PLANE TABLE SURVEY

INTRODUCTION

In plane table surveying, a plane table is used for taking the measurements and for plotting the plan in the field. A plane table consists of a drawing board mounted on a tripod. Plane table surveying is a method in which the field observations and plotting of the plan proceed simultaneously. Thus the plan is plotted as the survey progresses. It is unlike other methods of surveying, such as compass surveying and chain surveying, in which the plan is plotted in the office after taking the measurements in the field.

The main feature of plane table surveying is that the plotting is done in the field where all the stations and other features are in the view of the surveyor, and he can compare the plan and plotted details with actual features on the ground. Thus, the mistakes are easily detected.

1) EQUIPMENT AND ACCESSORIES:

- The following instruments are used in plane table survey
- The plane table with levelling head having arrangements for *(a)* levelling, *(b)* rotation about vertical axis, and *(c)* clamping in any required position.
- Alidade for sighting
- Plumbing fork and plumb bob.
- Spirit level.
- Compass.
- Drawing paper with a rainproof cover.

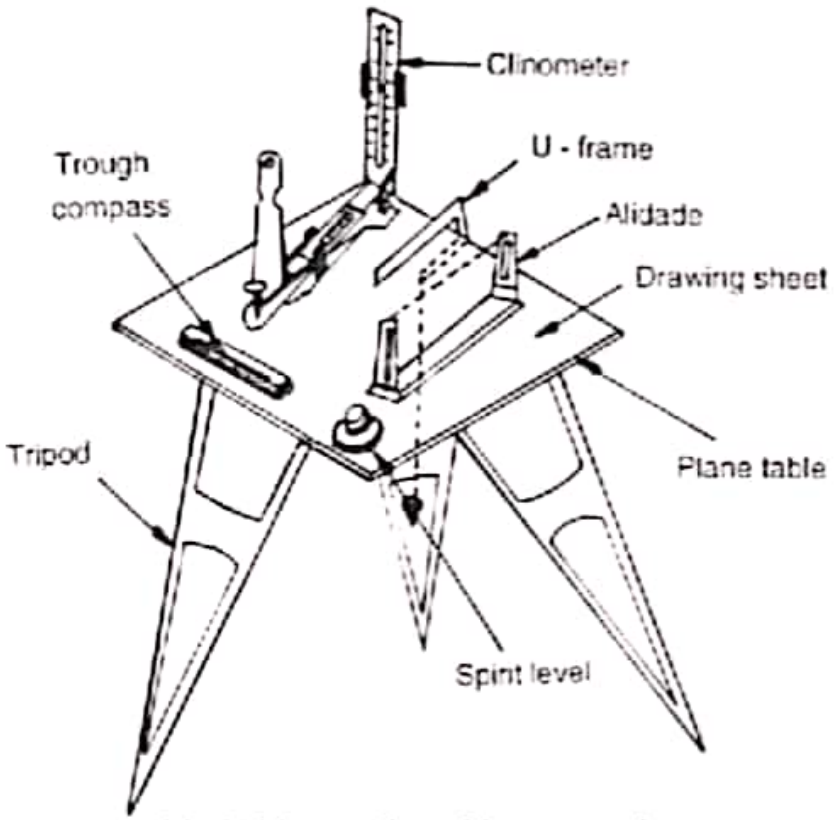

Fig.15 Plane table and its accessories

Spirit Level

A small spirit level may be used for ascertaining if the table is properly level. The level may be either of the tubular variety or of the circular type, essentially with a flat base so that it can be laid on. the table and is truly level when the bubble is central. The table is levelled by placing the level on the board in two positions at right angles and getting the bubble central in both positions.

Compass

The compass is used for orienting the plane table to magnetic north. The compass used with a plane table is a trough compass in which the longer sides of the trough are parallel and flat so that either side can be used as a ruler or laid down to coincide with a straight line drawn on the paper.

