

# Surveying

Define Surveying and classify it.

→ To determine the relative position of a point on, above or below the surface of the earth is called surveying.

→ Survey point is called station point

→ Line joining two station point is called survey line.

Classification :- based on instruments used in surveying.

(i) Chain Survey :- type of surveying in which measurement of line b/w two st<sup>n</sup> by chain is called chain surveying.

(ii) Compass Survey :- measurement is done by chain or tape and angle of line is measured by compass.

(iii) Theodolite Survey :- Angle as well as horizontal, vertical distance of survey line is done by theodolite

Q) What are the methods of surveying.

3 methods

(i) Direct measurement :- measurement directly by chain or tape

(ii) Measurement by optical means :- observations are taken by telescope and distances are calculated by triangulation method.

(iii) Electronic method :- distances are measured by propagation, deflection and radio or light waves. Various instrument are used under the electronic methods are done by EDM (electromagnetic distance measurement)

Q) What are the instrument used for chain surveying?

(i) Arrow (iv) Plumb bobs (vi) Chain

(ii) Pegs (v) Tape ,

(iii) Ranging rods / Poles

Arrows :- When measured length > chain length, there is need to mark the end of the chain length.

→ It is made up of 4mm dia steel wire one end sharpened and other end bent into a loop. Length of an arrow is approximately 450 mm.

Pegs :- These are used in measuring length of a line to mark the end points of the line. The pegs are made of hard wood of 25mm x 25mm sec<sup>n</sup>, 150mm long with one end tapered as shown in fig.

Ranging Rods / Poles

For ranging intermediate points along the line to be measured ranging rods and ranging poles are used.

ranging rods and ranging poles are made of hard wood. They are

→ These are 2 to 3m long and made of hard wood.

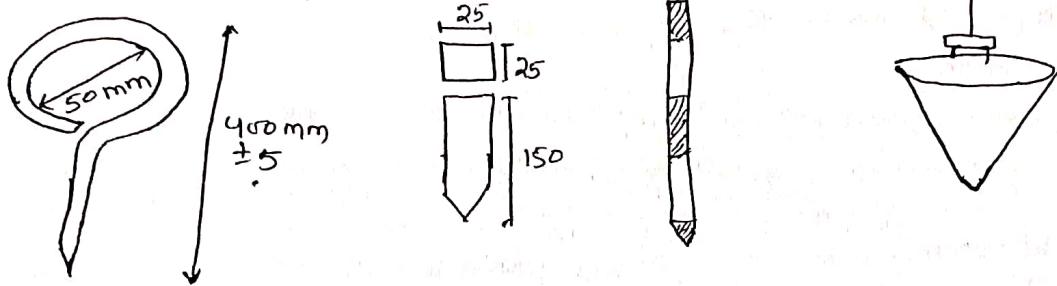
provided iron shoe at one end.

→ They are usually circular section with 30mm dia and are painted with 200 mm colour bands of black and white.

If the distance is more than 200m, for clear visibility they may be provided with multicolored flags at their top.

→ Ranging poles are similar to ranging rods except that they are longer. Their length varies from 4m to 8m & dia from 60mm to 100mm. They are made of hard wood or steel. They are fixed in the ground by making 0.5 m holes and then packed to keep them vertical.

Plumb Bob :- A typical plumb bob is shown in fig. In measuring horizontal distances along sloping ground plumb bobs are used to transfer the position to ground. They are also used to check the verticality of ranging poles. Generally they are used for centering work.



Classify different type of tapes.

Depending upon the materials used, they are classified as,

- (i) Cloth and Linen tape
- (ii) Metallic tape
- (iii) Steel tape
- (iv) Invar tape

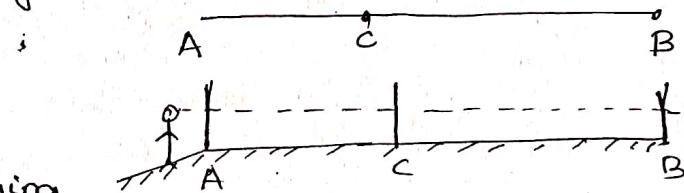
Q) Define ranging and what are the methods of ranging?

→ When a survey line is longer than a chain length, it is necessary to align intermediate points on chain line so that the measurements are along the line. The process of locating intermediate points on survey line is known as ranging.

→ There are two methods of ranging (i) Direct (ii) Reciprocal

Direct Ranging:- If the first and last points are intervisible this method is possible. The figure shows the intervisible stations A and B in which an intermediate point C is to be located. Point C is selected at a distance slightly less than a chain length.

