

The Compass.

Traverse Survey :

Traversing is the type of survey in which a number of connected survey lines form framework and the directions & lengths of the survey line are measured with the help of an angle (or direction) measuring instrument and a tape (or chain) respectively.

- * When the lines form a circuit which ends at the starting point, it is known as a closed traverse.
- * If the circuit ends elsewhere, it is said to be an open traverse.

Units of angle Measurements

1) Sexagesimal System

$$\begin{aligned} 1 \text{ Circumference} &= 360^\circ \\ 1 \text{ degree} &= 60' \\ 1 \text{ Minute} &= 60'' \end{aligned}$$

2) Centesimal System

$$\begin{aligned} 1 \text{ Circumference} &= 400^g \text{ (Grads)} \\ 1 \text{ grad} &= 100^c \text{ (Centigrads)} \\ 1 \text{ Centigrad} &= 100^{cc} \text{ (Centi Centi grads)} \end{aligned}$$

3) Hour System

$$\begin{aligned} 1 \text{ Circumference} &= 24^h \\ 1 \text{ hour} &= 60^m \\ 1 \text{ Minute} &= 60^s \end{aligned}$$

* Bearings and Angles.

Angle : - An angle is the difference in direction of two intersecting lines

Bearing : - Bearing of a line is its direction relative to a given meridian

Meridian : - Meridian is any direction and act as a reference line for finding direction of a line, such as.

- 1) True Meridian
- 2) Magnetic Meridian
- 3) Arbitrary meridian

1) True Meridian :-

The meridian through a point is the line in which a plane passing that point and the north and south pole, intersects with surface of the earth.

- * It thus passes through the true north & south.
- * The direction of true meridian through a point can be established by astronomical observations.

2) True Bearing :-
True bearing of a line is the horizontal angle which it makes with the true meridian

3) Magnetic Meridian :-

Magnetic meridian through a point is the direction shown by a freely floating & balanced magnetic needle free from all other attractive forces.

- * Direction can be established with the help of magnetic compass.

Magnetic bearing :-

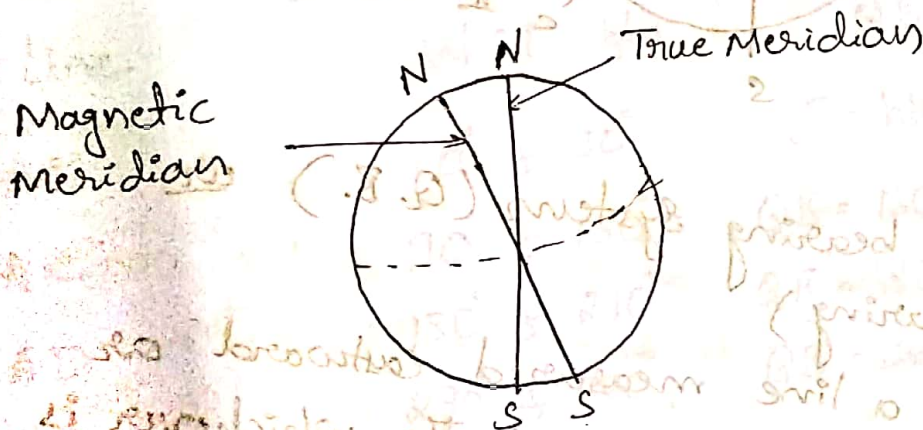
Magnetic bearing of a line is the horizontal angle which it makes with the magnetic meridian.

3) Arbitrary Meridian

It is any convenient direction towards a permanent & prominent mark or signal.

Arbitrary bearing :-

Arbitrary bearing of a line is the horizontal angle which it makes with any arbitrary meridian.



