

# Surveying (Plane Table Survey)

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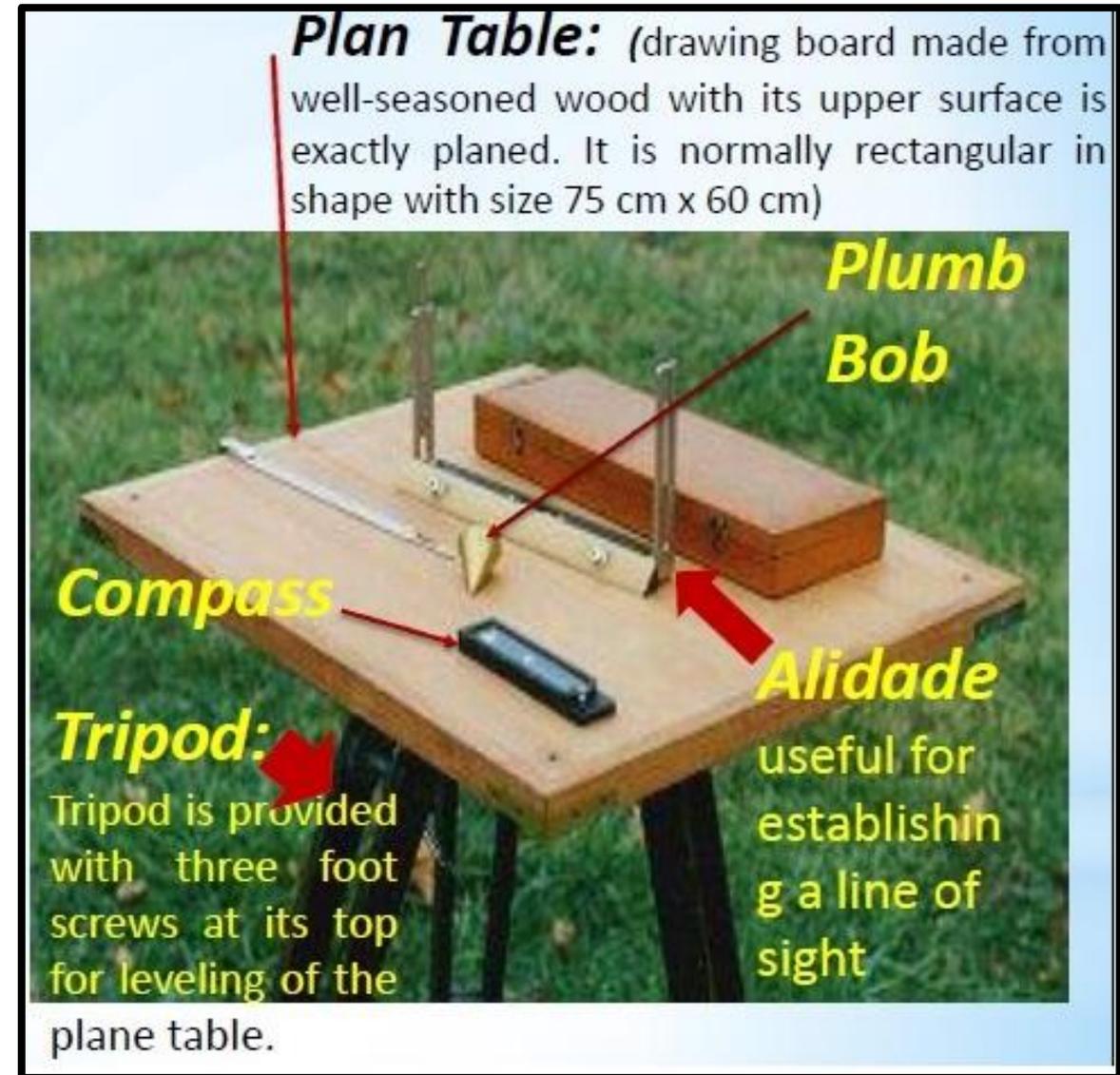
## Plane table Survey

This is a quick survey carried out in the field with measurements and drawings made at the same time using a plane table.

A plane table surveying is a graphical method of surveying. In this method, field observation and plotting are done simultaneously helping the surveyor to compare the plotted details with actual features of the ground.

It is simple and cheaper than theodolite survey.

The plane tabling is generally adapted for surveys in which high precision is not required. It is mainly employed for small-scale or medium size mapping.



## Plane table Survey Instruments and Accessories:

The equipment needed in plane table surveying is straightforward and almost available everywhere.

Following are the plane table survey instruments and accessories:-

- Plane Table or Drawing Board
- Tripod
- Alidade
- Spirit level
- Trough compass
- U-Frame or Plumbing Fork
- Water proof cover
- Paper or drawing sheet
- Drawing accessories

## Plane Table

- It is made of well-seasoned wood. It varies in size, the common sizes are from 40 cm x 30 cm to 75 cm x 60 cm or 45 cm square, 60 cm square, etc.
- The drawing board may be mounted on a tripod with a leveling head or a ball-and-socket arrangement in such a fashion that it can be leveled and revolved about a vertical axis and may be clamped in any position.

**NOTE:** The head of the tripod may sometimes be provided with a light metal frame carrying three milled-headed screws to level the table.



