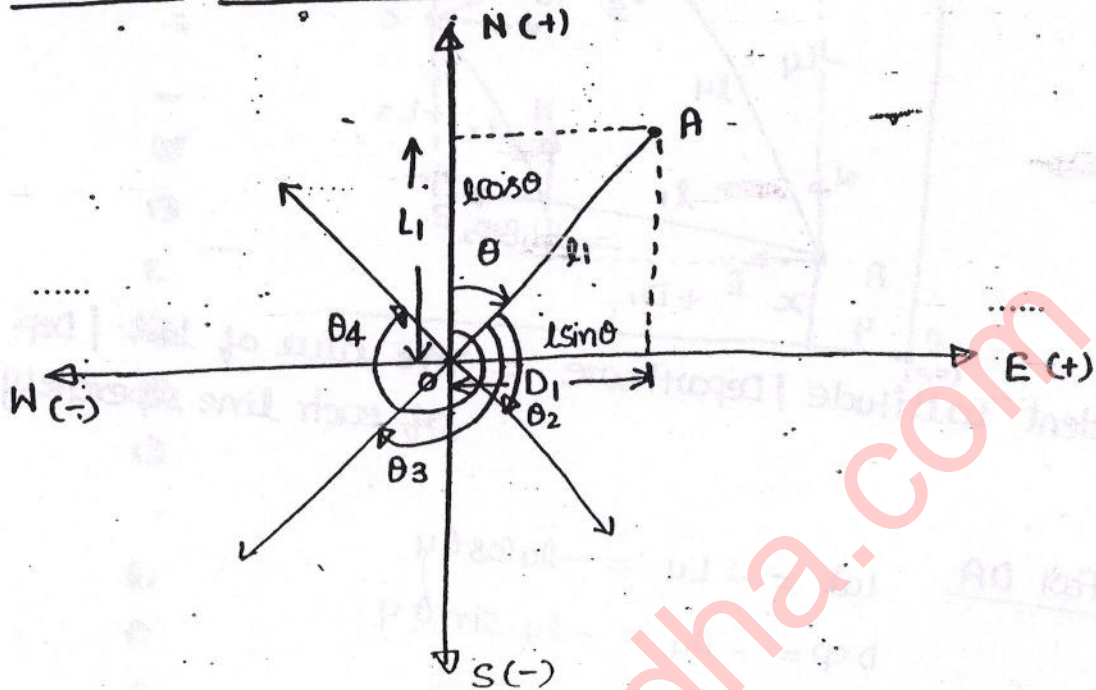


TRAVERSE SURVEY

Latitude and Departure :-



Latitude of a line is the projection on N-S line.

$$L = l \cos \theta$$

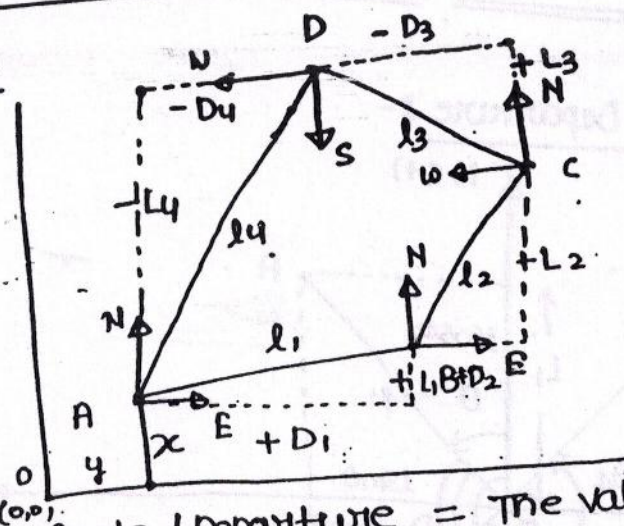
Departure : projection on E-W line.

$$D = l \sin \theta$$

WCB	QSB	Latitude	Departure
0 to 90°	N θ ₁ E	(+) $l \cos \theta$	(+) $l \sin \theta$
90 to 180°	S θ ₂ E	(-) $l \cos \theta$	(+) $l \sin \theta$
180° to 270°	S θ ₃ W	(-) $l \cos \theta$	(-) $l \sin \theta$
270° to 360°	N θ ₄ W	(+) $l \cos \theta$	(-) $l \sin \theta$

For a closed traverse :-

For ABCDA



Dependent Latitude / Departure = The value of lat. / Dep. of each line separately.