Drawing Paper: The drawing paper used for plane tabling must be of superior quality so that it may have minimum effect of changes in the humidity of the atmosphere. The changes in the humidity of the atmosphere produces expansion and contraction in different directions and thus alter the scale and distort the map. To overcome this difficulty, sometimes two sheets are mounted with their grains at right angles and with a sheet of muslin between them. Single sheet must be seasoned previous of the use by exposing it alternatively to a damp and a dry atmosphere. For work of high precision, fibre glass sheets or paper backed with sheet aluminium are often used.

The other equipment and accessories used are chain, tape, ranging rods, pegs and hammer.

2) TERMINOLOGY:

Radiation

In this method the instrument is setup at a station and rays are drawn to various stations which are to be plotted. The distances are cut to a suitable scale after actual linear measurements on the ground are taken.

Traversing

In this method the table is set at each of the stations in succession. A foresight is taken to the next station and the distance is cut to a suitably chosen scale.

Intersection

In this method two stations are so selected that all the other stations to be plotted are visible from these. The line joining these two stations is called *base line.* The length of this line is measured very accurately. Rays are drawn from these stations to the stations to be plotted. The intersection of the rays from the two stations gives the positions of the stations to be plotted on the drawing sheet. Sometimes, this method is also termed as *graphical triangulation*

Resection

It is a method of orientation employed when the table occupies a position not yet located on the drawing sheet. Therefore, it can be defined as the process of locating the instrument station occupied by the plane table by drawing rays from the stations whose positions have already been plotted on the drawing sheet. The resection of two rays will be the point representing the station to be located, provided the orientation at the station to be plotted is correct, which is seldom achieved. The problem can be solved by any of the methods such as resection after orientation by back ray, by two points, or by three points.

The Plane Table

Three distinct types of tables (board and tripod) having devices for levelling the plane table and controlling its orientation are in common use

(i) the *Traverse* Table, *(ii)* the *Johnson* Table and *(iii)* the *Coast Survey* Table.

The Traverse Table : The traverse table consists of a small drawing board mounted on a light tripod in such a way that the board can be rotated about the vertical axis and can be clamped in any position. The table is levelled by adjusting tripod legs, usually by eye-estimation.

Johnson Table : This consists of a drawing board usually 45 x 60 cm or 60 x 75 cm. The head consists of a ball-and-socket joint and a vertical spindle with two thumb screws on the underside. The ball-and-socket joint is operated by the upper thumb screw. When the upper screw is free, the table may be tilted about the ball-and-socket for levelling. The clamp is then tightened to fix the board in a horizontal position. When the lower screw is loosened, the table may be rotated about the vertical axis and can thus be oriented.

The Coast Survey Table : This table is superior to the above, two types, and is generally used for work of high precision. The levelling of the table is done very accurately with the help of the three foot screws. The table can be turned about the vertical axis and can be fixed in any direction very accurately with the help of a clamp and tangent screw.

Alidade

A plane table alidade is a straight edge with some form of sighting device. Two types are used :

(i) Plain alidade and (ii) telescopic alidade.

Plain Alidade: It is generally consist of a metal or wooden rule with two vanes at the ends. The two vanes or sights are hinged to fold down on the rule when the alidade is not in use. One of the vanes is provided with a narrow slit while the other is open and carries a hair or thin wire. Both the slits thus provide a definite line of sight which can be made to pass through the object to be sighted. The alidade can be rotated about the point representing the instrument station on the sheet so that the line of sight passes through the object to be sighted. A line is then drawn against the working edge (known as the *fiducial edge)* of the alidade.

Telescopic Alidade: The telescopic alidade is used when it is required to take inclined sights. Also the accuracy and range of sights are increased by its use. It essentially consists of a small telescope with a level tube and graduated arc mounted on horizontal axis.

Plumbing Fork

The plumbing fork, used in large scale work, is meant for centring the table over the point or station occupied by the plane table when the plotted position of that point is already known on the sheet. Also, in the beginning of the work, it is meant for transferring the ground point on to the sheet so that the plotted point and the ground station are in the same vertical line.

The fork consists of a hair pin-shaped light metal frame having arms of equal length, in which a plumb-bob is suspended from the end of the lower-arm. The fitting can be placed with the upper arm lying on the top of the table and the lower arm below it, the table being centred when the plumb-bob hangs freely over the ground mark and the pointed end of the upper arm coincides with the equivalent point on the plan.

