1st NOV,
SATURDAY

COMPASS SURVEY

* Principle

Direction of a line can be measured

→ Types of Meridian

(i) True meridian

It is at a point a grade circle passing throug the geographical north and south pole of earth surface.

(ii) Magnetic meridian.

It is a direction shown by a magnetic north when it is freely suspended.

(iii) Grid meridian

It is a reference line established by state ~~governments in the middle of the state for their~~ ~~cross~~ projec in various departments.

(iv) Arbitary meridian.

It is a local reference point taken for measureme

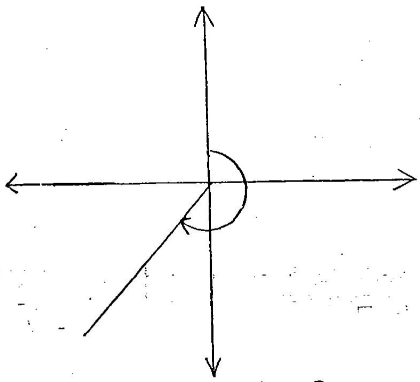
→ Bearing of a Line

It is the horizontal angle made by a line with any type of reference meridian.

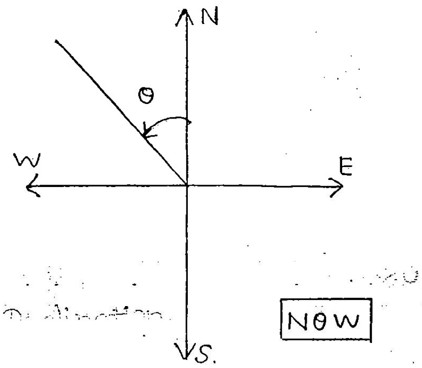
→ Systems of Bearing

1. Whole Circle Bearing (WCB) System (Azimuthal System)
2. Quadrantal (or) Reduced Bearing System.

Bearing of line will be measured wrt N or S whichever is nearer.

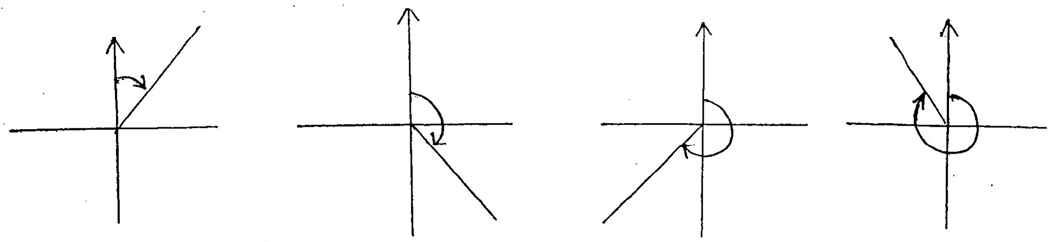


▫ WCB



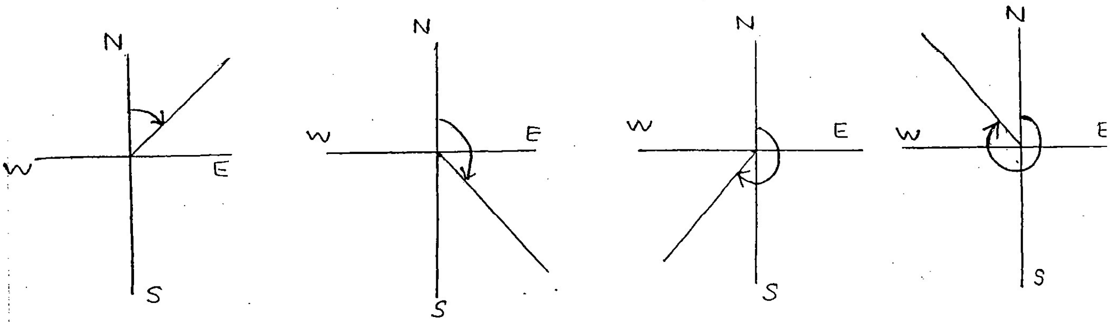
▫ QB or RB.