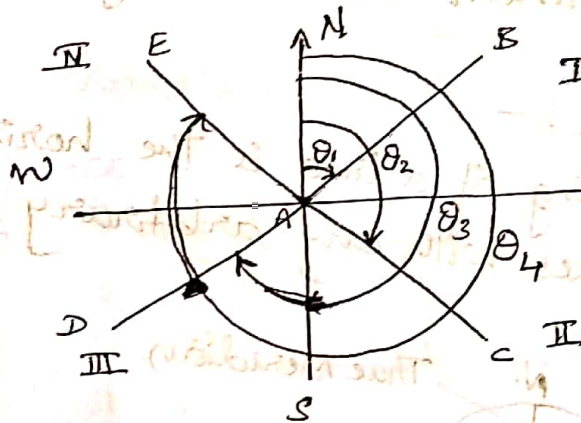
Designation of Bearings

The common systems of notation of bearings are

- The whole circle Bearing system (W.C.B.)
or Azimuthal system
- The Quadrantal bearing (Q.B.) system

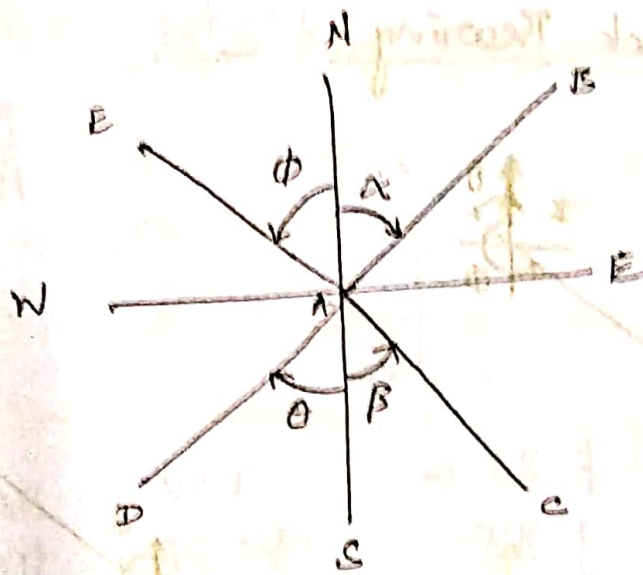
a) Whole Circle Bearing (W.C.B.) System

- * Bearing of a line is measured with magnetic north (or with south) in clockwise direction.
- * The value of bearings varies from 0° to 360° .
- * Prismatic compass is graduated in this system.



b) Quadrantal bearing system (Q.B.) or (Reduced bearing)

- * Bearing of a line measured eastward or westward from north or south, whichever is nearer.
- * Both north & south are used as reference meridian.
- * Directions can be either ~~positive or negative~~ clockwise or anticlockwise depending upon the position of the line.
- * Surveyor's compass is graduated in this system.
- * Q.B of the line varies from 0° to 90° .
- * This system is also known as Reduced Bearings (R.B.)



Q.B of line AB is α & it is written as N α E

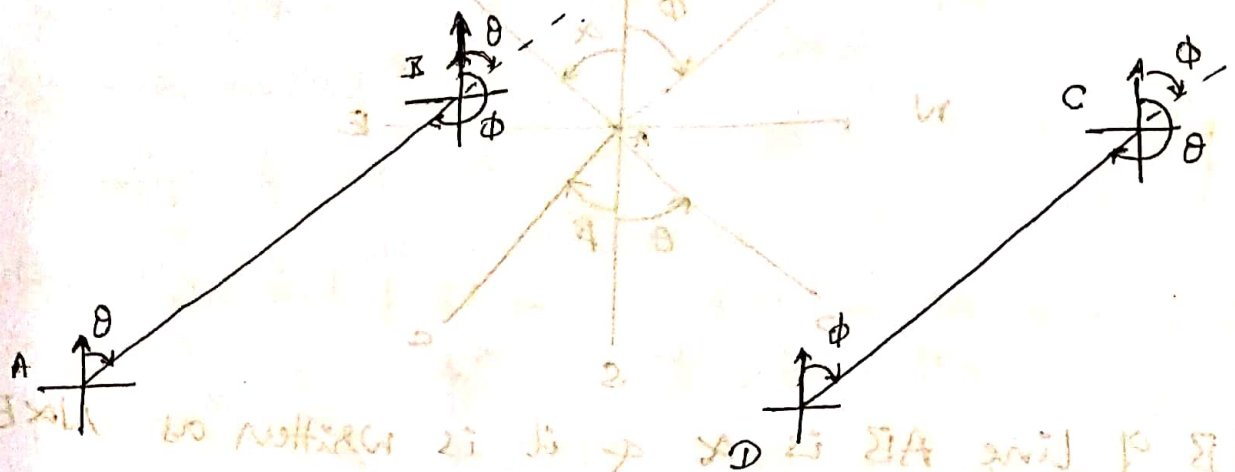
Conversion of Bearing from one system to another
Conversion of W.C.B into Q.B Quadrant