5) PRECAUTIONS:

In every fieldwork exercise relevant precautions have to be taken to minimize the errors that are mentioned in the previous paragraphs.

6) APPLICATIONS:

Maps can be produced directly with the plane table with complete networks of control points fixed with it and the whole of the detail filled in. This method can be used for the filling in of detail or the revision of plans when the control points have already been fixed by traversing or triangulation. This method can also be used for location of contour-lines.

RADIATION METHOD – PLANE TABLE

Aim:

To draw the position in plan of the given points by radiation method.

Equipment and Accessories:

Plane table and its accessories (tripod, alidate, trough compass, plumbing fork, spirit level, drawing sheet, cello- tape, pencil, eraser and dusting cloth), chain, tape, ranging rods, pegs, hammer and field-book.

Principle:

Plane table is a surveying instrument that can be used to prepare a map or plan of an area directly in the field without the direct measurement of any angles. Radiation is one of the methods employed in plane table survey. This method is generally employed for locating the details.

In this method, a ray is drawn from the instrument station towards the point. The distance is measured between the instrument station and the point. The point is located by plotting to some scale the distance so measured. This method is more suitable for small distances. One instrument station can cover several points to be detailed.

Procedure:

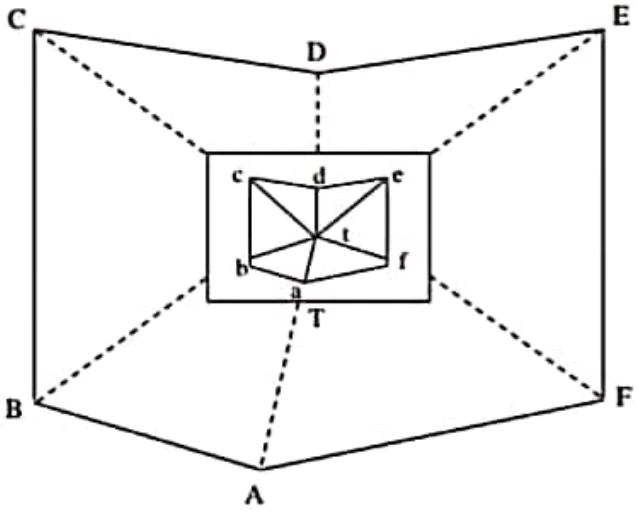

Fig.16 Radiation method – plane table

1) Select a point '*T*' on the ground so that all points to be located are visible from it.
2) Set up the table at '*T*', level it, and do centering.

3) Transfer the point '*T*' on to the drawing sheet by means of plumbing fork so that it is exactly over station '*T*' on the ground and name it '*t*'.
4) Mark the direction of the magnetic meridian on the drawing sheet by means of trough compass.
5) Centering the alidade on '*t*' BISECT the points *A, B, C, D, E* and *F* one after the other and draw the rays along the fiducial edge.
6) Measure the distances *TA, TB, TC, TD, TE* and *TF* on the ground and plot their distances to some scale along the corresponding rays and thus get the position of points *a, b, c, d, e,* and *f* on the drawing sheet. (upper case letters are used to represent stations on ground and lower case letters are used to represent stations on drawing sheet)
7) Join *a,b,c,d,e* and *f* on the drawing sheet.

Observations and Calculations:

1. Measure the distance *AB, BC, CD, DE, EF* and *FA* on the ground.
2. Scale the distance *ab, bc, cd, de, ef* and *fa* on the drawing sheet.

Result:

Compare the ground and plan distances between the stations *A, B, C, D, E* and *F*.

INTERSECTION METHOD – PLANE TABLE

Aim:

To draw the position in plan of the given points by intersection method.

Equipment and Accessories:

Plane table and its accessories (tripod, alidate, trough compass, plumbing fork, spirit level, drawing sheet, cello- tape, pencil, eraser and dusting cloth), chain, tape, ranging rods, pegs, hammer and field-book.