# Tripod

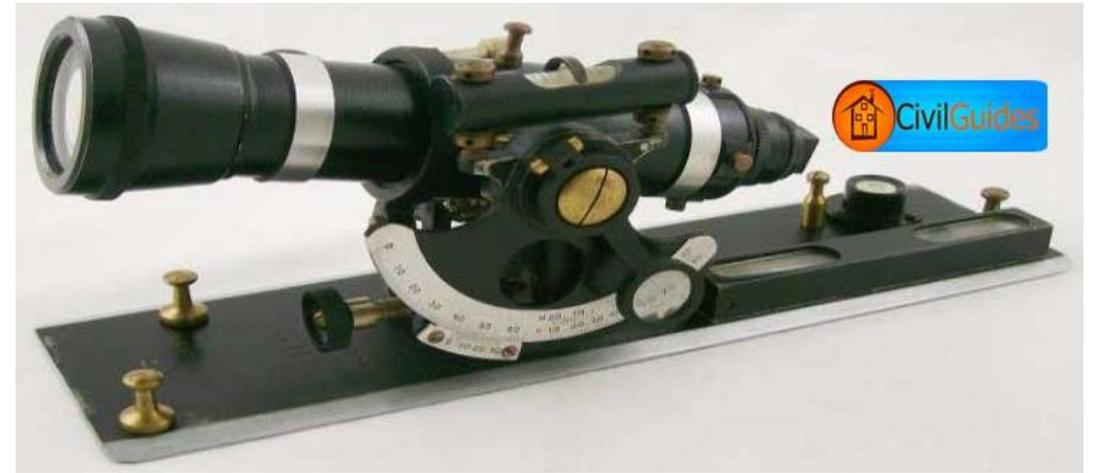
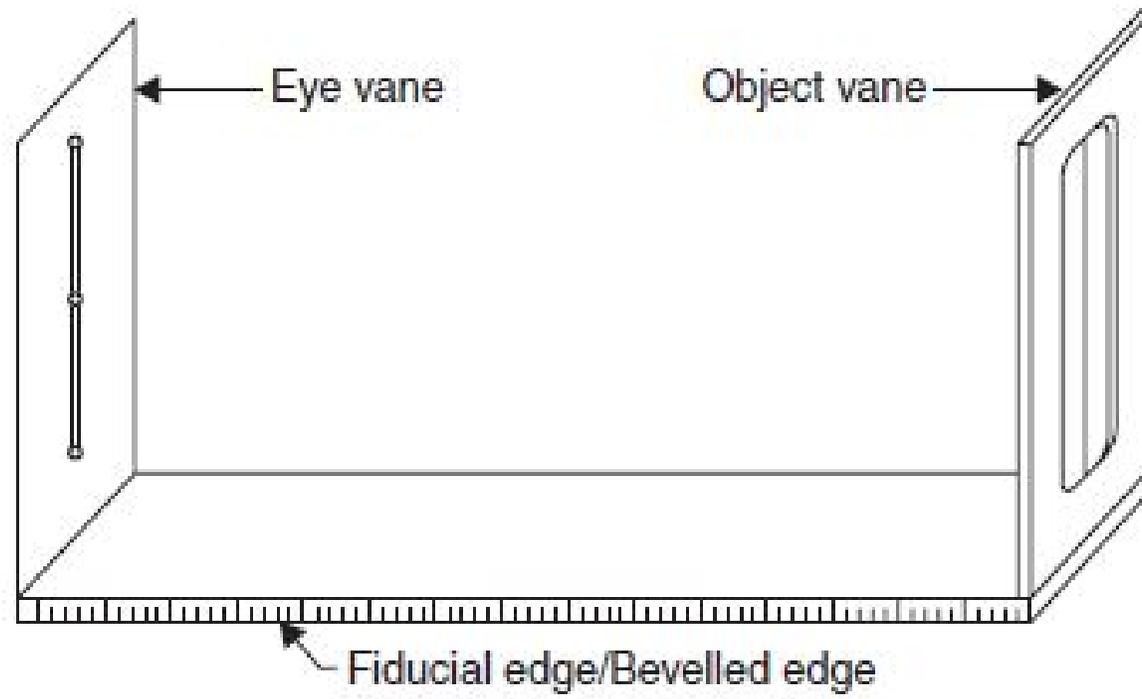
- Tripod is also required for plain table survey. It is in one of the important plane table survey instruments without it is impossible to do plain table survey.
- Tripod is used to fix the drawing board. It consists of a screw at the bottom which is used to set and level the drawing board on it comfortably.



# Alidade

The alidade is useful for establishing a line of sight. Two types of alidade are used-Simple and Telescopic alidade.

- Simple alidade is used for ordinary work. It is generally consists of a gun metal or wooden rule with two vertical vanes at the ends.
- The eye-vane is provided with a narrow slit while the object vane is open and carries a horse hair. Both the slits, thus provide a definite line of sight which can be made to pass through the object.
- To draw the rays, one of the edge of alidade is beveled and this perfectly smooth working edge is known as the fiducially edge. The fiducially edge is graduated to facilitate the plotting of distances to a scale.
- The telescopic alidade is used when it is required to take inclined sights.
- It essentially consists of a small telescope with a level tube and graduated arc mounted on horizontal axis.
- It gives higher accuracy and more range of sights.





## **Digital alidade**

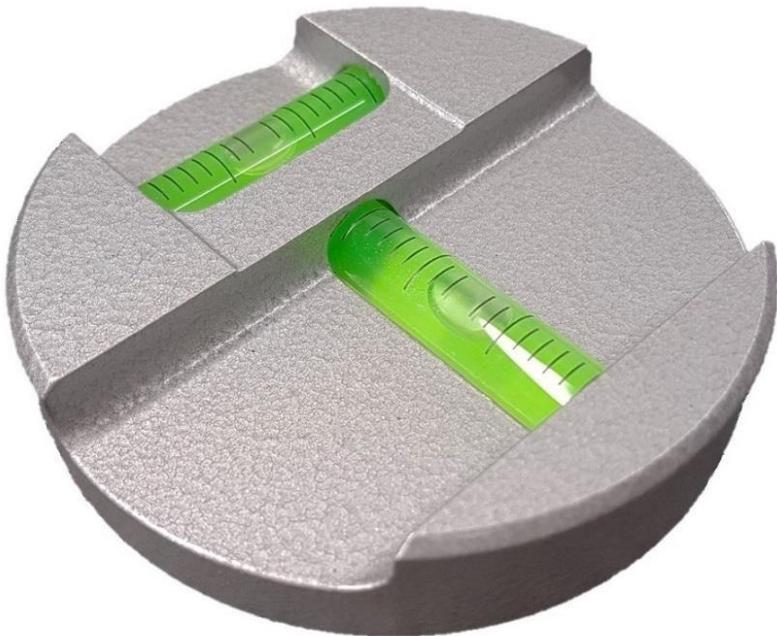
It consists of an EDM, with a built-in telescope for sighting, an automatic angle sensor for registering vertical angle and a microcomputer for yielding horizontal distance and difference in elevation.