| Line | W.C.B b/w | Q.B | Quadrant |
|------|---------------------------|---------------------|----------|
| AB | 0° & 90° | $Q.B = W.C.B$ | NE (I) |
| AC | 90° & 180° | $Q.B = 180 - W.C.B$ | SE (II) |
| AD | 180° & 270° | $Q.B = W.C.B - 180$ | SW (III) |
| AE | 270° & 360° | $Q.B = 360 - W.C.B$ | NW (IV) |

conversion of Q.B into W.C.B

| Line | Q.B. | Rule for W.C.B. | W.C.B. between |
|------|--------------|----------------------|---------------------------|
| AB | N α E | $W.C.B = Q.B.$ | 0° & 90° |
| AC | S β E | $W.C.B = 180 - Q.B$ | 90° & 180° |
| AD | S γ W | $W.C.B = 180 + Q.B.$ | 180° & 270° |
| AE | N δ W | $W.C.B = 360 - Q.B$ | 270° & 360° |

Fore and Back Bearing: -



* Fore Bearing (F.B.) :- If bearing of a line AB is measured from A towards B, it is known as forward bearing / Fore bearing.

* Back bearing (B.B.) :- If bearing of a line AB is measured from B towards A, it is known as backward bearing / back bearing.

⇒ The F.B. of line AB = θ .

B.B. of line AB = ϕ .

$$\therefore \text{Here } \phi = 180^\circ + \theta$$

$$\therefore \rightarrow \text{BB} = 180^\circ + \text{FB}$$

⇒ F.B. of line CD = θ

BB of line CD = ϕ

$$\therefore \phi = \theta - 180^\circ$$

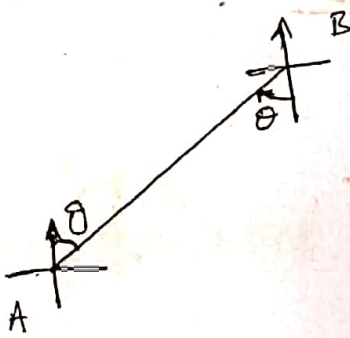
$$\text{BB} = \text{FB} - 180^\circ$$

Thus. It can be stated that

$$\boxed{\text{B.B.} = \text{F.B.} \pm 180^\circ}$$

For
W.C.B.
system

For Q.T.S. System



→ F.B. of Line AB = NθE

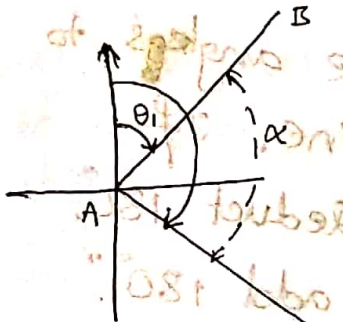
→ F.B. of line CD = SθW

B.B. of line AB = SθW

B.B. of line CD = NθE

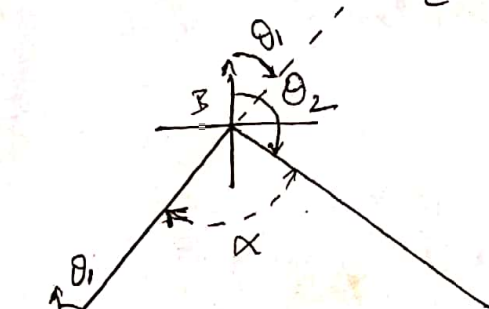
So, to convert F.B. to B.B. or B.B. to F.B. just change N to S & E to W. or vice versa