* Conversion of WCB into QB.



NθE   S(180−θ)E   S(θ−180)W   N(360−θ)W

* Conversion of QB into WCB.



θ   180−θ   180+θ   360−θ

→ Forebearing & Backbearing of a Line.

Forebearing of a line is the bearing of a line measured in the direction of progression of a survey.

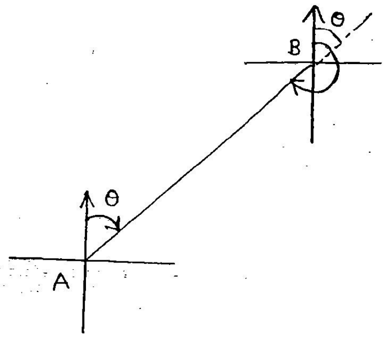
Back bearing of a line is the bearing of a line measured opposite to the direction of progression of survey.

- Backbearing of line AB

$= $ Bearing of line BA.

$= \theta + 180$

$= FB + 180$



$$\boxed{BB = FB \pm 180^\circ}$$

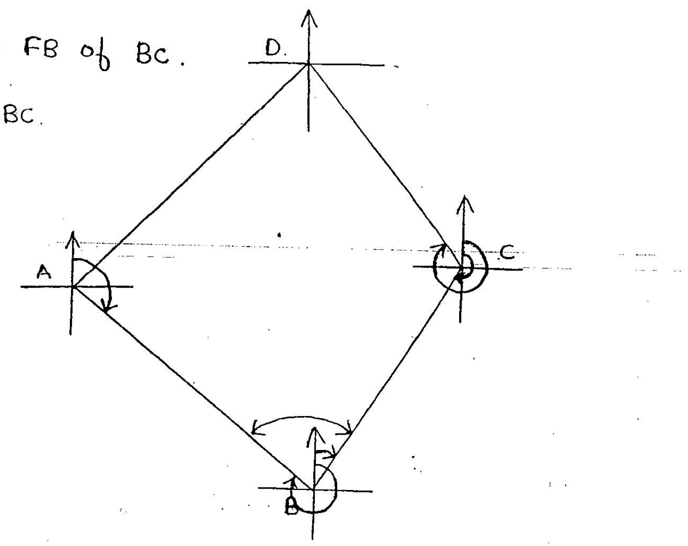
Use '+', if $FB < 180^\circ$

'−', if $FB > 180^\circ$

* Calculation of Interior Angles from given bearings.

$\angle B = (360 - BB \text{ of } AB) + FB \text{ of } BC.$

$\angle C = FB \text{ of } CD - BB \text{ of } BC.$

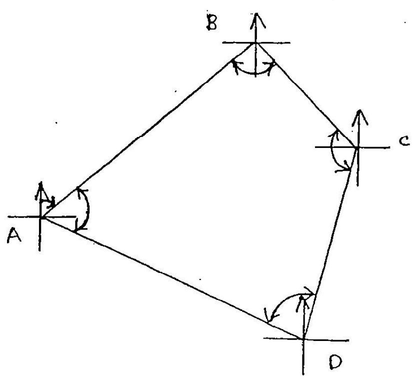


* Calculation of Bearings from given interior angles.

$(FB)_{BC} = (BB)_{AB} - \angle B.$

$360 - (FB)_{DA} + (BB)_{CD} = \angle D.$

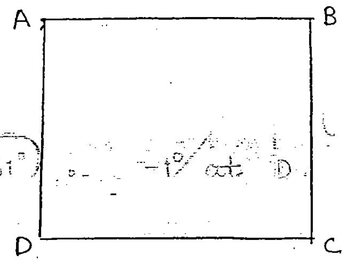
$(FB)_{DA} = 360 - \angle D + (BB)_{CD}.$



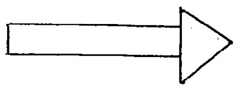
NOTE :

⊙ In a rectangle or square ABCD shown in fig,

- bearing of AB = bearing of DC.
- bearing of AD = bearing of BC



→ Differences b/w Prismatic Compass & Surveyor's Compass.

