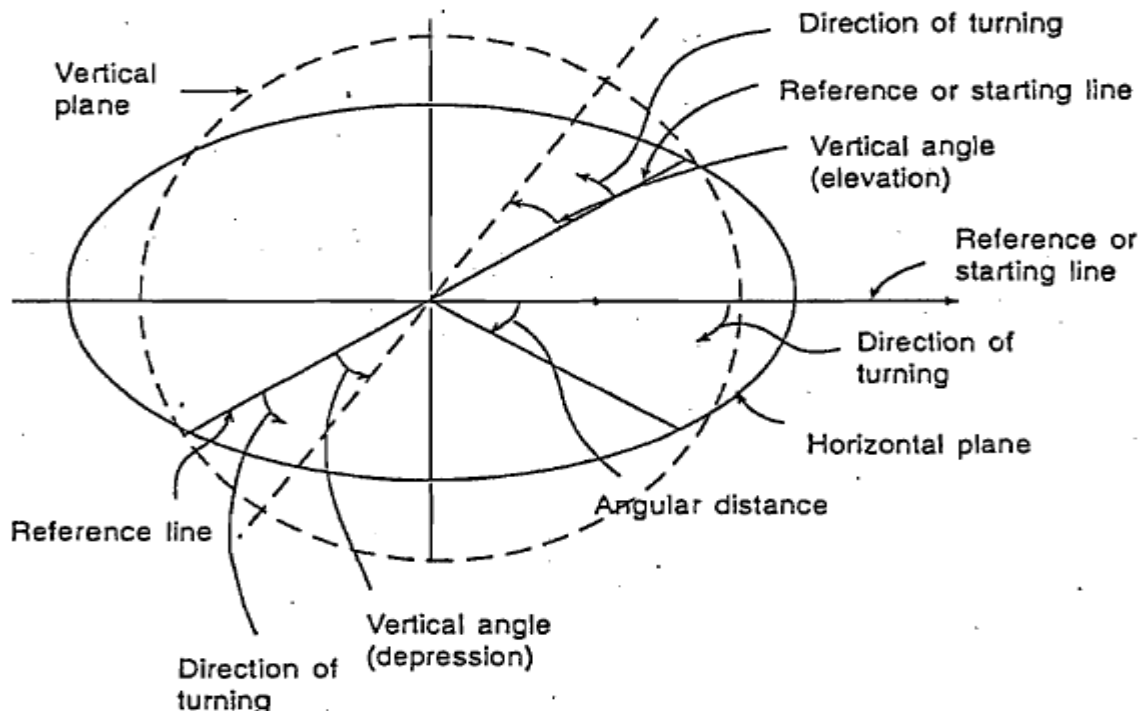


Computation technique of azimuth determination

Measurement of angles is basic to any survey operation. When an angle is measured in a horizontal plane it is horizontal angle, when measured in a vertical plane it is vertical angle. Angle measurements involve three steps:

- (i) Reference or starting line;
- (ii) Direction of turning;
- (iii) Angular value (Value of the angle).

These are shown in figure below



➤ ***DIRECTION OF A LINE***

Direction of a line is the horizontal angle from a reference line called the meridian.

There are four basic types of meridians:

1. ***Astronomic meridian***: It is an imaginary line on the earth's surface passing through the north-south geographical poles.

2. ***Magnetic meridian***: It is the direction of the vertical plane shown by a freely suspended magnetic needle.

3. ***Grid meridian*** A line through a point parallel to the central meridian or y-axis of a rectangular coordinate system:

4. ***Arbitrary meridian***: An arbitrary chosen line with a directional value assigned by the observer. These are explained graphically in the figure below:

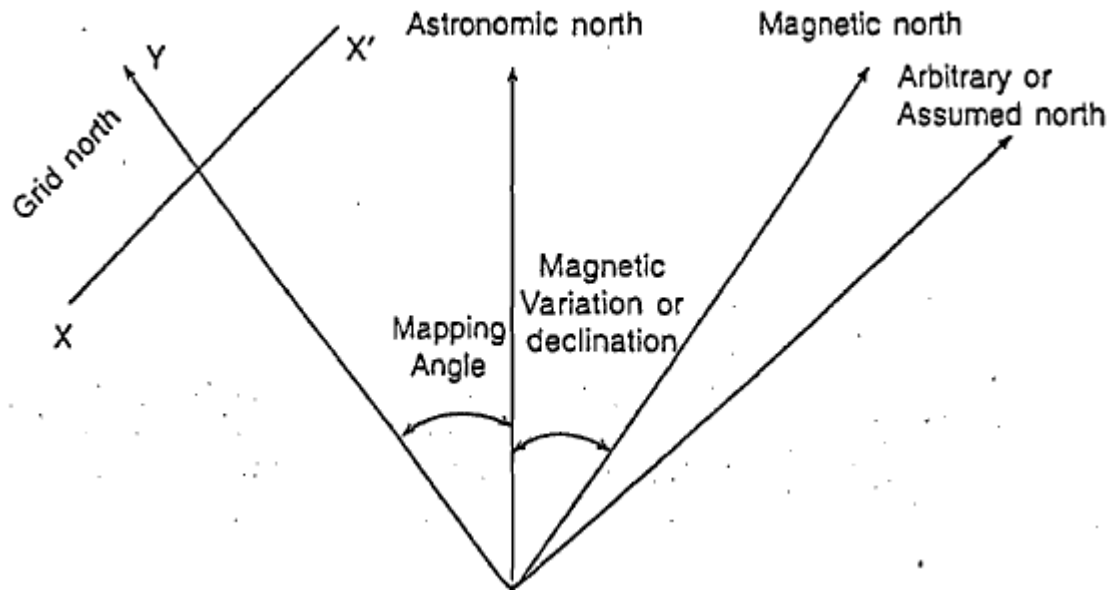


Fig. illustrate Different north directions.

Bearing

Bearing of a line is measured from the north or south terminus of a reference meridian. It is always less than 90° and is designated by the quadrant in which it lies as shown in Fig. below. From the figure it can be seen that

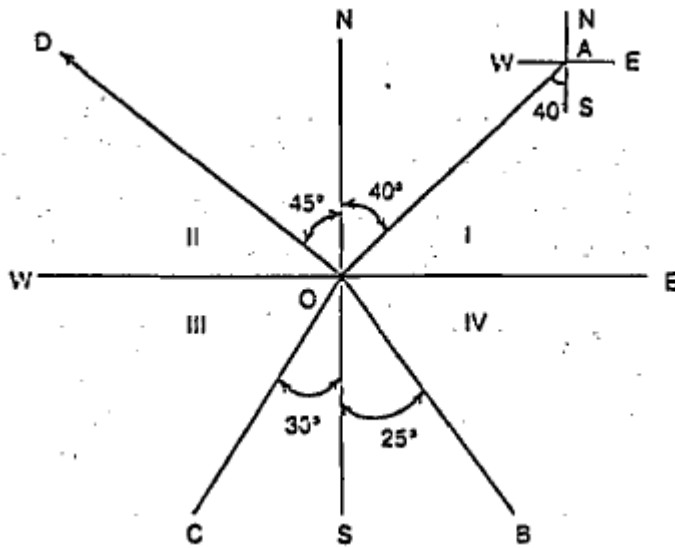
Bearing of

$$OA = N 40^\circ E$$

$$OB = S 25^\circ E$$

$$OC = S 30^\circ W$$

$$OD = N 45^\circ W$$



Since bearing is with reference to N-S line angles are measured clockwise in the 1st (NE) and 3rd (S.W) quadrants. It is measured anticlockwise in 2nd and 4th

Quadrants (NW and SE). When bearings are measured with reference to astronomic

or true meridian it is true bearing. If the bearing is from magnetic meridian, it is magnetic bearing and when from a grid it is grid bearing. If the instrument is set up at O and bearing of OA is taken it is forward bearing. But if the instrument

is set up at A and bearing of AO is taken it is forward bearing of AO but back bearing of OA. Hence back bearing of OA is S 40°W. Back bearings thus have the same numerical value but opposite letters.