★ Calculation of angles from Bearing

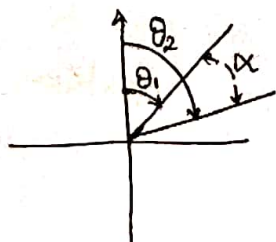


$$\alpha = \theta_2 - \theta_1$$

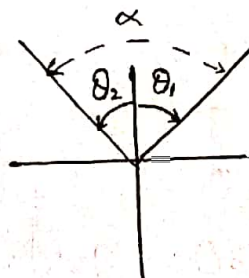
$$= \text{F.B. of AC} - \text{F.B. of AB}$$



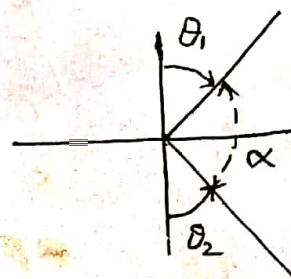
$$\alpha = 180 + \theta_1$$



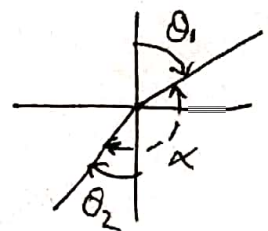
$$\alpha = \theta_2 - \theta_1$$



$$\alpha = \theta_1 + \theta_2$$



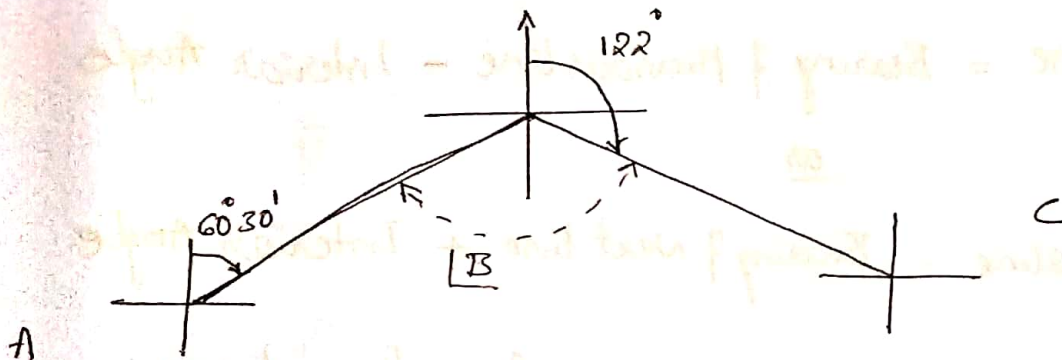
$$\alpha = 180 - (\theta_1 + \theta_2)$$



$$\alpha = 180 - (\theta_1 - \theta_2)$$

► Example :-

Case 1



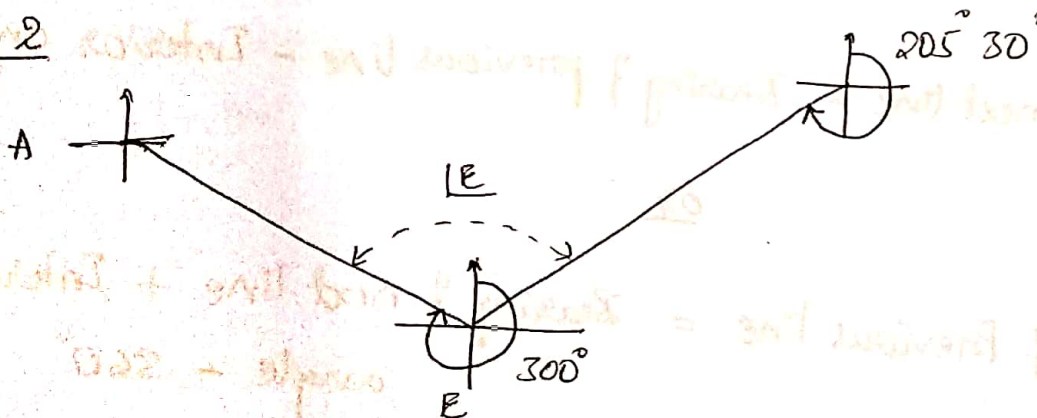
$$IB = \text{Bearing of } BA - \text{Bearing of } BC$$