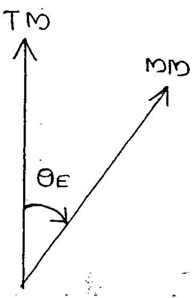
Prismatic Compass	Surveyor's Compass.
1. Broad type of magnetic needle. 	1. Edge bar type
2. Graduated cord ring is attached to the needle.	2. Graduated chord ring is attached to compass box.
3. Graduations marked are inverted.	3. Direct graduations are marked.
4. WCB system is followed. 0° at S, 180° at N, 90° at W, 270° at E	4. QB system is followed. 0° at N & S, 90° at E & W.

→ Temporary Adjustments.

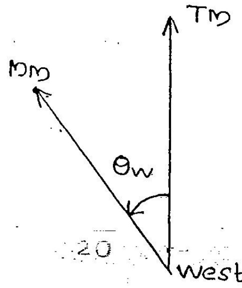
Centering, leveling & focussing the prism.

→ Magnetic Declination.

It is at the place, horizontal angle b/w true meridian and magnetic meridian shown by needle at the time of observation.



Eastern Declination.



Western Declination.

$$\boxed{TB = MB \pm \text{Declination.}}$$

Use +, if declination is towards east.
−, if declination is towards west.

$$\boxed{MB = TB \mp \text{Declination.}}$$

Use −, if eastern declination
+, if western declination

→ Diurnal Variation.

- calculated for 24 hours.
- Ranges b/w 3' to 12'

→ Annual Variation

- calculated for 365 day
- Ranges b/w 1' to 2'

→ Secular Variation

- calculated for 250 years.
- b/w 5' to 10' per year.

→ Irregular Variation.

- calculated during natural calamities, magnetic storm.
- observed as 2'

→ Isogonic Lines

It is a line joining the points of same declination.

→ Agonic Lines

It is a line joining points of ~~+~~zero declinati (when MM & TM coincides).

→ Dip.

Inclination of magnetic needle with horizontal.

Dip is zero at equator and 90° at S & N magnetic pole

NOTE :

- TB is also called as 'Azimuth'.
- TB of sun at noon (12.00 hrs) is 180°
- If longitude is greater than the standard meridian, the difference b/w them will be added to the standard time to get the local mean time.

2nd Nov, SUNDAY

→ Local Attraction:

It is the deviation of magnetic needle with the influence of magnetic attracted materials like fencing, steel materials etc

- Detection of local attraction:-

If the difference b/w FB & BB is not 180°, stations represented by that line are affected by local attraction.

- Connection for Local Attraction:-

a) For bearings

Q.

Line	FB	BB	Line	FB	BB.
AB	120° 30'	299°	CD	80°	261°
BC	140° 30'	320° 30'	DA	100° 30'	281°

Find the correction for bearings:

Ans.

Line	FB	BB	Correction
AB	120°30' 119°	299°	0° at B.
BC	140°30'	320°30'	0° at C.
CD	80°	261° → 260°	−1° at D.
DA	100°30' −1°	281°	−1°30' at A.

$99°30' + 180 = 279°30'$

$\{(BB)_{BC} - (FB)_{BC} = 180°$

∴ B & C are free from corrections.}

b) For Interior Angles.