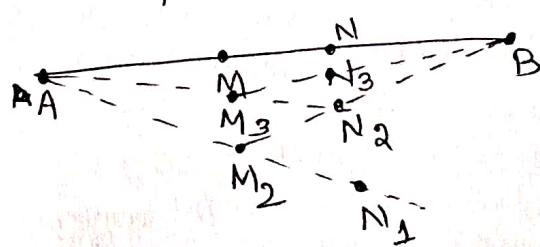
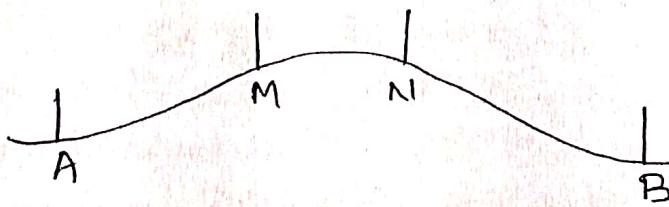
→ At points A & B ranging rods are fixed. The assistant holds another ranging rod near C. Surveyor positions himself approximately 2m behind station A and looking line AB directs the assistant to move at right angles to the line AB till he aligns the ranging rod along AB. Then surveyor instructs the assistant to mark that point and stretch the chain along AC.



Indirect or Reciprocal Ranging

→ Due to intervening ground, if the ranging rod at B is not visible from station A, reciprocal ranging may be used. The fig. shows the scheme of ranging. It needs two assistants one at point M and another at N, where from those points both station A and B are visible.

→ It needs one surveyor at A and another at B. To start with M and N are approximately selected, say  $M_1$  &  $N_1$ . The surveyor near end A directs person near M to position  $M_2$  such that  $AM_2N_1$  are in a line. Then surveyor at B directs the person at N to move  $N_2$  such that  $BN_2M_2$  are in a line. The process is repeated  $AMNB$  are in a line.



Q) Define leaders and followers in the chaining.

→ Two chain men are required for measuring the length of a line which is greater than a chain length. The more experienced of the chainmen remains at the zero end or rear end of the chain and is called as the leaders. The other chainmen holding the forward handle is known as the followers.

Q) How we use the chain and tape for measurement of current length of line.

→ If length of the chain used in measuring the length of the line is not equal to the true length, the measured length of the line will not be correct and suitable correction will have to be applied. If the chain is too long, the measured distance will be less and the error will be -ve and correction is +ve.

→ Similarly if chain is too short, the measured distance will be more. Hence the error will be +ve and the correction will be -ve.

Correction to measured length

$$\text{True length of line} = L = l' \left( \frac{l'}{L} \right)$$

$l'$  = measured length of line

$l'$  = incorrect length of the chain or tape

$L$  = true length of chain or tape.

Correction to the area

$$\text{True area} = \text{measured area} \times \left( \frac{l'}{L} \right)^2$$

Correction to the volume

$$\text{True Volume (V)} = \text{measured vol. (V')} \times \left( \frac{l'}{L} \right)^3$$

Q) The length of a line measured with 20m chain was found to be 500m. It was subsequently found that the chain was 0.04m too long. What is length of line?

Correct length of chain =  $L' = 20 + 0.04 = 20.04\text{ m}$

$$L = 20\text{ m} \quad l' = 500\text{ m}$$

$$\text{True length} = 500 \times \left( \frac{20.04}{20} \right) = 501\text{ m}$$

Q) The length of the survey line was measured with a 20 m chain was found to be equal to 1200m. The length was again measured with 25m chain and was found to be 1212m. On comparing the 20m chain with the test gauge it was found to be 1 decimeter too long. Find the actual length of the 25m chain used.

With 20m chain

$$l' = 1200$$

$$L' = 20.10 = 20 + 0.1\text{ m}$$

$$L = 20$$

$$L = 1200 \times \left( \frac{20.10}{20} \right)$$

$$= 1206\text{ m}$$

With 25m chain,

$$\text{measured length} = l' = 1212\text{ m}$$

$$\text{correct length} = L = 1206\text{ m}$$

$$\text{length of chain} = L = 25\text{ m}$$

$$L' = \frac{1212 \times 25}{1206} = 24.88\text{ m.}$$

Why we use compass surveying and write down different instrument for this surveying.

When large areas are involved it becomes essential to use some sort of instrument which are able to measure the angles and directions of the survey lines to be observed.