$$= (60^\circ 30' + 180^\circ) - 122^\circ$$

$$= 118^\circ 30'$$

$$= 118^\circ 30'$$

Case 2



$$IE = (\text{Bearing of } ED - \text{Bearing of } EA) + 360^\circ$$

$$= [(205^\circ 30' - 180^\circ) - 300^\circ] + 360^\circ$$

$$= 85^\circ 30'$$

Adjustment of Prismatic compass

The following are the adjustments usually necessary in the prismatic compass.

(a) Station or Temporary Adjustments:

(i) Centring

(ii) Levelling

(iii) Focusing the prism.

(b) **Permanent Adjustments.** The permanent adjustments of prismatic compass are almost the same as that of the surveyor's compass except that there are no bubble tubes to be adjusted and the needle cannot be straightened. The sight vanes are generally not adjustable. (See the permanent adjustments of Surveyor's compass).

Temporary Adjustments

Temporary adjustments are those adjustments which have to be made at every set up of the instrument. They comprise the following:

(i) **Centring.** Centring is the process of keeping the instrument exactly over the station. Ordinary prismatic compass is not provided with fine centring device as is generally fitted to engineer's theodolite. The centring is invariably done by adjusting or manipulating the legs of the tripod. A plumb-bob may be used to judge the centring and if it is not available, it may be judged by dropping a pebble from the centre of the bottom of the instrument.

(ii) **Levelling.** If the instrument is a hand instrument, it must be held in hand in such a way that graduated disc is swinging freely and appears to be level as judged from the top edge of the case. Generally, a tripod is provided with ball and socket arrangement with the help of which the top of the box can be levelled.

(ii) **Focusing the Prism.** The prism attachment is slid up or down for focusing till the readings are seen to be sharp and clear.

THE SURVEYOR'S COMPASS

TABLES 5.3. DIFFERENCE BETWEEN SURVEYOR'S AND PRISMATIC COMPASS

| Item | Prismatic Compass | Surveyor's Compass |
|----------------------------|---|--|
| (1) <i>Magnetic Needle</i> | The needle is of 'broad needle' type. The needle does not act as index. | The needle is of 'edge bar' type. The needle acts as the index also. |
| (2) <i>Graduated Card</i> | <p>(i) The graduated card ring is attached with the needle. The ring does not rotate along with the line of sight.</p> <p>(ii) The graduations are in W.C.B. system, having 0° at South end, 90° at West, 180° at North and 270° at East.</p> <p>(iii) The graduations are engraved inverted.</p> | <p>(i) The graduated card is attached to the box and not to the needle. The card rotates along with the line of sight.</p> <p>(ii) The graduations are in Q.B. system, having 0° at N and S and 90° at East and West. East and West are interchanged.</p> <p>(iii) The graduations are engraved erect.</p> |
| (3) <i>Sighting Vanes</i> | <p>(i) The object vane consists of metal vane with a vertical hair.</p> <p>(ii) The eye vane consists of a small metal vane with slit.</p> | <p>(i) The object vane consists of a metal vane with a vertical hair.</p> <p>(ii) The eye vane consists of a metal vane with a fine slit.</p> |
| (4) <i>Reading</i> | <p>(i) The reading is taken with the help of a prism provided at the eye slit.</p> <p>(ii) Sighting and reading taking can be done simultaneously from one position of the observer.</p> | <p>(i) The reading is taken by directly seeing through the top of the glass.</p> <p>(ii) Sighting and reading taking cannot be done simultaneously from one position of the observer.</p> |
| (5) <i>Tripod</i> | Tripod may or may not be provided. The instrument can be used even by holding suitably in hand. | The instrument cannot be used without a tripod. |