments (EDMI)

Direct measurements of distances and their directions can be obtained by using electronic instruments that rely on propagation, reflection and reception of either light waves or radiowaves. They may be broadly classified into three types:

a. Infra red wave instruments
b. Light wave instruments
c. Microwave instruments

Infrared wave instruments:

The instruments measure distances by using amplitude modulated infrared waves. At the end of the line, prisms mounted on targets are used to reflect the waves. These instruments are light and economical and can be mounted on the theodolites for angular measurements. The range of such an instrument will be 3km and the accuracy achieved is ±10mm.

Eg: Distomat D1 1000 and Distomat D1 5

It is a very small, compact EDM, particularly useful in building construction and other civil engineering works where distance measurements are less than 500m.

Linear measurements can be taken without the use of conventional tapes and chains thus reducing the number of instruments. To measure distances, one has to simply point the instrument to the reflector, and at the touch of a key the measurements are displayed.

Light wave instruments

These are instruments which measure distances based on propagation of modulated light waves. The accuracy of such an instrument varies from 0.5 to 5 mm / km distance and has a range of nearly 3 km.

Eg: Geodimeter

This instrument which works based on the propagation of modulated light waves, was developed by E Bergstand of the Swedish geographical Survey in collaboration with the manufacturer M/s AGA of Sweden. The instrument is more suitable for night time observations and requires a prism system at the end of the line for reflecting the waves.

Microwave instruments

These instruments make use of high frequency radio waves. These instruments were invented as early as 1980 in South Africa by Dr. T L Wadley. The range of these instruments is up to 100 km and can be used during both day and night.

Eg: Tellurometer

It was the first successful microwave electronic distance measurement equipment. The name derives from the Greek tellus, meaning Earth.

The Tellurometer emits an electronic wave: the remote station reradiates the incoming wave
in a similar wave of more complex modulation, and the resulting phase shift was a measure of the distance travelled. The results appear on a cathode ray tube with circular sweep. This instrument penetrates haze and mist in daylight or darkness and has a normal range of 30–50 km but can extend up to 70 km.

For measuring distance using a Tellurometer, two such instruments are required, one to be stationed at each end of the line, with two highly skilled persons, to take observations. One instrument is used as a master unit and the other as a remote unit. Just by pressing a button a master can be converted to a remote unit and vice versa. A speech facility (communication facility) is provided to each operator to interact during measurement.

**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

**Keyboard 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 the reflector can be stored and can be recalled for the next setup 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 (levelling) instrument which contains an optical compensation which maintains a horizontal line of sight or line of collimation even though the instrument is slightly tilted.

**Result:**
The various modern instruments used in surveying were studied.
Experiment No- 11

Aim: To determine the horizontal and vertical measurements using total station

Instruments used: Total station, tripod, reflecting prism

Procedure:
- Set up the instrument over a station (say O).
- Centre it accurately and level it.
- Press the power button to switch on the instrument
- Select MODE A D- 30.
- Press 'DIS' twice to get the page which consists of all horizontal and vertical measurements.
- Turn the total station to point P. Focus it and bissect it exactly using vertical and horizontal clamp.
- Set the horizontal as 0 by double clicking on OSET (F3).
- Then release the horizontal and vertical clamp and turn the total station to the point Q where the reflecting prism is fixed.
- Bisect the prism exactly and press MEAS (F1).
- Then the display panel will show all the vertical and horizontal measurements.

Result:
The horizontal and vertical measurements were taken to a given point using total station

Horizontal angle = __________
Vertical angle = __________
Vertical distance = __________
Horizontal distance = __________
Experiment No-12

**Aim:** To find the area of a closed traverse using total station.

**Instruments used:** Pentax Total Station

**Procedure:**
1. Fix the total station over a station and level it.
2. Press the power button to switch on the instrument.
3. Select MODE B -----> S function-------> file management------> create(enter a name)------->accept
4. Then press ESC to go to the starting page
5. Then set zero by double clicking on 0 set(F3)
6. Then go to S function ------> measure------> rectangular co-ordinate------> station ----> press enter.
7. Here enter the point number or name, instrument height and prism code.

| PN .................................................... |
| E........................................................ |
| N........................................................ |
| IH..................................................... |
| PC.................................................... |

8. Then press accept(Fs)
9. Keep the reflecting prism on the first point and turn the total station to the prism, focus it and bisect it exactly using a horizontal and vertical clamps.
10. Then select MEAS and the display panel will show the point specification
11. Now select edit and re-enter the point number or name point code and enter the prism height that we have set.

12. Then press MEAS/SAVE (F3) so that the measurement to the first point will automatically be saved and the display panel will show the second point.
13. Then turn the total station to second point and do the same procedure.
14. Repeat the steps to the rest of the stations and close the traverse
15. Now go to S function------> view/edit------> graphical view.
16. It will show the graphical view of the traverse.
17. Select S function ---> calculation ---> 2D surface ---> All ----> accept
18. This will give the area of the closed traverse.

**Result:** Area of the closed traverse is calculated.