The instruments are,

(a) Instrument for direct measurement of dir<sup>n</sup>,

1) Surveyors compass

2) Prismatic Compass

(b) Instrument for measurement of angles

1) Theodolite

Q) Write down the principle of surveyor compass surveying.

The principle of compass surveying is traversing which involves a series of connected lines. The magnetic bearing of the lines are measured by prismatic compass and the distance of the lines are measured by chain. Compass surveying is not recommended for areas where local attraction is suspected due to presence of magnetic substance.

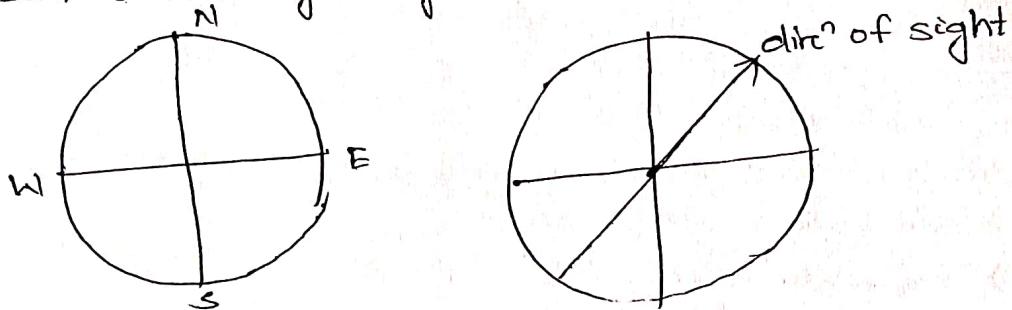
Q) Write a short note on prismatic compass.

It is one of the magnetic compass in which there is a prism for taking observations. The prismatic compass is generally smaller in size than a surveyor compass. The prismatic compass is used to determine the whole circle bearing of the lines. It consists of 1. Circular box, about 85 to 100mm in diameter. The box is made up of brass or a non metallic material. At the centre of the box there is a hard steel pivot which supports the magnetic needle. The needle used in a prismatic compass is made of iron. The box is fitted with a glass disc at its top. When the compass is not in use, the box is covered with the brass disc.

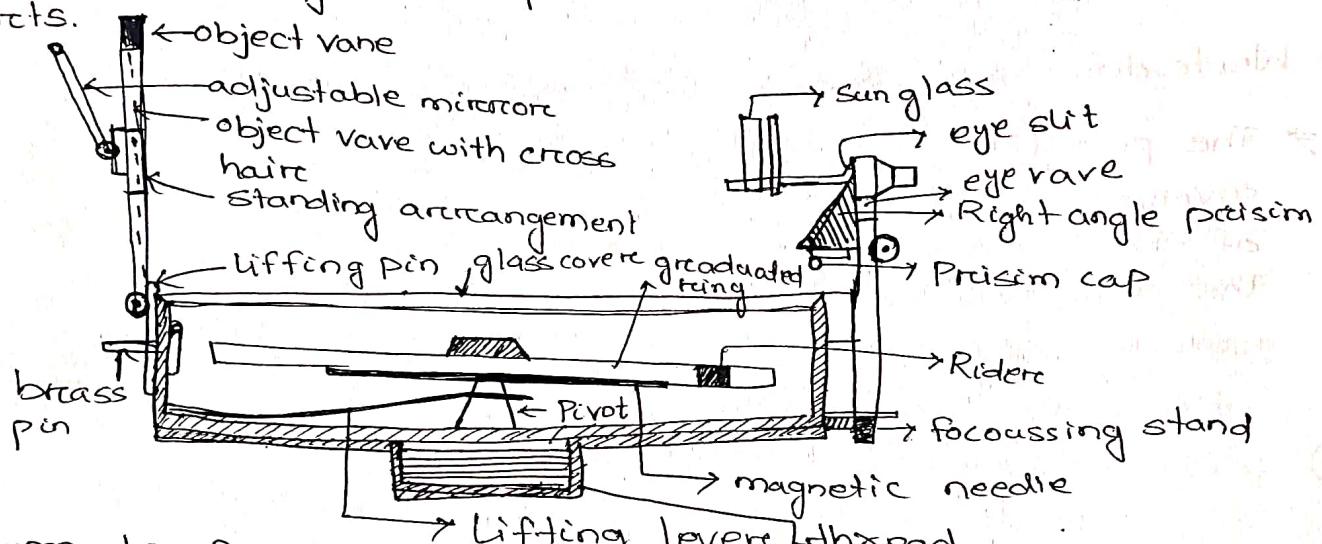
The prism when carried on a mounting frame which can be raised or lowered for focussing of the prism. The image of the graduations is viewed through a small circular aperture in the prism mounting. ~~The image of the graduation is viewed through a small circular aperture in the prism~~