Principle:

Plane table is a surveying instrument that can be used to prepare a map or plan of an area directly in the field without the direct measurement of any angles. Intersection is one of the methods employed in plane table survey. This method is generally employed for locating the details.

In this method the location of an object is determined by sighting at the object from two plane table stations and drawing the rays. The intersection of these rays will give the position of the object. Therefore in this method it is essential to have at least two plane table stations. The distance between the two plane table stations is measured and plotted on the sheet to some scale. The line joining the two plane table stations is known as the base line. No linear measurement other than that of the base line is made in this method of surveying.

This method is preferred when the distance between the point and the plane table station is either too large or cannot be measured accurately due to some field conditions.

Procedure:

It is required to plot the position of ground points *PQRS* (shown in figure given below) on the drawing sheet. The line *AB* is a base line measured on the ground. It is represented by the line *ab* on the board drawn to scale. The position of the base line *AB* is chosen such that it is in the middle of the boundary formed by *PQRS*.

1. Set up the plane table over *A* and orient the plane table by laying the alidade along the drawn line *ab* and rotate the board until *B* is sighted from *A* through the alidade (Now the line *ab* is aligned with line *AB* on the ground).
2. Pivot the alidade at '*a*' and sight to the points *P, Q, R & S* and draw the rays. These rays represent the lines of sight to these features.
3. Shift the table to *B*. Plumb point *b* on the board over *B* on the ground.
4. By laying the alidade along the drawn line *ba* rotate the board until *A* is sighted and clamp the board (Now the line *ab* is aligned with line *AB* on the ground)
5. Mark the direction of the magnetic meridian on the drawing sheet by means of trough compass.

6. Pivot the alidade at '*b*' and sight to the points *P*, *Q*, *R* & *S* and draw the rays (The rays from *B* will intersect those drawn from *A*, thus establishing the positions *p*, *q*, *r* and *s* on the board).
7. Join the points *p*, *q*, *r* & *s* on the drawing sheet.

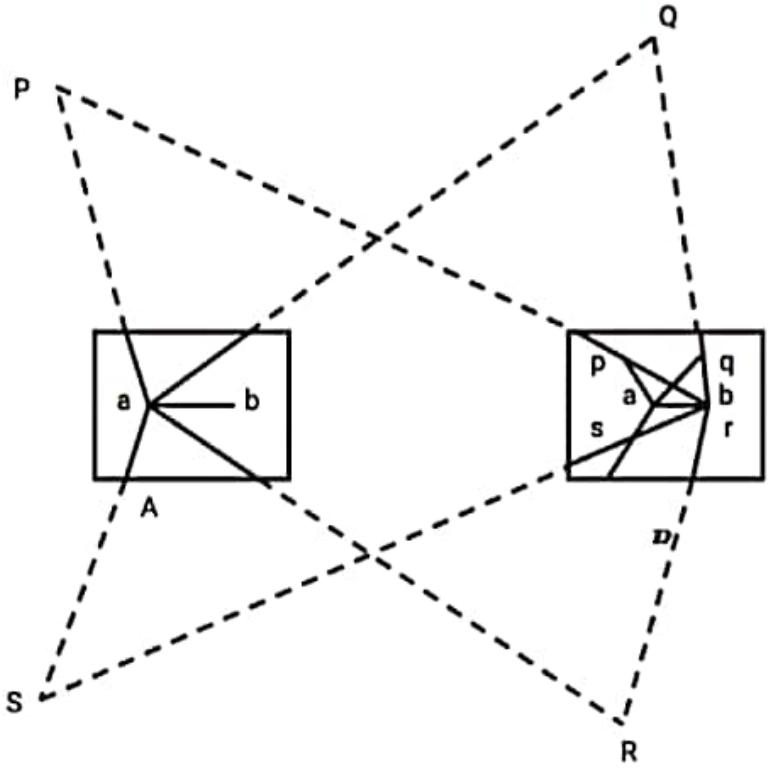

Fig.17 Intersection method – plane table

Observations and Calculations:

1. Measure the distance *PQ*, *QR*, *RS* and *SP* on the ground.
2. Scale the distance *pq*, *qr*, *rs* and *sp* on the drawing sheet.