For DA

$$\text{Lat} = -L_4 = -l_4 \cos \theta_4$$

$$\text{Dep} = -D_4 = -l_4 \sin \theta_4$$

Independent Co-ordinate :-

→ Co-ordinate of different points with one fixed origin

Point	Lat.	Dep
A	x	y
B	$x + L_1$	$y + D_1$
C	$x + L_1 + L_2$	$y + D_1 + D_2$
D	$x + L_1 + L_2 + L_3$	$y + D_1 + D_2 - D_3$

For a closed Traverse :-

$$\sum \text{Lat} = 0$$

$$\sum \text{Dep} = 0$$

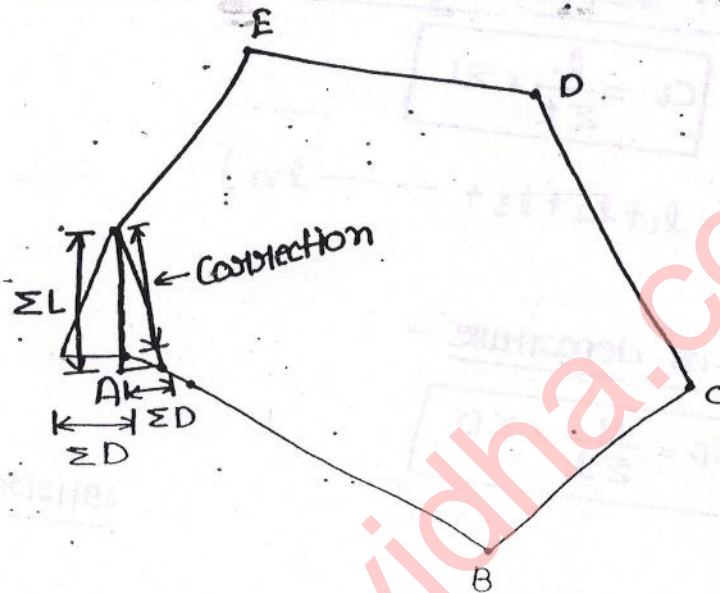
$$l_1 \cos \theta_1 + l_2 \cos \theta_2 + \dots = 0 \quad \text{--- (I)}$$

$$l_1 \sin \theta_1 + l_2 \sin \theta_2 + \dots = 0 \quad \text{--- (II)}$$

⊕ Closing Error :-

Sum of lat $\nabla \sum lat \neq 0$
 $\sum Dep \neq 0$

Then there are some errors in measurements.



⇒ The traverse drawn on the paper will not close at end.

Methods for correcting a closing error :-

- (1) Bowditch Method.
- (2) Transit Method.
- (3) Graphical method.
- (4) Axis method.

(i) Bowditch Method :- This method is used when linear and angular both measurements have been taken with equal degree of precision.

→ The corrections are based on length of different lines.

$\Sigma L =$ Total error in latitude.
(Adding all lat. with +/-)

$\Sigma D =$ Total error in departure.
(using +/- sign)

④ Correction in latitude of a line

$$CL = \frac{l_1}{\Sigma l} \times \Sigma L$$

$$(\Sigma l = l_1 + l_2 + l_3 + \dots + l_n)$$

④ Correction in departure

$$CD = \frac{l_1}{\Sigma l} \times \Sigma D$$

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(2) Transit Method :

→ This method is used when angular measurement are more accurate than linear measurement.

gfb,

$\Sigma L =$ Total error in latitude
(Adding with +/- sign)

$\Sigma D =$ Total error in departure
(Adding with +/- sign)

$L_T =$ Total sum of latitude (without sign, consider all +ve)

$D_T =$ Total sum of departure (without sign, consider all +ve)

Correction in Latitude of a line :