Just above the aperture there is an narrow slit or a small V-cut used as an eyevane. The object vane consist of a metal frame hinged to the box. It has a vertical hair. The object vane is usually provided with a hinged mirror. So that the object which are either too low or high can be sighted by

sighted by folding the mirror. Dark coloured glasses are placed near the eye vane which can be interposed between the eye and the prism when sighting an illuminous object.



(Q) Draw the diagram of prismatic compass. Explain all its parts.



### Components of prismatic compass

1) Cylindrical Metal box :- (i) dia 8 cm to 12 cm  
 (ii) Protect the compass  
 (iii) Forms entire casing of the compass.

2) Pivot :- Centre of the compass  
 → Supports the magnetic needle over it.

### Lifting pin and lifting box :-

→ A lifting pin is provided just below the sight vane. When the sight vane is folded, it passes the lifting pin.

→ The lifting pin with the help of lifting lever lifts the magnetic needle out of pivot point to prevent damage to the pivot head.

3) Magnetic Needle :- (i) Magnetic needle is the heart of the instrument

(ii) This needle measures angle of a line from magnetic meridian as the needle always remains pointed towards north south pole of two ends of the needle when freely suspended on any support.

### Graduated circle or ring :-

→ This is an aluminium graduated ring with  $0^\circ$  to  $360^\circ$ .

→ It measures all possible bearing of lines, attached with the magnetic needle.

Prism :- Prism is used to read graduations on ring and to take exact reading by compass.

→ It is placed exactly opposite to object vane.

→ The prism hole is protected by prism cap to protect it from dust and moisture.

7) Object Vane :- Object vane is diametrically opposite to the prism and eye vane.

→ The object vane is carrying a horse hair or black thin wire to sight object in line with eye sight.

8) Eye Vane :- Eye vane is ~~is~~ a fine slit provided with the eye hole at bottom to bisect the object from slit.

9) Glass Cover :- It covers the instrument box from the top surface such that the graduated ring is seen from the top.

10) Sun glasses :- These are used when some luminous / bright object are to be bisected.

11) Reflecting Mirror → It is used to get image of an object located above or below the instrument level while bisection.

→ It is placed on the object vane.

12) Spring brake or break pin

→ To damp the oscillation of the needle before taking a reading and to bring it to rest quickly, the light spring brake attached to the box is brought with the edge of the ring by gently pressing inward the brake pin.

#### Use of prismatic compass

1) It is a small instrument which is held in the hand for observing and is these employed on the rougher classes of work.

2) The prismatic attachment consist of a  $45^\circ$  reflecting prism with the eye and reading faces made slightly convex so as to magnify the image of the graduations.

3) The prism is carried on a mounting which can be moved up and down between slides fixed on the outside of the case. The purpose of this up and down movement is to provide an adjustment for focusing.

4) The image of graduations is seen through a small circular aperture in the prism mounting, and immediately above this a vertical V-cut is viewed.

5) The ablong micrscope located in front of the forward vane slides

6) Two circular disc in front of the back vane are dark glasses

Q) Which can be swing in front of the vane.

Q) Write a short note on Local attraction & Magnetic Bearing.

### Local Attraction

A magnetic needle indicates the north direction when freely suspended. But if the needle comes near some magnetic substances such as iron ore, it is found to be deflected from its true direction, and does not show the actual north. This disturbing influence of the magnetic substance is called local attraction.

→ Measuring both the forward and the back bearing helps to detect local attraction.

### Magnetic Bearing

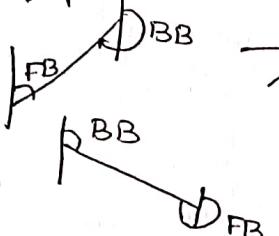
It is termed as a survey line makes angle with respect to the magnetic meridian.



↳ Whole Circle bearing (WCB)

↳ Quadrantal Bearing (QB)

↳ Fore bearing



↳ Back bearing

$$FB + BB = 180^\circ$$

$$FB > 180^\circ \quad BB = FB - 180^\circ$$

$$FB < 180^\circ \quad BB = FB + 180^\circ$$