Step 1:

Q. Calculate the interior angles at all stations from the given bearings

Step 2:

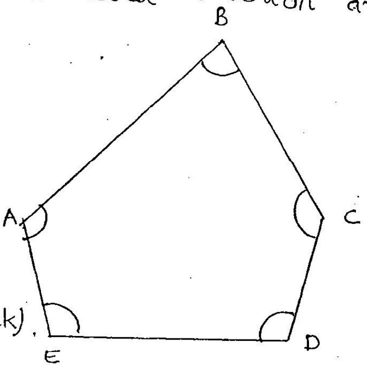
Check for a closed traverse, ie, sum of interior angles $= (2n-4)90$ where n is no. of sides in a closed traverse.

For exterior angles, check will be applied

Sum of exterior angles $= (2n+4)90$; for a closed traverse

Step 3:

If check is not verified, total correction obtained from the check verification, is distributed equally to all interior angles. and calculate corrected interior angles.



Sum of interior angles

$= 538°\ 30'$ (given).

Sum of interior angles

$= (2n-4)\,90$

$= (2\times5-4)\,90 = 540°$ (check).

Correction $= \dfrac{540 - 538°30'}{5} = 0°18'0''$

Step 4:

Calculate correct bearings of lines in a closed traverse by taking FB of first line (AB) as correct and the corrected interior angles.

NOTE:

If there is no line that is unaffected by local attraction, the line whose FB and BB differs least from 180°, find mean bearing of that line by distributing half the error to each of FB & BB.

P-29

01. MB = S 28°30' E

= 151° 30'

TB = MB ± Declination

= 151°30' + 5° 38' = 157° 08'

= $\underline{\underline{S\ 22°\ 52'\ E}}$

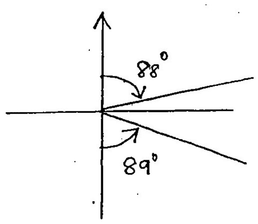
02 TB = 48° 24' + 5° 38' = $\underline{\underline{54°\ 02'}}$

03. Declination = 184° − 180°

= $\underline{\underline{4°\ W}}$

04. TB = 180 − 89 = 91°

Declination = $\underline{\underline{3°\ E}}$



05 True bearing = Azimuth = 260°

06. S10° W = 180 + 10 = 190° (in WCB).

08. MB < 180 (Sun in Eastern Hemisphere).

MB > 180 (Sun in Western Hemisphere.

09. If FB is given as N θ E, then BB is obtained as S θ W and vice versa.

$$FB = 225^\circ$$

$$BB = 225-180 = 45^\circ$$
$$= N\,45\,E$$

12 $\angle BAC = 120^\circ - 30^\circ = \underline{90^\circ}$

13 $\angle ABC = (BB)_{AB} - (FB)_{BC}$
$= (180+50) - 310 = \underline{80^\circ}$

14. $(FB)_{AB} = N\,70\,W$ $\quad (FB)_{BC} = N\,70^\circ\,W = 290$

$(BB)_{AB} = S\,70\,E = 110$

$\angle ABC = 290 - 110 = \underline{180^\circ}$

15. $(FB)_{AB} = N38E = 88^\circ$ $\quad (FB)_{BC} = S\,70\,E = 110.$

$(BB)_{AB} = 180+38 = 218^\circ$

$\angle ABC = 218-110 = \underline{108^\circ}$

17. $(FB)_{AB} = N\,30\,E = 30^\circ.$

$\angle ABC = 90^\circ.$ (Square).

$(FB)_{BC} = (BB)_{AB} - 90^\circ = 210-90 = 120^\circ = \underline{S\,60^\circ\,E}$

18. $(FB)_{AB} = 30^\circ$ $\quad (FB)_{BC} = 150$ $\quad (FB)_{CA} = 270$

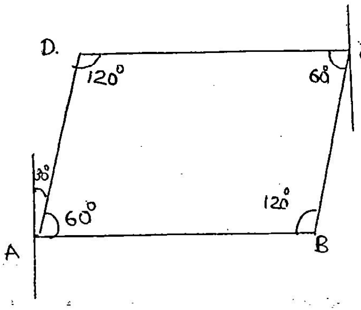
$(BB)_{AB} = 210$ $\quad (BB)_{BC} = 330$ $\quad (BB)_{CA} = 90$.

