

Compass

→ When large areas are involved, method of chain surveying alone are not sufficient and convenient. In such cases, it becomes essential to use some sort of instrument which enables angles or direction of survey line to be surveyed.

(a) Instrument for direct measurement of dirⁿ

- (i) Surveyor's compass
- (ii) Prismatic compass

Traverse Survey → Traversing is the type of survey in which a number of connected survey lines form the framework and the directions and length of survey lines are measured with the help of angle measuring instrument and a tape respectively.

→ When the lines form a circuit which end at the starting point, it is known as closed traverse.

→ If the circuit ends elsewhere, it is said to be an open traverse.

Bearing and Angles

If direction of a Survey line is established with relation to each other, give the angle b/w two lines.

and with relation to any meridian, will give bearing of the line.

→ Bearing of a line is Its direction relative to given meridian

1) True Meridian → True meridian through a point is the line in which a plane, passing that point and the north and South poles, Intersects with Surface of Earth.

True bearing → True bearing of a line is the Horizontal angle which it makes with the true meridian through one of the extremities of the line.

→ direction of true meridian through a point remain fixed.

② Magnetic meridian → ~~is the~~ through a point is the direction Shown by a freely floating and balanced magnetic needle free from all other attractive forces.

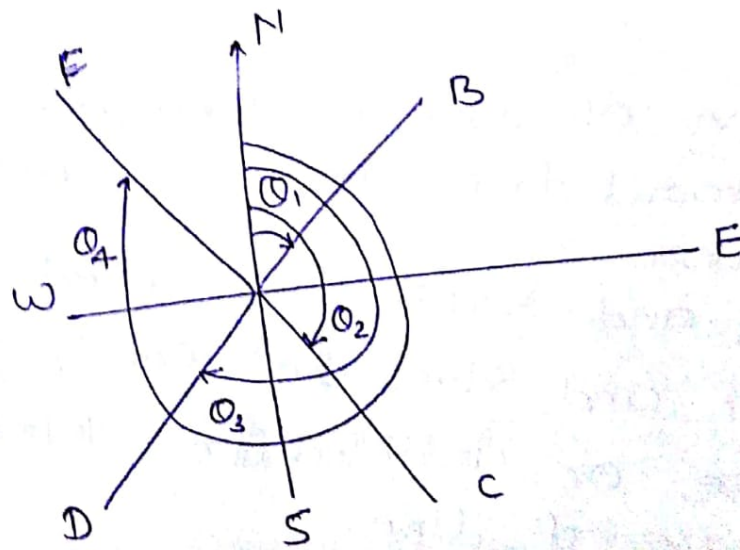
magnetic bearing

3) Arbitrary Bearing ^{meridian} $\rightarrow$ is any convenient direction toward a permanent and prominent mark or signal. Such as church spire or top of chimney

Arbitrary Bearing $\rightarrow$ is the Horizontal angle which it makes with any arbitrary meridian

Designation of Bearings

(a) Whole Circle Bearing System $\rightarrow$ (Azimuthal)

