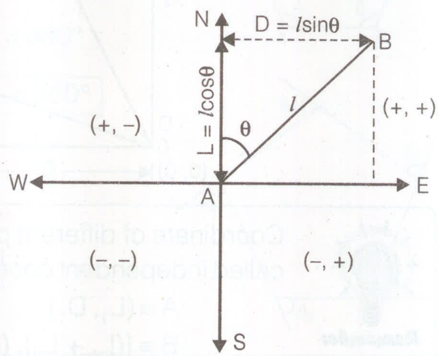
4. TRAVERSE SURVEYING

LATITUDE AND DEPARTURE

The latitude and departure of the line AB of length l and reduced bearing θ are given by

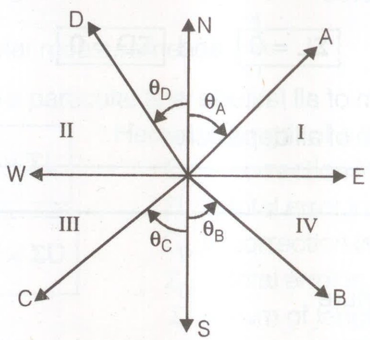
$$L = +l\cos\theta$$
$$D = +l\sin\theta$$



Latitude : Projection of a line on N-S direction is called latitude.

Departure : Projection of a line on E – W direction is called departure.

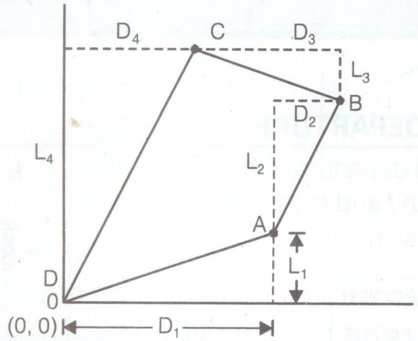
- **Latitude and departure in various quadrants**



Line	Reduced Bearing	Quadrants	Latitude	Departure
OA	$N\theta_AE$	I	$+l_1\cos\theta_A$	$+l_1\sin\theta_A$
OB	$S\theta_BE$	IV	$-l_2\cos\theta_B$	$+l_2\sin\theta_B$
OC	$S\theta_CW$	III	$-l_3\cos\theta_C$	$-l_3\sin\theta_C$
OD	$N\theta_DW$	II	$+l_4\cos\theta_D$	$-l_4\sin\theta_D$

Here, l_1, l_2, l_3, and l_4 are length of line OA, OB, OC and OD respectively.

INDEPENDENT COORDINATE



Remember

Coordinate of different point with respect to single origin is called independent coordinate.

$A \equiv (L_1, D_1)$

$B \equiv [(L_1 + L_2), (D_1 + D_2)]$

$C \equiv [(L_1 + L_2 + L_3), (D_1 + D_2 - D_3)]$

$D \equiv [(L_1 + L_2 + L_3 - L_4), (D_1 + D_2 - D_3 - D_4)] \sim (0, 0)$

For a closed Traverse

$$\boxed{\Sigma L = 0} \text{ and } \boxed{\Sigma D = 0}$$

where, ΣL = Sum of all latitude

ΣD = Sum of all departure

CLOSING ERROR

If sum of latitude,

$\Sigma L \neq 0$

and sum of departure

$\Sigma D \neq 0$

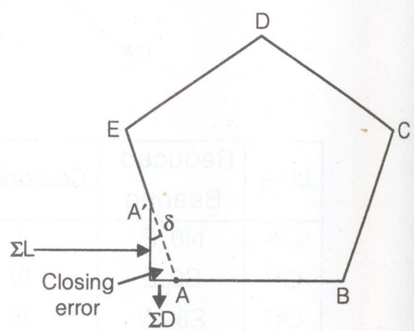
then there is a closing error

Closing error,

$$\boxed{e = AA' = \sqrt{(\Sigma L)^2 + (\Sigma D)^2}}$$

direction of closing error (δ)

$$\boxed{\delta = \tan^{-1}\left(\frac{\Sigma D}{\Sigma L}\right)}$$

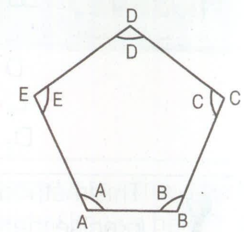


Remember The sign of ΣD and ΣL will thus define the quadrant in which the closing error lies.

ADJUSTMENT OF CLOSING ERROR

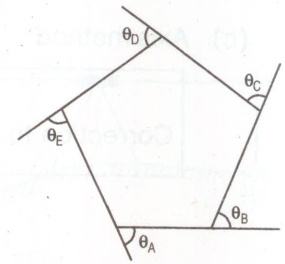
- Sum of all internal angles of a closed traverse $= (2n - 4) \times 90°$

  where n = no. of sides



- Sum of all deflection angles = 360°

  i.e. $\boxed{\theta_A + \theta_B + \theta_C + \theta_D + \theta_E = 360°}$



- Sum of latitude, $\boxed{\Sigma L = 0}$

  Sum of departure, $\boxed{\Sigma D = 0}$

BALANCING THE TRAVERSE

(a) Bowditch method

Error in linear measurement $\propto \sqrt{l}$

where l = length of a line

Error in angular measurement $\propto \frac{1}{\sqrt{l}}$

correction to a particular line

$$\boxed{C_L = \left(\frac{l}{\Sigma l}\right) \times \Sigma L}$$

$$\boxed{C_D = \left(\frac{l}{\Sigma l}\right) \times \Sigma D}$$

Here, l = length of a line,

C_L = correction in latitude of a line

ΣL = total error in latitude,

C_D = correction in departure of a line

Σ_D = total error in departure

Σl = sum of length of all lines

Remember This method is mostly used to balance a traverse where linear and angular measurements have been taken with equal precision.

(b) Transit method

Correction in latitude of all line, $\boxed{C_L = \left(\frac{L}{L_T}\right) \times \Sigma L}$

Correction in departure of a line, $\boxed{C_D = \left(\frac{D}{D_T}\right) \times \Sigma D}$

Here, ΣL = Total error in latitude

ΣD = total error in departure

L = latitude of a line

D = departure of a line

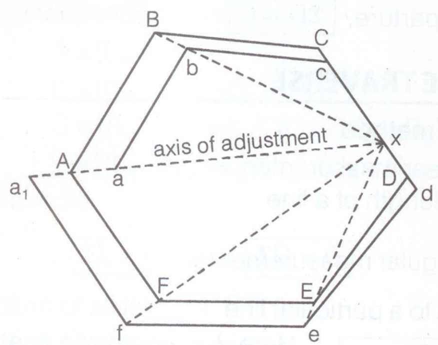
L_T = sum of all latitude without considering sign

D_T = Sum of all departure without considering sign.

> **Remember** This method is suitable where angular measurements are more precise than linear measurements.

(c) Axis method

$$\text{Correction to any length} = \text{that length} \times \frac{\frac{1}{2}\text{Closing error}}{\text{Length of axis}}$$



i.e. $$\text{Correction of } a_{1f}.\frac{\frac{1}{2}.a_a a}{aX}$$

> **Remember** This method is used where angles are measured very accurately, so correction are done in length of line only, bearing of lines are not changed.

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