UNIT II

THEODOLITE AND TACHEOMETRIC SURVEYING

Theodolite :

It is the most precise instrument designed for the measurement of horizontal and vertical angle and has widely applicability in surveying such as laying off horizontal angles, locating point on line, prolonging survey lines, establishing grades, determining difference in elevation, setting out curves etc. It may be classified as

i). Transite theodolite.

ii. Non-transit theodolite.

A transit theodolite is one in which the line of sight can be reversed by revolving the telescope through 180° in the vertical plane.

The Non-transite theodolites in which the telescope cannot be transited.

The vertical axis: The vertical axis is the axis about which the instrument can be rotated in horizontal plane. This is the axis about which the lower and upper plates rotate.

The horizontal axis: ~~The~~ or trunnion axis is the axis about when the telescope and the verticle circle rotate in vertical plane.

Line of sight (LOS) or Line of Collimation: It is the line passing through the intersection of the horizontal and vertical cross-hairs and the optical centre of the object glass and its Continuation.

Temporary Adjustments:

Temporary adjustments or station adjustments are those which are made at every instrument setting and preparatory to taking observations with the instrument. They are.

1. Setting over the station.
2. Levelling up.
3. Elimination parallax.

1. Setting Up: The operation of setting up includes.

i) Centering of the instrument over the station mark by a plumb bob or by optical plummet.

ii) Approximate levelling with the help of tripod legs.

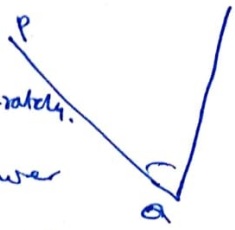
2- Levelling Up: After having centered and approximately levelled the instrument, accurate levelling is done with the help of foot screws and with reference to the plate levels. The pupose of levelling is to make the vertical axis truely vertical.

3. Elimination of Parallax:

Parallax is a condition arising when the image formed by the objective is not in the plane of the cross-hairs. Unless parallax is eliminated, accurate sighting is impossible. Parallax can be eliminated in two steps: i) by focusing the eye-piece for distinct vision of the cross-hairs. ii) by focusing the objective to bring the image of the object in the Plane of Cross-hairs.

Measurement of Horizontal Angles :

To measure the horizontal angle PQR



1. Set up the instrument at Q and level it accurately.

2. Release all clamps. Turn the upper and lower plates in opposite direction till the zero of one of the vernier is against the zero of the scale and the vertical circle is to the left. clamp both the plates together by upper clamp and lower clamp and bring the two zeros into exact co-incidence by turning the upper tangent screw. Take both vernier readings. The reading on vernier B will be 180°, if there is no instrumenter error.

3. Loose the lower clamp and turn the instrument towards the signal at P. Since both the plates are clamped together, the instrument will rotate about the outer axis. Bisect point P accurately by using lower tangent screw. Check the readings of vernies A & B. The should be no change in the previous reading.

4. Un clamp the upper clamp and the instrument clockwise about the inner axis to bisect the point R. Clamp the upper clamp and bisect R accurately by using upper tangent screw.

5. Read the both verniers. The reading of vernier A gives the angle PAR directly while the vernier B gives by deducting 180°.

6. Change the face by transiting the telescope and repeat the whole process. The mean of the two vernier readings gives the angle with other face.

The average horizontal angle is then obtained by taking the mean of the two readings with different faces.

Two types to measuring horizontal angle:

1. Repitition method
2. ~~Rot~~ Reiteration method.

Measurement of Vertical Angles.

Vertical angle is the angle which the inclined line of sight to an object makes with the horizontal.

1. Level the instrument with reference to the plate level, as already explained.

2. Keep the altitude level parallel to any two foot screws and bring the bubble to the centre ~~with~~. Rotate the telescope through 90° till the

altitude bubble or the third screw. Repeat the procedure till the bubble is central in both the positions. If the bubble is in adjustment it will remain central for all pointings of the telescope.

3. Loose the vertical circle clamp and rotate the telescope in vertical plane to sight of the object. Use vertical circle tangent screw for accurate bisection.

4. Read both vernviers of vertical circle. The mean of the two gives the vertical circle. Similar observation may be made with another face. The average of the two will give the required angle.

Note: It is assumed that the altitude level is in adjustment and that index error has been eliminated by permanent adjustments. The clip screw should not be touched during these operations.

Contouring :

The value of plan or map is highly enhanced if the relative position of the points is represented both horizontally as well as vertically. Such maps are known as topographic maps. Thus in topographic survey, both horizontal as well as vertical control are required. On a plan, the relative altitudes of the points can be represented by shading, hachures form lines or Contour lines. Out of these, Contour lines are most widely used because they indicate the elevations directly.

A contour is an imaginary line on the ground joining the point of equal elevation. It is a line in which the surface of the ground is intersected by a levwl surface. A contour line is a line on the map representing a contour.

Contour Interval:

The vertical distance between any two consecutive contours is called Contour interval. The contour interval is kept constant for a contour plan, otherwise the general appearance of the map will be misleading. The horizontal distance between two points on two consecutive contours is known as the horizontal ~~alignment~~ equivalent. and depends upon the steepness of the ground. The choise of proper contour interval depends upon the following considerations.

1. Nature of the ground.
2. The scale of the map
3. The purpose of the extent of survey.
4. Time and expense of field and office work.

Characteristics of Contours :

1. Two contour lines of different elevations cannot cross each other. If they did, the point of intersection would have two different elevations which is absurd. However contour lines of different elevations can intersect only in the case of an overhanging cliff or a cave.

2. Contour lines of different elevation can unite to form one line only in the case of a vertical cliff.

3. Contour lines close together indicate steep slope. They indicate a gentle slope if they are far apart. If they are equally spaced, uniform form slope is indicated. A series of straight, parallel and equally spaced contours represent a plane surface,

4. A contour passing through any point is perpendicular to the line of steepest slope at that point. This agree with (3), since the perpendicular distance b/w contour lines is the shortest distance.

5. A closed contour line with one or more higher ones inside it represents a hill.

6. To contour lines having the same elevation cannot unite and continue as one line. Similarly a single contour split into two lines. This is evident because the single line would otherwise indicate a knife edge ridge or depression which does not occur in nature.

7. A contour line must close upon itself, though not necessarily within the limits of the map.

8. Contour lines cross a watershed or ridge line at right angles. The form curves of U-shape round it with the concave side of the curve towards the higher ground.

9. Contour line cross a valley line at right angles. They form sharp curves of V-shape across it with convex side of the curve towards the higher ground. If there is a stream, the contour on either side, turning upstream, many disappear in coincidence with the edge of the stream and cross underneath the water surface.

10. The same contour appears on either sides of a ridge or valley. For the highest horizontal plane that intersects the ridge must cut it on both sides. The same is true of the lower horizontal plane that cuts a valley.

Methods of Locating Contours :

a) Direct method.

b) Indirect method.

In direct method, the contour to be plotted is actually traced on the ground. Only those points are surveyed which happen to be plotted. After having surveyed those points, they are plotted and contours are drawn through them. The method is slow and tedious and is used for small areas and where great accuracy is required.

In the Indirect method, some suitable guide points are selected and surveyed; the guide points need not necessarily be on the contours. These guide points, having been plotted, serve as basis for the interpolation of contours. This is method most commonly used in engineering surveys.