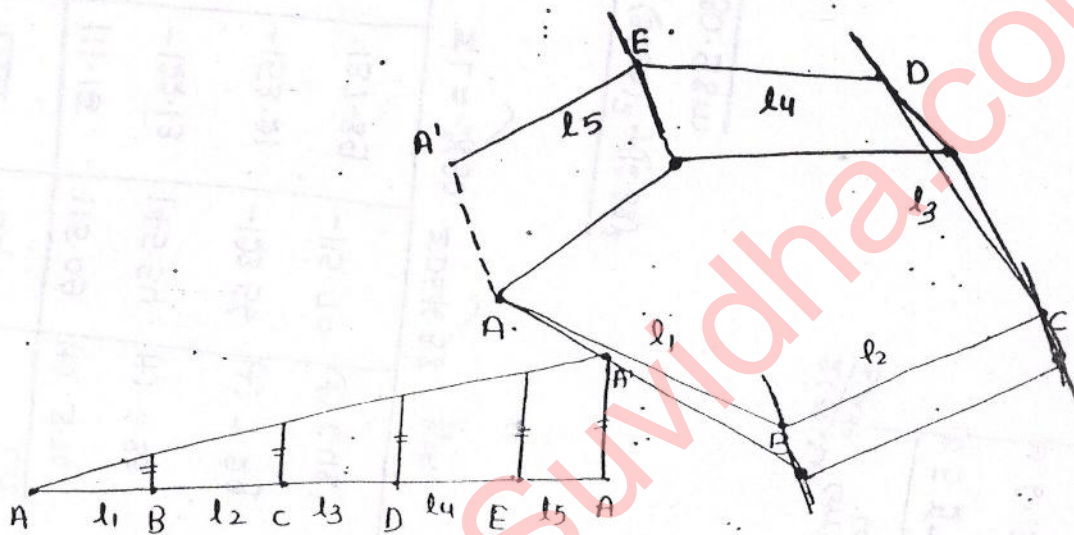
$$C_L = \frac{L_i}{L_T} \times \Sigma L$$

Correction in Departure of line :

$$C_D = \frac{D_i}{D_T} \times \Sigma D$$

(3) Graphical Method :-


→ It is based on bowditch method.



Ques: (1) A closed traverse has following length and bearing. Find out the closing error and correct the traverse for closing error by - (a) Bowditch Method (b) Transit method.

Line	length	Bearing
AB	160	46°
BC	190	130°
CD	200	220°
DA	180	320°

Line	Length	Bearing	Lat.	Dep.	Correction in Lat.	Correction in Dep.	Corrected Lat	Corrected Dep.
AB	160	46°	111.15	115.09	(+) 5.76	(-) 3.59	116.91 (111.15+5.76)	111.50
BC	190	130°	-122.13	145.54	(+) 6.85	(-) 4.26	-115.28	141.28
CD	200	220°	-153.21	-128.56	(+) 7.29	(-) 4.49	-146.0	-133.05
DA	180	320°	137.89	-115.70	(+) 6.48	(-) 4.02	144.37	-119.74
$\Sigma L = 730$			$\Sigma L = -26.30$	$\Sigma D = 16.38$	$\frac{1}{2} \times \Sigma L$	0	0	

ΣD

 closing error = $\sqrt{(26.30)^2 + (16.38)^2}$
 = 30.98m

$\frac{1}{\Sigma L} \times \Sigma L =$
 $\frac{1}{730} \times 730 = 1$

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Fast Transit Error \rightarrow
 $LT = 524.38$ (w/o sign)
 $LD = 504.89$ (w/o sign)

Correction in Lat	Correction in Dep	Corrected Lat	Corrected Dep.
(+) 5.76	(-) 3.74	116.72	118.36
(+) 6.126	(-) 4.72		
(+) 7.68	(-) 4.17		
(+) 6.92	(-) 3.75		
$\Sigma 26.30$			16.38

Ques (2) A closed traverse has following length and bearing Calculate missing values —

Line	Length	Bearing	Lat	Dep.
PQ	x	35°	$0.819x$	$0.57x$
QR	280	80°	48.62	215.75
RS	350	165°	-338.07	90.59
ST	y	238°	-0.53y	-0.85y
TP	275	310°	176.76	-28.66