AZIMUTHS

Azimuths are angles measured clockwise from any reference meridian. They are measured from the north and vary from 0° to 360° and do not require letters to identify their quadrant. Figure below shows the azimuths of different lines whose bearings are given in previous figure

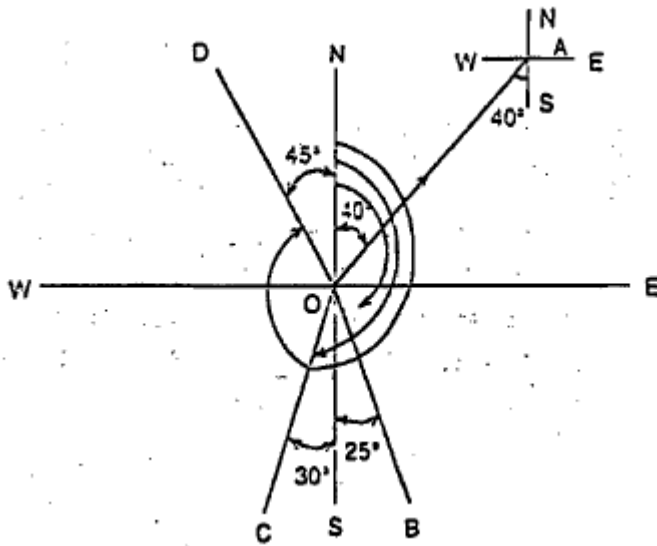


Fig. illustrate Azimuth or whole circle bearing

$$\text{Azimuth of } OA = 40^\circ$$

$$OB = 180^\circ - 25^\circ = 155^\circ$$

$$OC = 180^\circ + 30^\circ = 210^\circ$$

$$OD = 360^\circ - 45^\circ = 315^\circ$$

As stated before, forward azimuth of OA is 40° . The back azimuth of OA is forward azimuth of AO and from the figure it is clearly equal to $40^\circ + 180^\circ = 220^\circ$. Thus the forward azimuth and back azimuth differ by 180° . As before azimuths are true, magnetic, grid or assumed when they are measured with reference to true, magnetic, grid or assumed meridian respectively. From a study of the bearings and azimuths of the lines OA, OB, OC and OD, the following observations are made:

- (a) When a line is in the 1st quadrant the azimuth varies from 0 to 90° and azimuth and bearing of a line are the same (line OA).
- (b) When a line is in the 2nd quadrant the azimuth lies between 90° and 180° and it can be obtained from bearing by subtracting it from 180° (line OB).
- (c) When a line is in 3rd quadrant the azimuth lies between 180° and 270° and it can be obtained from bearing by adding 180° (line OC)
- (d) Finally, when a line is in the 4th quadrant, the azimuth is obtained by subtracting the bearing from 360° . The azimuth will lie between 270° and 360° (line OD).

To convert azimuth to bearing the following rules should be followed:

(a) When the azimuth is between 0° to 90° , it lies in 1st quadrant and the bearing is the same as azimuth with the symbols NE.

(b) Between 90° to 180° , the line lies in the 2nd quadrant and the bearing is obtained by subtracting azimuth from 180° with the symbols SE.

(c) Between 180° and 270° , the line lies in the 3rd quadrant and bearing is obtained by subtracting 180° from azimuth with symbols SW.

(d) Finally, in the 4th quadrant; azimuth is subtracted from 360° to get bearing with the symbols NW.

Usually azimuth is known as whole circle bearing and bearing is designated as quadrantal bearing or reduced bearing.

The following table comparison between Bearing and Azimuth

Point	Bearing	Azimuth
1. Angle	Varies from 0° to 90°	Varies from 0° to 360°
2. Designation	It always lies between any two of the four letters N, S, E and W	No letter is necessary
3. Measurement	(i) Both clockwise and anticlockwise measurement is necessary (ii) Measured from north and south	Measured always clockwise Measured only from north