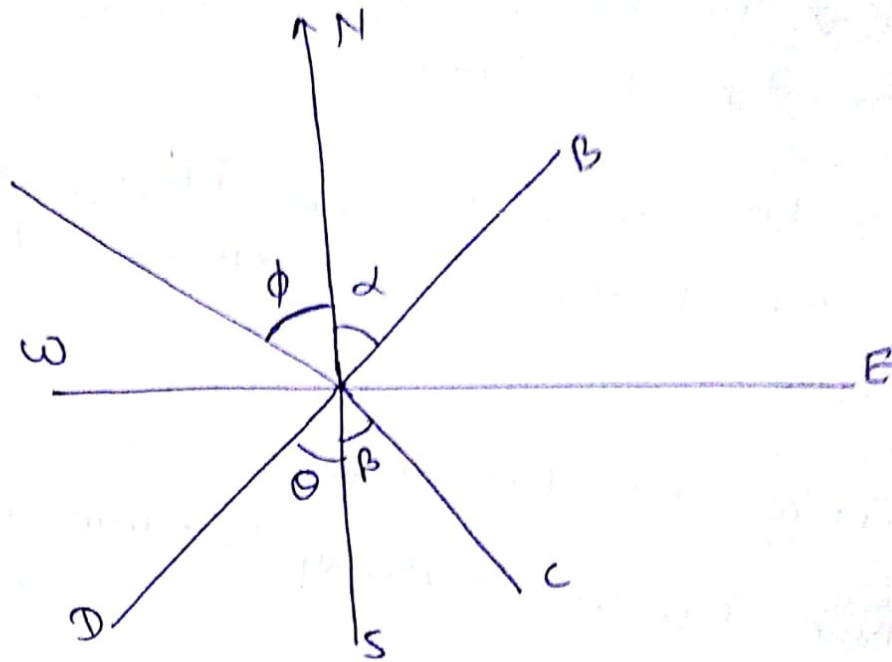


In this system, The bearing of a line is measured with magnetic north in Clockwise direction

$\rightarrow$ The value of bearing thus varies from 0° to 360°

$\rightarrow$ Prismatic compass is graduated on this system

(b) Quadrantal Bearing System (Reduced)



Bearing of line is measured eastward or westward from north or south whichever is nearer.

- North and South are used as reference meridian and the dirⁿ can be either Clockwise or anticlockwise depending upon the position of line.
- These bearing are observed by Surveyor's Compass.
- O.B. of line AB is α & is written as $N\alpha E$, the bearing being measured with reference to North meridian toward East.

Fore and Back Bearing



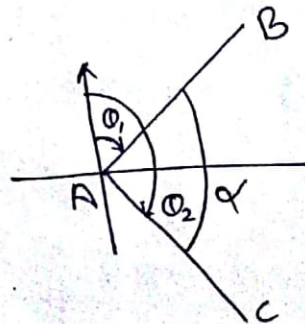
If the bearing of line AB is measured from A toward B, It is known as forward bearing. or Fore bearing (F.B). If the Bearing of the line AB is measured from B towards A, It is known as Back Bearing (B.B.)

→ Fore bearing of AB is θ .

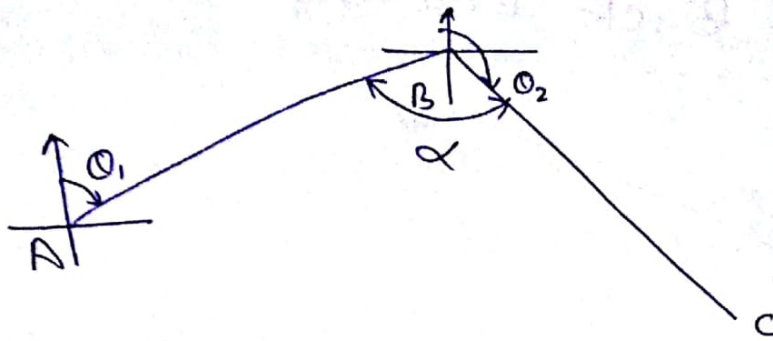
Back bearing = ϕ

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

Calculation of angles from bearing



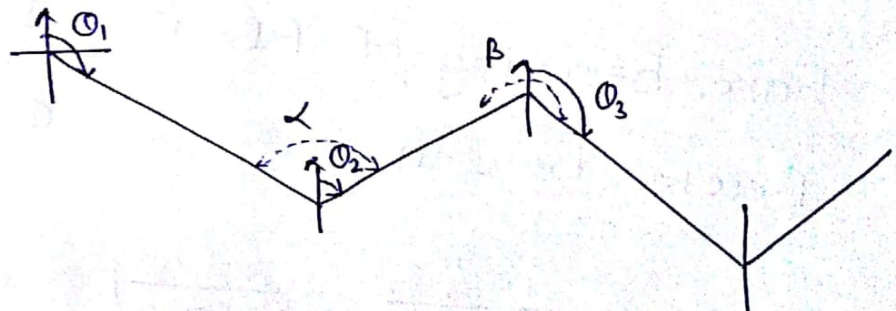
Knowing the bearing of two lines, the angle b/w the two can very easily be calculated.



Included angle α b/w the lines AC and AB = $\theta_2 - \theta_1$

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

Calculation of Bearing from angles



$$\theta_2 = \theta_1 + \alpha - 180^\circ$$

$$\theta_3 = \theta_2 + \beta - 180^\circ$$

Magnetic declination

Generally the magnetic meridian and true meridian at a place do not coincide with each-other. The Horizontal angle which the magnetic meridian makes with the true meridian is known as the magnetic declination.