It also consists of a liquid crystal display which is used to display and thus read and retrieve the observed and calculated parameters.

Digital alidade is particularly useful for accurate plotting of detail and for the long line of sight.

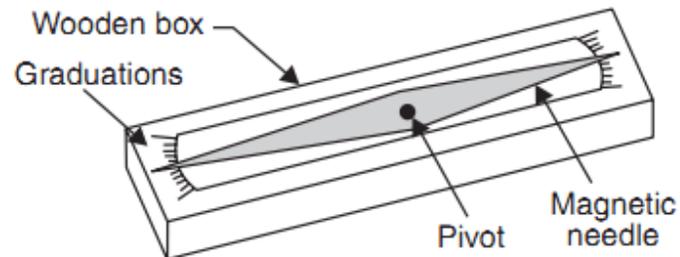
# Spirit level

- A spirit level is used for ascertaining if the table is properly level.
- The table is leveled by placing the level on the board in two positions at right angles and getting the bubble central in both positions.
- If the spirit level which may be very sensitive, is not fitted to the alidade, the table can be leveled by placing the spirit level.



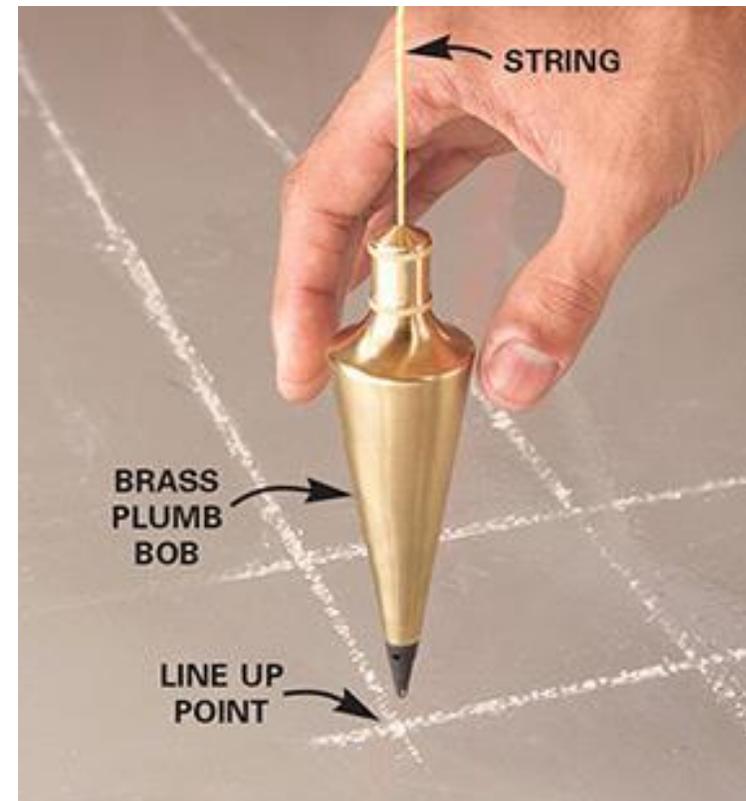
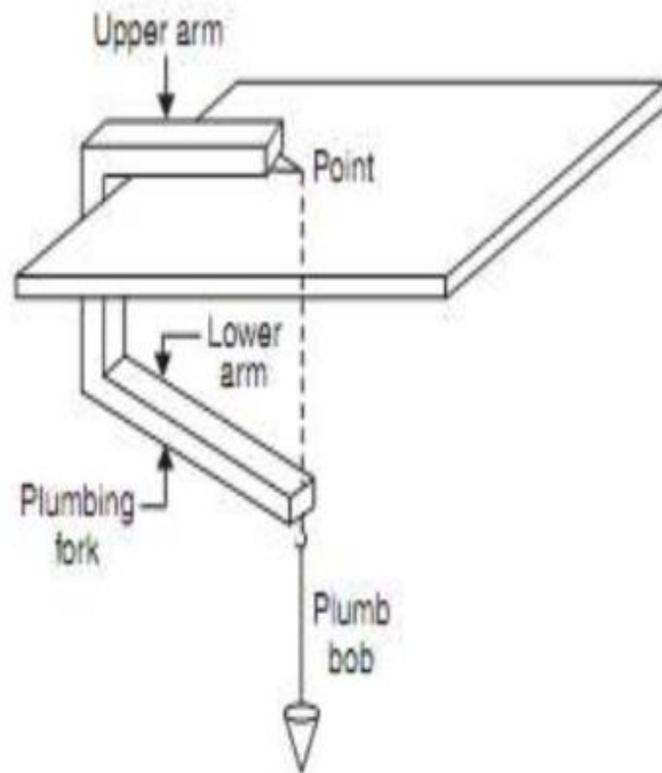
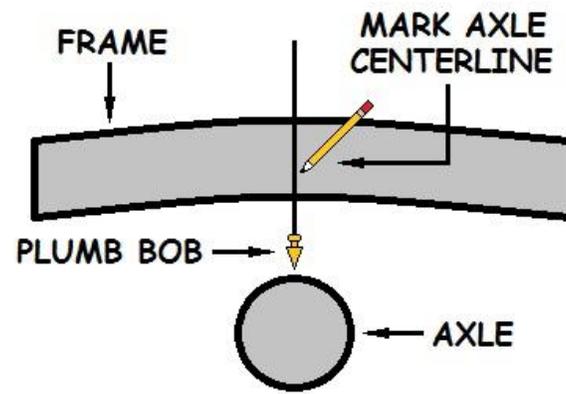
# Trough Compass

- A trough compass consists of a long, narrow rectangular box, covered with glass. Inside the box, at its centre, there is a magnetic needle resting on the pivot.
- At the extremities of the trough compass, there are graduated scales with zero at the centre and marking up to  $5^\circ$  on either side of the zero line.
- The trough compass is used for marking the magnetic north line on the drawing sheet of the plane table.
- In this case, the magnetic needle point to  $0^\circ - 0^\circ$  of the graduated scale and a line drawn parallel to the edge of the trough compass is along the magnetic meridian.
- A trough compass is also used to orient the plane table with respect to the magnetic meridian.



