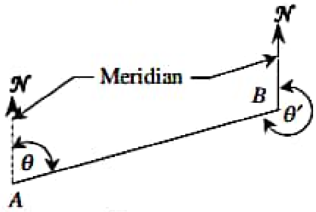
4.5 BEARING

Bearing is defined as the direction of any line with respect to a given meridian as shown in Fig. 4.6. If the bearing θ or θ' is measured clockwise from the north side of the meridian, it is known as the *whole-circle bearing* (W.C.B.).The angle θ is known as the *fore bearing* (F.B.) of the line *AB* and the angle θ' as the *back bearing* (B.B.). If θ and θ' are free from errors, $(\theta - \theta')$ is always equal to 180°.

The acute angle between the reference meridian and the line is known as the *reduced bearing* (R.B.) or *quadrantal bearing*. In Fig.   ie reduced bearings of the lines *OA*, *OB*, *OC*, and *OD* are Nθ_AE, Sθ_BE, Sθ_CW, and Nθ_DW, respectively.



Fig

4.6 DEPARTURE AND LATITUDE

The coordinates of points are defined as departure and latitude. The latitude is always measured parallel to the reference meridian and the departure perpendicular to the reference meridian. In Fig. .he departure and latitude of point *B* with respect to the preceding point *A*, are

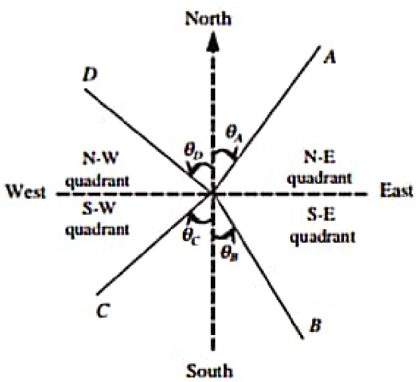
$$\text{Departure} = BC = l \sin \theta$$

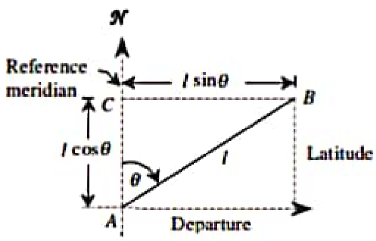
$$\text{Latitude} = AC = l \cos \theta.$$

where l is the length of the line *AB* and θ its bearing. The departure and latitude take the sign depending upon the quadrant in which the line lies. Table   gives the signs of departure and latitude.

	Quadrant			
	N-E	S-E	S-W	N-W
Departure	+	+	–	–
Latitude	+	–	–	+

Departure and latitude of a forward point with respect to the preceding point is known as the *consecutive coordinates*.





The coordinates (X, Y) given by the perpendicular distances from the two main axes are the eastings and northings, respectively, as shown in Fig. · The easting and northing for the points P and Q are $(E_P, N_P,)$ and $(E_P, N_P,)$, respectively. Thus the relative positions of the points are given by

$$\Delta E = E_Q - E_P$$

$$\Delta N = N_Q - N_P.$$

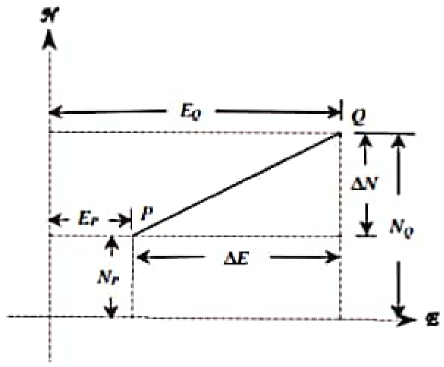


Fig.

.3 BALANCING THE TRAVERSE

In a closed traverse the following conditions must be satisfied:

$$\Sigma \text{ Departure} = \Sigma D = 0$$

$$\Sigma \text{ Latitude} = \Sigma L = 0$$

If the above conditions are not satisfied, the position A of the originating stations and its computed position A' will not be the same as shown in Fig. , due to the observational errors. The distance AA' between them is known as the *closing error*. The closing error is given by

$$e = \sqrt{(\Sigma D)^2 + (\Sigma L)^2}$$,

and its direction or reduced bearing is given by

$$\tan\theta = \frac{(\Sigma D)}{(\Sigma L)}.$$

The term *balancing* is generally applied to the operation of adjusting the closing error in a closed traverse by applying corrections to departures and latitudes to satisfy the conditions given by the Eq.

The following methods are generally used for balancing a traverse:

(a) *Bowditch's method* when the linear errors are proportional to $\sqrt{l}$ and angular errors are proportional to $1/\sqrt{l}$, where l is the length of the line. This rule can also be applied graphically when the angular measurements are of inferior accuracy such as in compass surveying. In this method the total error in departure and latitude is distributed in proportion to the length of the traverse line. Therefore,

$$c_D = \Sigma D \frac{l}{\Sigma l}$$

$$c_L = \Sigma L \frac{l}{\Sigma l}$$

where

c_D and c_L = the corrections to the departure and latitude of the line to which the correction is applied,

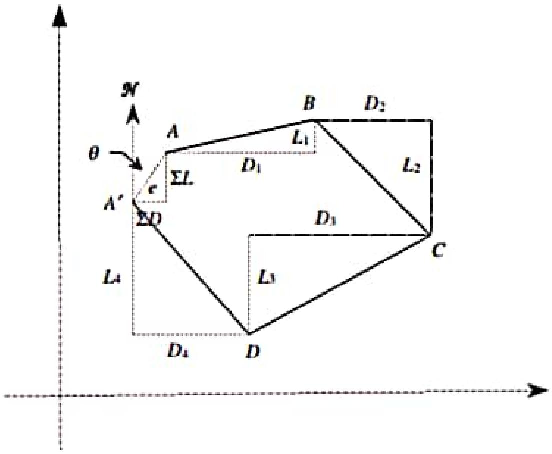
l = the length of the line, and

Σl = the sum of the lengths of all the lines of the traverse, i.e., perimeter p.

(b) *Transit rule* when the angular measurements are more precise than the linear measurements. By transit rule, we have

$$c_D = \Sigma D \frac{D}{D_T}$$

$$c_L = \Sigma L \frac{L}{L_T}$$



where

D and L = the departure and latitude of the line to which the correction is applied, and

D_T and L_T = the arithmetic sum of departures and latitudes all the lines of the traverse, (i.e., ignoring the algebraic signs).

OMITTED OBSERVATIONS

In a closed traverse if lengths and bearings of all the lines could not be measured due to certain reasons, the omitted or the missing measurements can be computed provided the number of such omissions is not more than two. In such cases, there can be no check on the accuracy of the field work nor can the traverse be balanced. It is because of the fact that all the errors are thrown into the computed values of the omitted observations.

The omitted quantities are computed using

$$\Sigma D = l_1 \sin \theta_1 + l_2 \sin \theta_2 + ... + l_n \sin \theta_n = 0$$

$$\Sigma L = l_1 \cos \theta_1 + l_2 \cos \theta_2 + ... + l_n \sin \theta_n = 0$$

It may be noted that

length of the traverse lines $l = \sqrt{D^2 + L^2}$

departure of the line $D = l \sin \theta$

latitude of the line $L = l \cos \theta$

bearing of the line $q = \tan^{-1}(D/L)$.

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