$$\sum \text{Lat} = 0$$

$$0.819x - 0.53y - 112.69 = 0 \quad \text{--- (i)}$$

$$\sum \text{Dep} = 0$$

$$0.57x - 0.85y + 155.68 = 0 \quad \text{--- (ii)}$$

$$x = -452.47 \text{ m}$$

$$y = -486.57 \text{ m}$$

Ques : (3) A closed traverse has following length & bearing —

Line	Length	Bearing	Lat	Dep.
AB	240 m	86°	16.74	239.42
BC	x	43°	$0.73x$	$0.68x$
CD	140 m	310°	89.99	-107.25
DE	225 m	300°	112.5	-194.86
EF	160 m	θ	$160 \cos \theta$	$160 \sin \theta$
FA	200	165°	-193.185	51.76

$$26.045 - 10.132 - 10.93 + 160 \sin \theta + 0.68x$$

$$\Sigma \text{Lat} = 0$$

$$0.73x + 160 \cos \theta + 26.04 = 0 \quad \text{--- (I)}$$

$$\Sigma \text{Dep} = 0$$

$$0.68x + 160 \sin \theta - 10.93 = 0 \quad \text{--- (II)}$$

$$160 \cos \theta = -(26.04 + 0.73x)$$

$$160 \sin \theta = (10.93 - 0.68x)$$

$$\therefore \sin^2 \theta + \cos^2 \theta = 1$$

$$\therefore (160 \cos \theta)^2 + (160 \sin \theta)^2 = (0.73x + 26.04)^2 + (0.68x - 10.93)^2$$

$$160^2 = 0.99x^2 + 797.546 + 23.153x$$

$$\approx x^2$$

$$x = 79.77, -310.92$$

$$x = 146.31$$

$$\cos \theta = \frac{-0.73x - 26.04}{160}$$

$$= -0.830289$$

$$\sin \theta = \frac{-0.68x + 10.93}{160}$$

$$= (-) 0.55369$$

$$\tan \theta = \frac{0.55369}{0.830289} = 0.66687$$

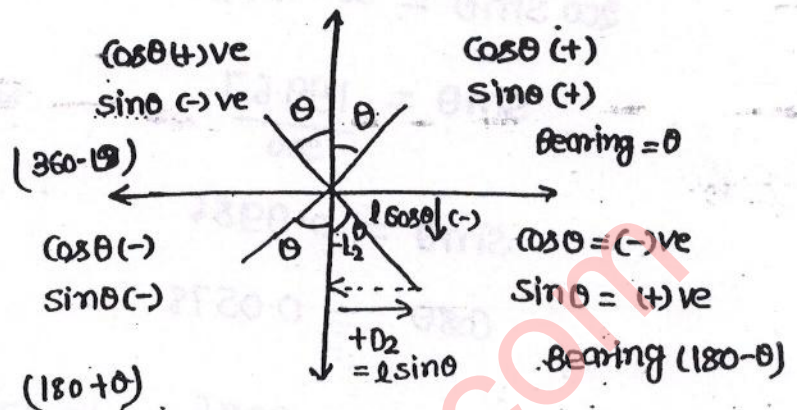
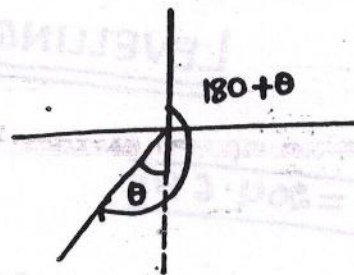
$$\theta = 33^\circ 41' 52''$$

Bearing of line

$$= 180 + \theta$$

$$= 180 + 33^\circ 41' 53''$$

$$= 213^\circ 41' 53''$$



Ques 1(c) A closed traverse as following length & bearings -
ES: 2000

Line	Length	Bearing	cos theta Lat	sin theta Dep.
AB	200	theta	$200 \cos \theta$	$200 \sin \theta$
BC	98	178°	-97.94	3.42
CD	x	270°	0	-x
DA	86.4	1°	86.38	1.51

$$\sum \text{Lat} = 0$$

$$\sum \text{Dep} = 0$$

$$200 \cos \theta - 11.56 = 0$$

$$200 \sin \theta - x + 4.93 = 0$$

$$\cos \theta = \frac{11.56}{200}$$

$$200 \sin \theta = x - 4.93$$

$$\cos \theta = 0.0578$$

$$(200 \sin \theta)^2 + (200 \cos \theta)^2 = (x - 4.93)^2 + (11.56)^2$$

$$(200)^2 = x^2 + 24.301 - 9.86x + 133.634$$

$$x^2 - 9.86x - 39842.065 = 0$$