## U-Frame or Plumbing Fork

- A plumbing fork is a U-shaped piece of metal or wood frame. The end of one of its arms is pointed and the other arm is having an arrangement for hanging a plumb bob.
- The frame is constructed in such a way that the tip of the pointed arm and the plumb line lie in the same vertical line.
- U-frame with plumbing fork is used for centering the table over the point or station occupied by the plane table when the plotted position of that point is already on the sheet.
- At the time of use, the pointed arm is placed on the table and the other arm, with a plumb bob attached, is kept below the table. Plumbing fork with a plumb bob is used in large scale surveying for Centring of plane table and for Transferring of ground point.
- Also, in the beginning of the work, it is used for transferring the ground point on the sheet.
- This is used in large-scale work for setting the table such that the point on the paper (representing the instrument station being occupied) may be brought vertically over the station marked on the ground.



## Adjustment of Plane Table

The setting up of the table includes three operations,

- (1) leveling the table;
- (2) Orienting the table; and
- (3) Centering the table



**Leveling:** The plane table should be set up at a convenient height (nearly a meter) by spreading the legs to keep the table approximately leveled above the particular station.

The leveling is then completed by using of leveling screws (if provided) or by tilting the board by hand if the instrument has a ball and socket arrangement.

A level tube or circular level is placed on the table first parallel to two screws and then over the third screw.

If the leveling or the ball-and-socket arrangement is not provided, the leveling may be completed by simply adjusting the legs.

**Orientation:** The process by which the position occupied by the board at various survey stations are kept parallel is known as the orientation.

In the plane table surveying, the whole table needs to be moved at several stations to complete a survey. Every time the table is moved one has to make sure that the new station is parallel to the previous one otherwise the lines drawn on paper will not represent the same lines on the field. Methods of orientation are:-

*Orientation by Magnetic Needle:* This method is used when it is not possible to bisect the previous station from the new station. This method is not much reliable and prone to errors due to variations of the magnetic field.

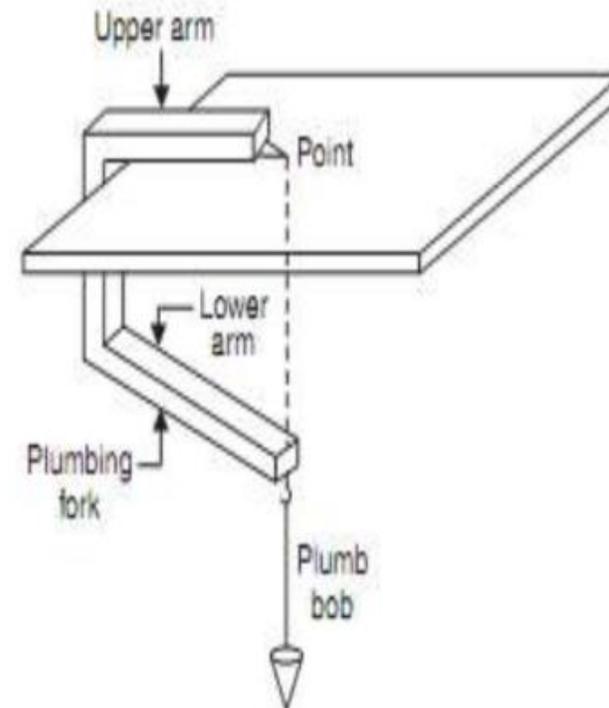
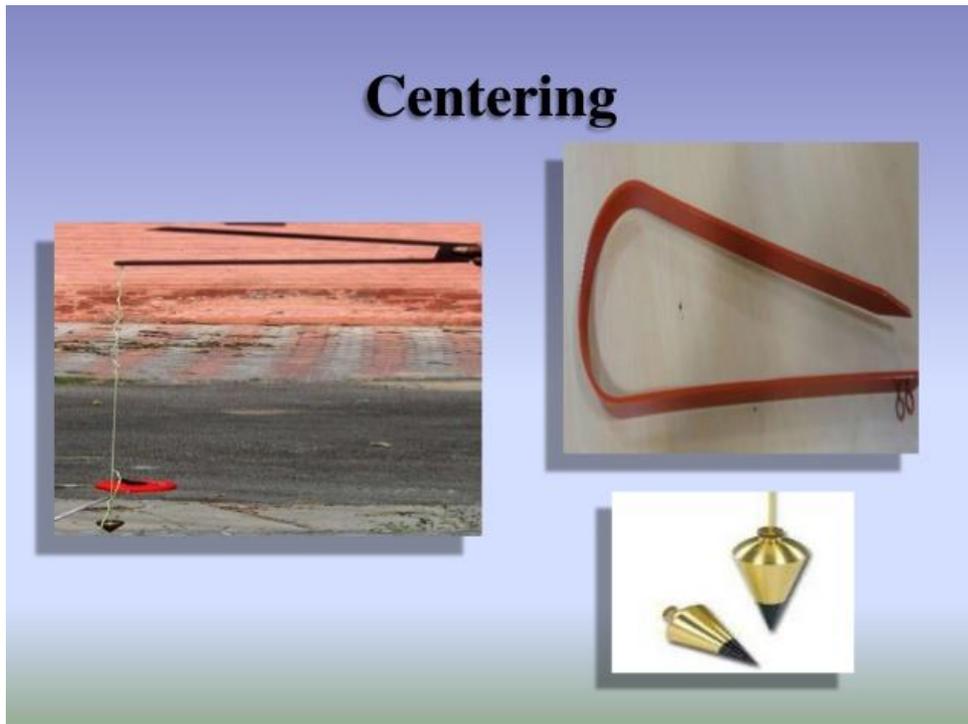
*Orientation by Back Sighting:* This is a more reliable method. In this method, a particular line drawn from the previous station is drawn again from the new station.