Result:

Compare the ground and plan distances between the stations *P*, *Q*, *R* and *S*.

EXERCISE 10
TRAVERSING – PLANE TABLE

Aim:

To survey a small piece of land by closed traverse technique using plane table.

Equipment and Accessories:

Plane table and its accessories (tripod, alidate, trough compass, plumbing fork, spirit level, drawing sheet, cello- tape, pencil, eraser and dusting cloth), chain, tape, ranging rods, pegs, hammer and field-book.

Principle:

Traversing is that of survey in which a number of connected survey lines form a framework. The directions and lengths of the survey lines are measured with the help of an angle (or direction) measuring instrument and a tape respectively. If the framework formed by the lines closes at the starting station, that is, if they form a closed polygon, it is called closed traverse.

In plane table traversing, at each successive station the table is set, a foresight is taken to the following station and its location is plotted by measuring the distance between the two stations as in the radiation method.

Procedure:

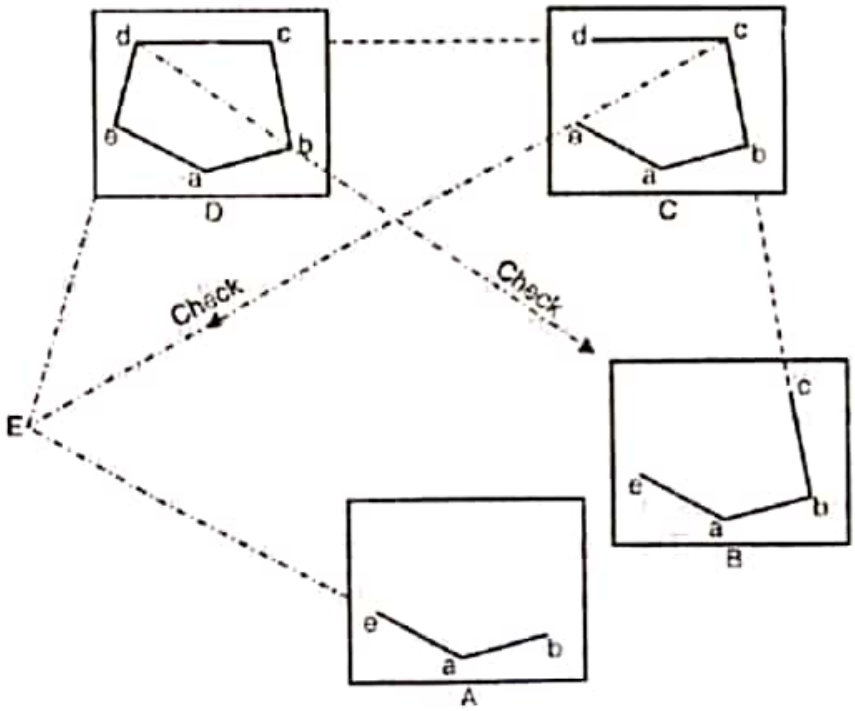

Fig.20 Traversing – plane table

1) Select the traverse stations *A,B,C,D* and *E* on the ground.

2) Set the table at *A*. Use plumbing fork and transfer *A* on to the sheet and name it *'a'*. On the top right corner of the sheet mark the direction of magnetic north with the help of trough compass.

3) With the alidade pivoted about a, sight it to *B* and draw the ray. Measure *AB* and scale of ab to a suitable scale. Similarly draw a ray towards *E*, measure *AE* and mark *'e'*.

4) Shift the table to *B* and set it. Orient the table accurately by back sighting *A*. Clamp the table.

5) Pivoting the alidade about *b*, sight to *C*. Measure *BC* and plot it on the drawn ray to the same scale. Similarly, the table can be set at other stations and the traverse is completed.

Note: *While being at each station, take measurements by radiation to any details that are to be included in the plan.*

Observations and Calculations:

1) Measure the distance *DB* and *EC* on the ground.
2) Scale the distance *db* and *ec* on the drawing sheet.

Result:

Compare the ground distances *DB* and *EC* with corresponding plan distances *db* and *ec*.