- The declination changes from one place to the other. It also varies at same place from time to time.
- The Isogonic lines are the lines passing through the points on the earth's surface at which the declination is the same at a given time.
- Agonic lines are special Isogonic lines which pass through the points of zero declination.

Variation of magnetic declination

There are four types of magnetic declination at a place based on the pattern of these variations.

1. Secular Variation : Secular variation of declination occurs continuously over a long period of time.

For ex : Over a period of approximately 150 years there is a gradual shift in the earth's magnetic field in one direction. Thereafter declination

Shifts in the opposite direction for 150y
Hence cycle is completed in about 300 years

- The lines of equal annual change called Isopar.
- The annual rate of change of secular variation is generally b/w 5 to 10 mint.

2. Annual Variation

It is the change in the declination at a place over a period of 1 yr.

- It is caused because of rotation of earth about sun.

3. Diurnal Variation → It is the change in the declination at a place in 24 hr.

- It is because of the rotation of earth about its own axis.

4) Irregular Variation

Magnetic disturbance or magnetic storms in the earth's magnetic field cause the irregular variation of the declination at a place.

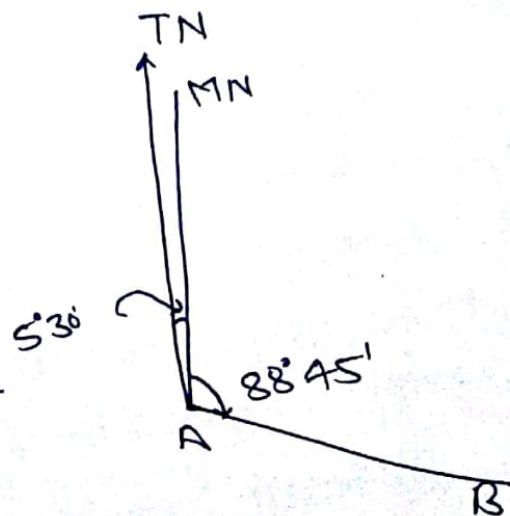
- Such variations are uncertain, unpredictable and random in nature.
- Natural phenomena, such as earthquakes, volcanic eruptions also cause irregular variation of declination.

Determination of true bearing from magnetic bearing

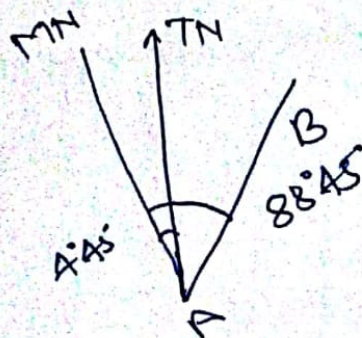
If the magnetic declination at a place at the time of observation is known, the true bearing of a line, say AB can be calculated from its magnetic bearing.

ex The magnetic bearing of a line AB is $88^{\circ}45'$. Determine the true bearing
If (a) magnetic declination is $5^{\circ}30'$ east
(b) Magnetic declination is $4^{\circ}45'$ W

Sol



$$\begin{aligned}\text{True bearing} &= 88^{\circ}45' + 5^{\circ}30' \\ &= 94^{\circ}15'\end{aligned}$$



$$\begin{aligned}\text{True bearing} &= 88^{\circ}45' - 4^{\circ}45' \\ &= 84^{\circ}\end{aligned}$$

Adjustment of Angles

In a closed traverse, the theoretical Sum of Internal Included angles should be equal to ~~24~~ $(2n-4) \times 90^\circ$.

Where n is Number of Sides of traverse

→ If the error in the sum of angles is within the permissible limit, the error should be distributed equally among the angles, provided all the angles are being measured with equal precision.

Local Attraction ÷ local Attraction is the attraction of the magnetic Needle to a local magnetic field other than earth's magnetic field.

→ local magnetic field is can be caused by Iron fences, Iron pipes, steel bars, Vehicles, Steel doors and window, wrist watch, pen, belt buckle.

→ Local Attraction at any station is detected by observing the fore and back bearing of the line.

- If the difference b/w them is 180° , both the end Stations are Considered to be free from local attraction.
- If the difference is Not 180° . i.e. local Attraction is present.