This process is called back-sighting. One does not necessarily have to draw the line the second time rather check if the new line superposes over the previous one or not.



**Centering:** Centering is an essential step in plain table survey. The centering means to set the table vertically on the ground point.

To perform this operation, place the pointed end of the upper leg of the fork coinciding with the point on the paper and suspend a plumb-bob from the lower leg and shift the table body until the plumb-bob of the fork hangs precisely over the center of the station peg.



# Method and Procedures of Plane Table Survey

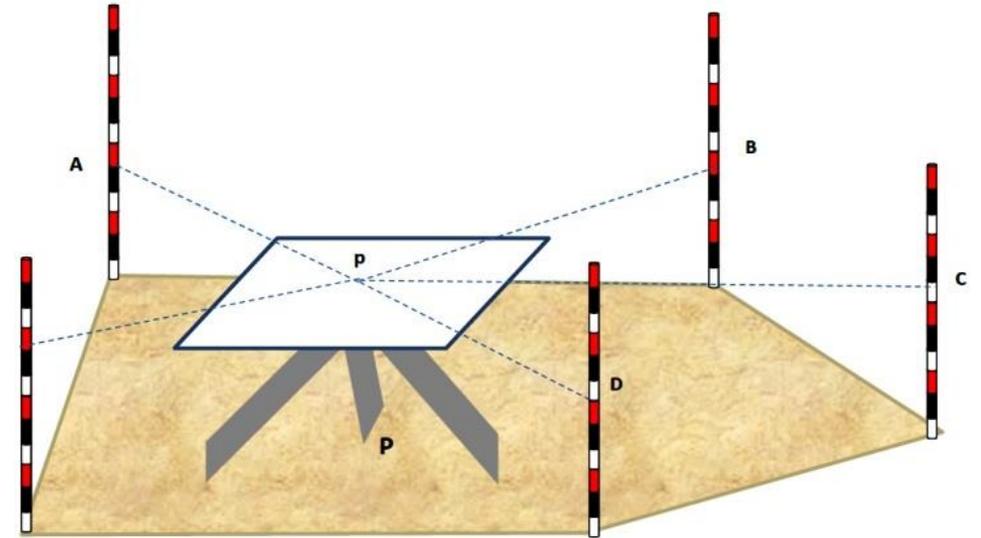
There are four distinct methods of plane table survey,

- (1) Radiation;
- (2) Intersection;
- (3) Traversing; and
- (4) Resection

## Radiation Method

In this method, the plane table is set up at only one station and the points to be plotted are located by radiating rays from the instrument-station to the points and plotting to scale the respective distances along the rays.

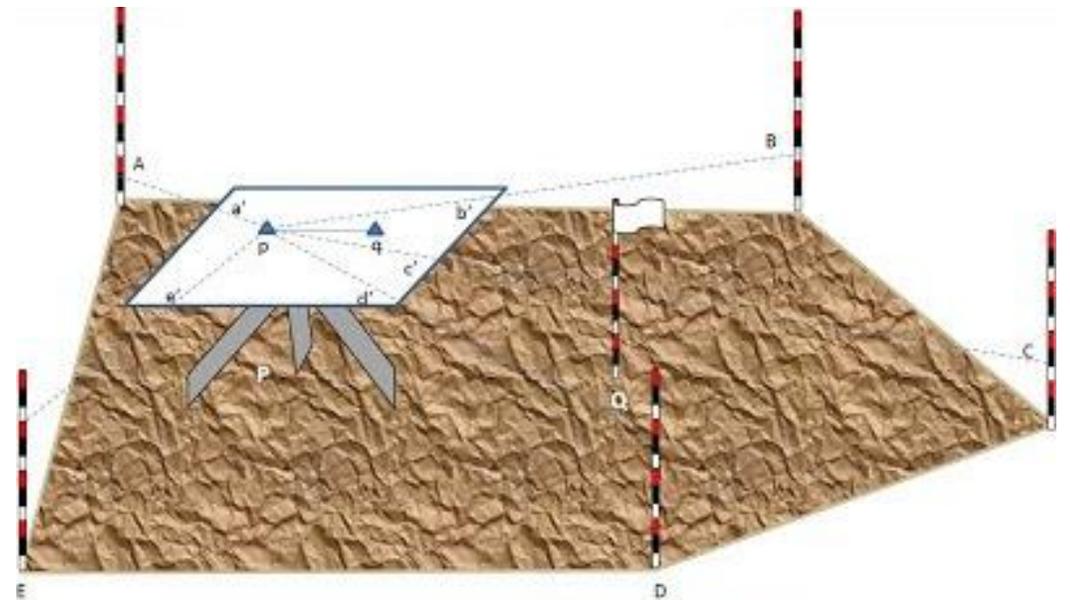
This method is suitable for the survey of small areas which can be commanded from a single station. This is rarely used for making a complete survey but is useful in combination with other methods for surveying- detail within a tape length from the station.



## Procedure of Radiation Method

The procedure is as follows:

- A point P is to be selected in such a fashion that all the other points ( A B C D E) are seen easily from P.
- Centering, leveling, and orientation must be done prior to surveying.
- At first, by putting the alidade on point P a line of sight for station A is to be draw
- After measuring the distance of PA on field, the measurement needs to be put on paper to a suitable scale.
- Similarly, points b, c, d, and e are obtained on paper by drawing lines of sight for stations B, C and D and measuring the distances PB, PC, PD and PE on ground respectively.
- Points a, b, c, d, and e are joined on paper, as shown in the figure.



## Intersection Method

In previous method it was possible to measure every distance on the field manually. In case of a mountainous terrain or rough surface where distances cannot be taken physically, it is best to use intersection method.