$\angle ABC = 210-150 = 60^\circ$ $\quad \angle BCA = 330-270 = 60^\circ$

$\angle CAB = 90-30 = \underline{60^\circ}$

$\Rightarrow$ equilateral triangle

20.



$(FB)_{AB} = 30^\circ$

$(BB)_{AB} = 210^\circ.$

$(FB)_{BC} = 210 - 120 = 90^\circ.$

$(BB)_{BC} = 210^\circ. = \underline{\underline{(FB)_{CD}}}$ 15

22. MB of AB $= 89^\circ + 1^\circ = 90^\circ$

MB of BA $= 360 - 90 = \underline{\underline{270^\circ}}$

23.

	FB	BB.
PQ	59°	235° 239°
QR	125°30' 129°30'	309°30'

For an open traverse, first reading is assumed as correct

$\angle PQR = (BB)_{PQ} - (FB)_{QR}$

$= 239 - 129^\circ 30' = \underline{\underline{109^\circ 30'}}$

24. MB $=$ S 45 E $= 135^\circ$

Declination $= 5^\circ$ w.

$TB = 135 \mp 5 = 140^\circ - 5 - 5 = 130^\circ.$

$\Rightarrow$ $\underline{\underline{S\,50^\circ E}}$.

25 TB = MB + declination − correction

$= 185 + 3.5 - 1.5 = \underline{\underline{187}}$

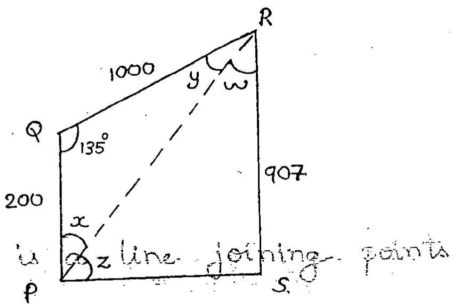
28.

Line	AB	BC	CD.	DA.
FB	120°30'	78°15'	300°30' +2°15'	210° 15' = 207° 45'
BB	300°30'	256° 258°15'	125° 15' (122°45')	12°45' = 27°40'

P-28

Q.51.

Line	Length (m)	Bearing (WCB)
PQ	200	0°
QR	1000	45°
RS	907	180°
SP	?	?



$$\angle PQR = (BB)_{PQ} - (FB)_{QR}$$

$$= (180+0) - 45 = 135^\circ$$

$$PR^2 = PQ^2 + QR^2 - 2PQ.QR\cos 135^\circ$$

$$= 200^2 + 1000^2 - 2\times 200\times 1000\cos 135^\circ$$

$$\Rightarrow PR = \underline{\underline{1150\text{ m}}}$$

Applying sine rule in ΔPQR,

$$\frac{\sin x}{1000} = \frac{\sin y}{200} = \frac{\sin 135}{1150}$$

$$\Rightarrow \sin x = \frac{1000\sin 135}{1150}$$

$$\therefore x = \underline{\underline{37.94^\circ}}$$

Similarly $y = 7.06^\circ$

$$\angle QRS = (BB)_{QR} - (FB)_{RS}$$

$$= (180+45) - 180 = \underline{\underline{45^\circ}}$$

$$\therefore y + w = 45^\circ$$

$$\text{or } w = 45 - 7.06 = \underline{\underline{37.94^\circ}}$$

$$SP^2 = PR^2 + RS^2 - 2PR.RS\cos 37.94^\circ$$

$$= 1150^2 + 907^2 - 2\times 1150\times 907\cos 37.94^\circ$$

$$\Rightarrow SP = \underline{\underline{707.06\text{ m}}}$$

Applying sine rule in ΔPRS

$$\frac{\sin z}{907} = \frac{\sin 37.94}{707.06}$$

$$\Rightarrow z = \underline{\underline{52.06^\circ}}$$

$\angle QPS = \cancel{(BB)_{QP} \mp (FB)_{PS}}$

$= 0 - (FB)_{PS}$

But $\angle QPS = x + z = 52.06 + 37.94 = \underline{\underline{90^\circ}}$

$\therefore \angle QPS = (FB)_{PS} = (BB)_{SP} = \underline{\underline{90^\circ}}$