### Procedure of Intersection Method

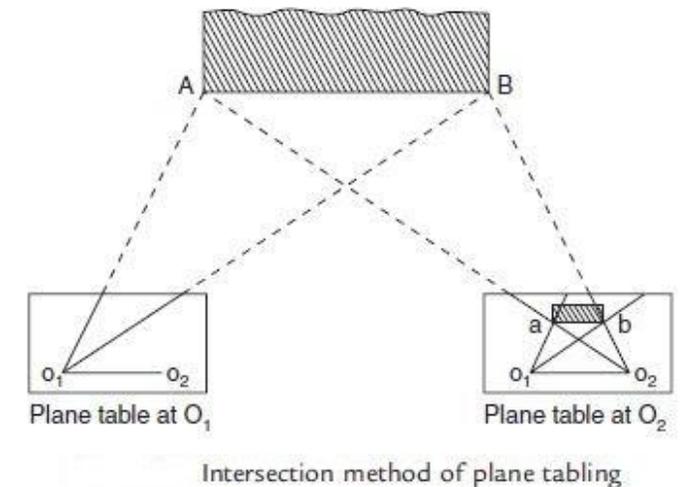
In this method two suitable stations  $O_1$  and  $O_2$  are selected so that the points to be located on paper easily. The baseline ( $O_1O_2$ ) is plotted on the paper. This is done in the way below:

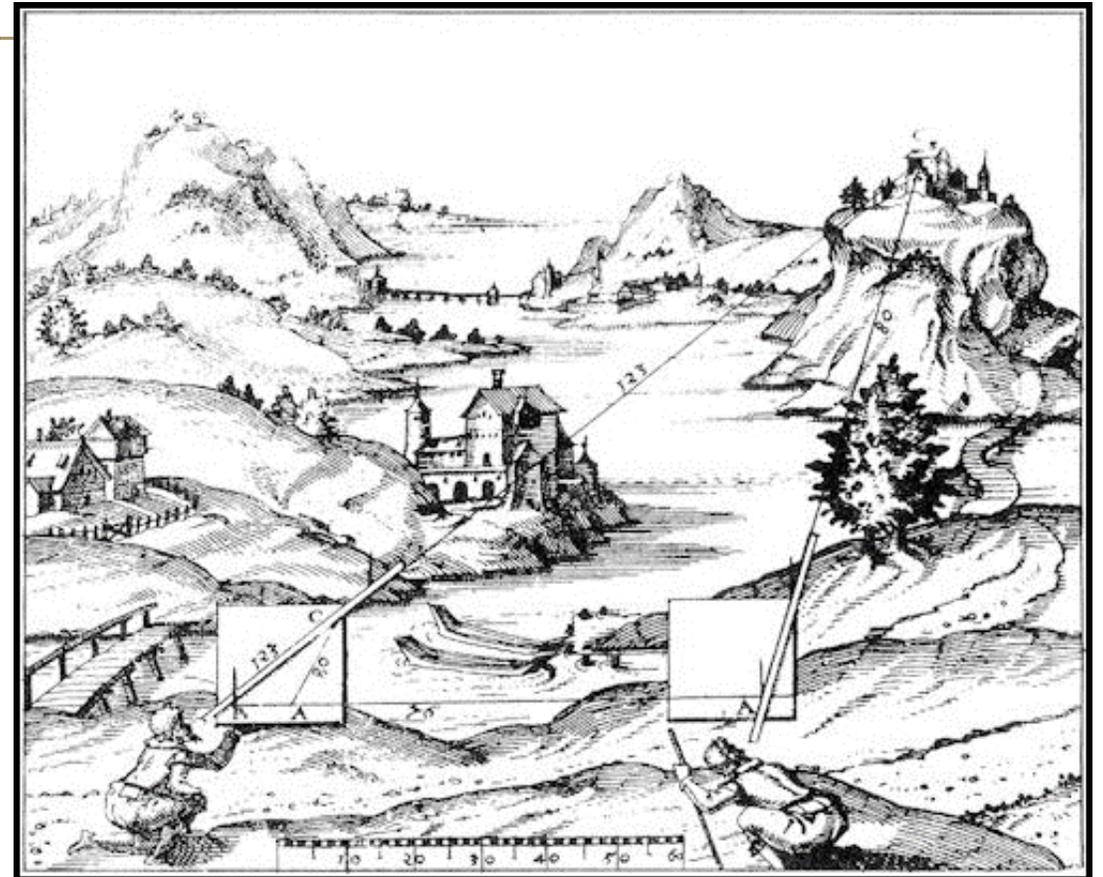
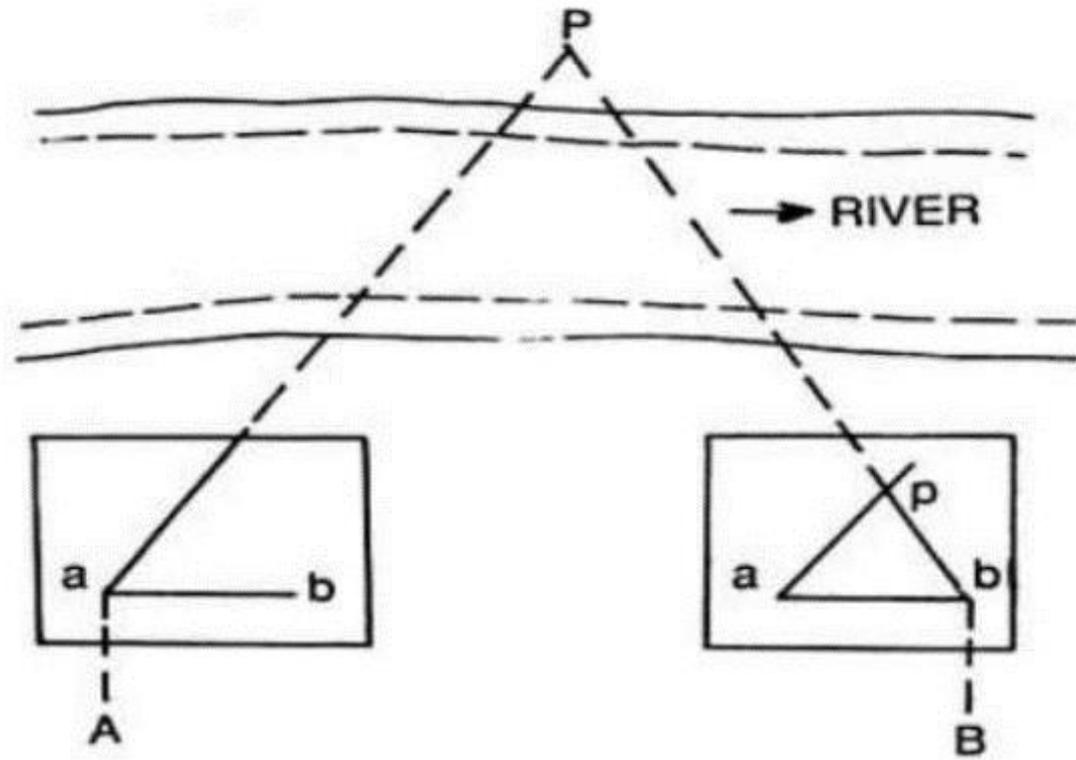
The table can be centered and leveled at station  $O_1$  and then after orienting at station  $O_2$ , the distance  $O_1 O_2$  can be accurately measured and put up to some scale on the paper. Then the board can be adjusted from station  $O_1$  by back sighting at station  $O_2$ .

From station  $O_1$ , rays for stations A, B are drawn etc.

Now moving the table to the new station and orienting it again the rays of stations A, B are drawn etc.,

The intersection of rays from stations  $O_1$  and  $O_2$  will give points a, b etc. on paper, as shown in the figure.





## **Traversing Method**

This is more or less like the compass survey. It is used for running survey lines between stations, which have been previously fixed by other methods of survey, to locate the topographic details.

### **Procedure of Traversing Method**

The plane table is fixed at a location (say A)

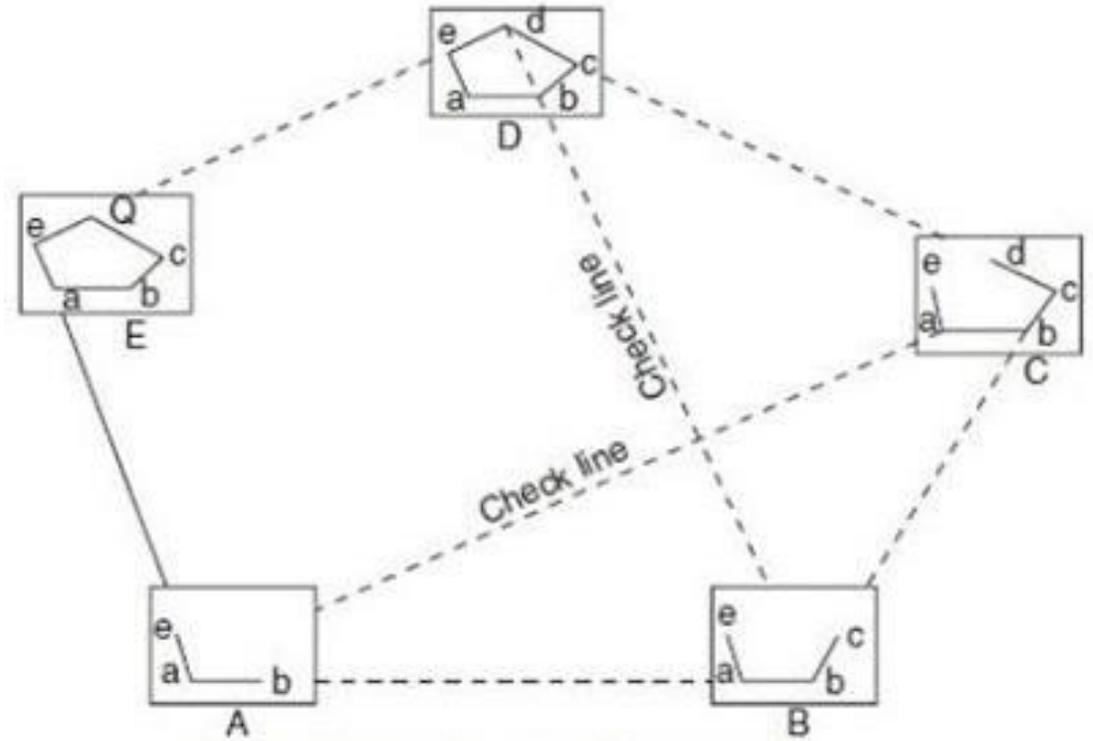
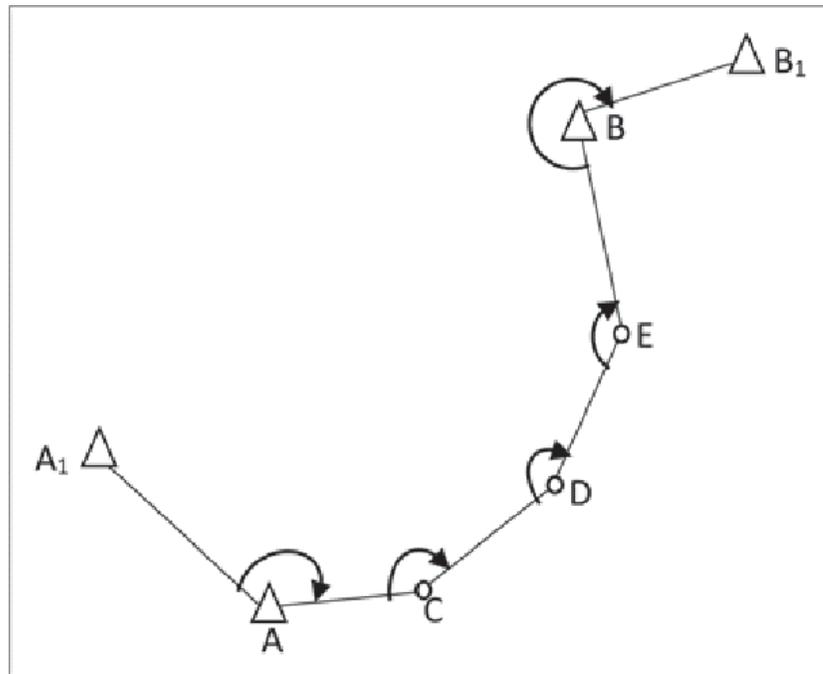
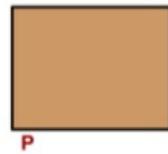
From that point, a sight is taken toward B and the distance AB is measured.