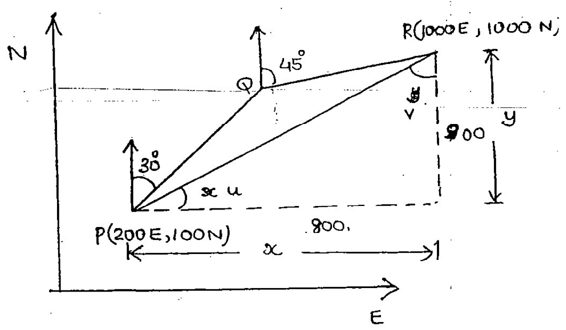
$(FB)_{SP} - (BB)_{SP} = 180^\circ$

$(FB)_{SP} = 180^\circ + 90^\circ = \underline{\underline{270^\circ}}$

52. Find lengths PQ & QR.

$x = 1000 - 200 = 800$

$y = 1000 - 100 = 900$



$\tan u = \frac{900}{800}$

$\therefore u = \tan^{-1}\left(\frac{9}{8}\right) = 48.36$

$\therefore V = 90 - u = 41.64$

$PR = \sqrt{x^2 + y^2} = \sqrt{800^2 + 900^2} = 1204.16$ m.

$30^\circ + u + \angle QPR = 90^\circ$

$\therefore \angle QPR = \underline{\underline{11.64^\circ}}$

$\angle PQR = (BB)_{PQ} - (FB)_{QR} = 210 - 45 = 165^\circ$

$\therefore \angle QRP = 180 - (11.64 + 165) = \underline{\underline{3.36^\circ}}$

Applying sine rule,

$$\frac{\sin 165}{PR} = \frac{\sin(3.36)}{PQ} = \frac{\sin(11.64)}{QR} \Rightarrow$$

$PQ = \frac{\sin 3.36}{\sin 165} \times PR = \underline{\underline{272.68 \text{ m}}}$

$QR = \frac{\sin 11.64}{\sin 165} \times PR = \underline{\underline{938.7 \text{ m}}}$

3) 24 hours $\longrightarrow$ 360°

1 hour $\longrightarrow$ 15°

Degree System	Hour System.
15°	1 hour
$15'$	1 min.
$15''$	1 sec.

Difference $= 90^\circ 40' - 82^\circ 30'$

$= \underline{\underline{8^\circ 10'}}$

$\frac{8^\circ}{15} \Rightarrow 0$ hour

$\frac{490'}{15} \Rightarrow 32$ min.

$\frac{10 \times 60}{15} \Rightarrow 40$ sec.

Local mean time = 6 hr 30 m 0s
0 hr 32 m 40s

$\underline{\underline{7\text{ hr } 02\text{m } 40\text{s}}}$

Q.

Line	FB	BB	
AB	$131^\circ 30'$ $126^\circ 45'$	$311^\circ 30'$ 308°	$3^\circ 30'$ @ B.
BC	$45^\circ 15'$ $48^\circ 45'$	$227^\circ 30'$	
CD	$340^\circ 30'$	$161^\circ 45'$	
DE	$258^\circ 30'$	$78^\circ 30'$	
EA.	$216^\circ 30'$	$31^\circ 45'$ $36^\circ 30'$	$+4^\circ 45'$ @ A.

After applying correction for local attraction, correct bearing of line BC = ?

$\Rightarrow (FB)_{BC} = \underline{\underline{48^\circ 45'}}$