The plane table is shifted to station B and sighted toward A (this is called back sighting). Distance BA was measured.

The average distance between AB and BA are plotted to suitable scale on the drawing paper.

Then the point C is sighted from B and the distance was measured. This process is repeated for all the stations.

Conduct some check at uniform intervals. Finally, plot the traverse lines on the drawing sheet. Notice that back sighting was done only for the first two stations.



## Resection Method

The word 'Resection' in surveying means a technique of ascertaining the location of a point by taking bearings from the point on two other points of known location.

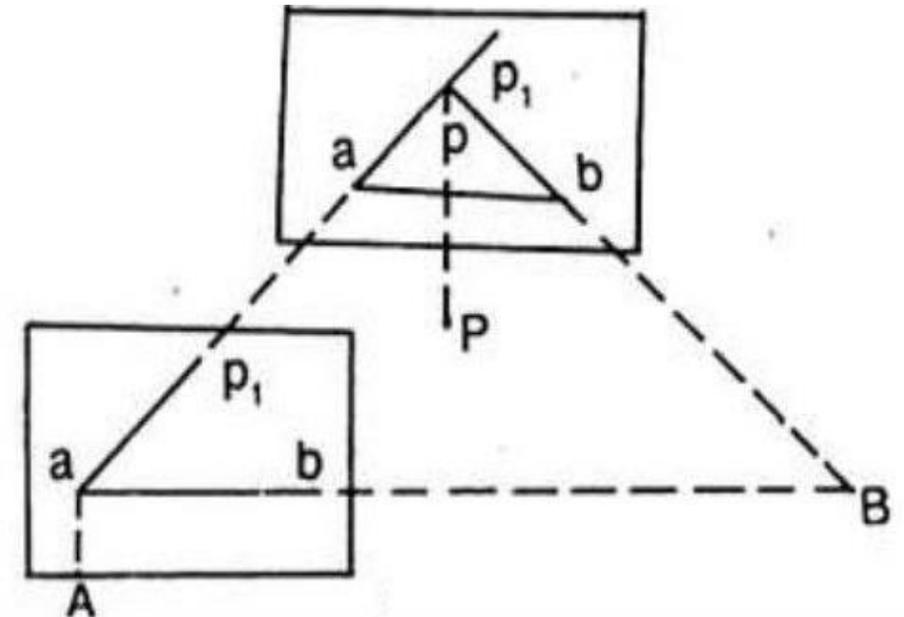
This method is suitable for establishing new stations at a place in order to locate missing details. It is the process of determining the previously plotted position of any peg station, by means of sight taken towards known points, the location of which has been plotted.

### Procedure of Resection Method

Suppose it is required to establish a station at position P. Let us select two points A and B on the ground. The distance AB is measured and plotted to any suitable scale. The AB is known as the 'base line'.

The table is set up at A, leveled-centered and oriented by bisecting the ranging rod at B and the table is clamped.

With the alidade touching point a, the ranging rod at P is bisected and a ray is drawn. Then a point  $P_1$  is marked on this way by estimating with the eye.



The table is shifted and centered in such a way the  $P_1$  is just over P. It is then oriented by back sighting the ranging rod at A.

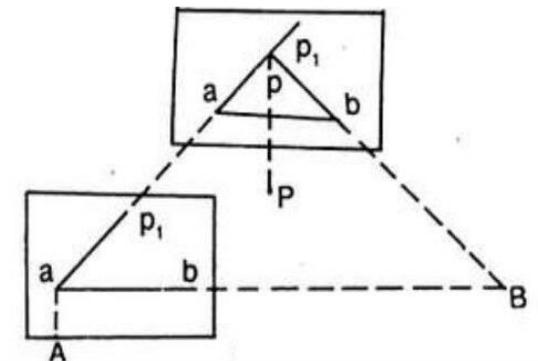
With the alidade touching point b, the ranging rod at B is bisected and a ray is drawn. Suppose this ray intersects the previous ray at a point P.

This is the point represents the position of the station P on the sheet. Then the actual position of the station is marked on the ground by U-fork and plumb-bob.

The method described above is known as back-ray method as it necessitates a ray drawn from a preceding station to that being occupied, and therefore requires the previous selection of the instrument-station. This is only a particular case of resection.

The more usual cases where no ray has already been drawn to the instrument station are:

1. Two-point problem, and
2. Three point problem.



## Advantages of Plane Table Survey

- ✓ Map of the area is plotted in the field, i.e., both the field work and the plotting are done simultaneously.
- ✓ Field notes of the measurements are not required, and thus the errors in booking are eliminated.
- ✓ The correctness of plotted work can be checked by check observations in the field.
- ✓ Office work is only finishing up of the drawing.
- ✓ Direct measurements of lines and angles are avoided as they are obtained graphically.
- ✓ This is suitable in a magnetic area where you can't rely on the compass survey.
- ✓ It is less costly than a theodolite survey.
- ✓ The survey can be completed very rapidly.
- ✓ Much skill is not required to prepare a map.

## Disadvantages of Plane Table Survey

- ✓ Plane tabling is not suitable for work in wet climates, in places where high winds predominate.
- ✓ If the area to be surveyed is large, frequent changes in the size of drawing sheets are required.
- ✓ If the sun is bright, plotting may be difficult due to the strain on the eyes.
- ✓ It is not very accurate for large-scale surveys as compared to compass and theodolite surveys.
- ✓ The instruments and its accessories are heavy and cumbersome, and they are likely to be lost.
- ✓ Since the field notes are not maintained, it is inconvenient to calculate the quantities or re-plot the survey to a different scale if required.
- ✓ The plane tabling is not intended for accurate work.

# Plane Table Survey

