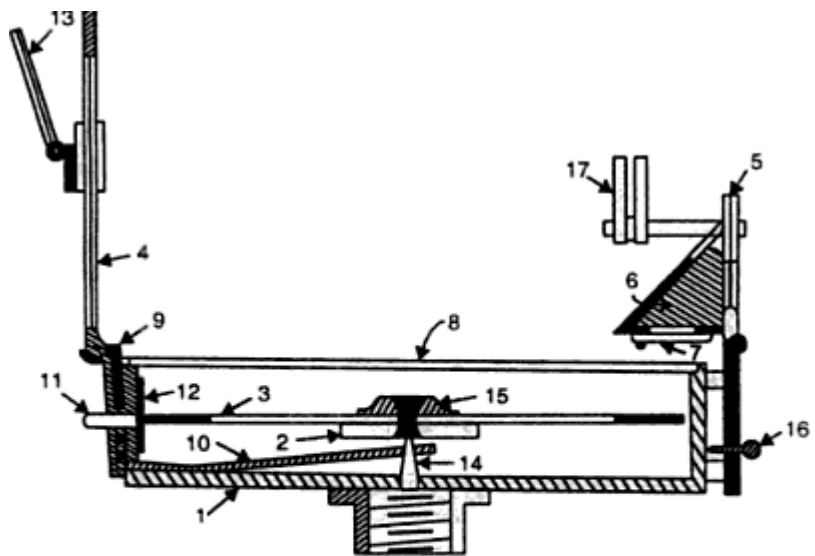


# Compass surveying

# Prismatic compass



- |                   |                   |                   |
|-------------------|-------------------|-------------------|
| 1. Box            | 7. Prism cap      | 13. Mirror        |
| 2. Needle         | 8. Glass cover    | 14. Pivot         |
| 3. Graduated ring | 9. Lifting pin    | 15. Agate cap     |
| 4. Object vane    | 10. Lifting lever | 16. Focusing stud |
| 5. Eye vane       | 11. Brake pin     | 17. Sun glass     |
| 6. Prism          | 12. Spring brake  |                   |

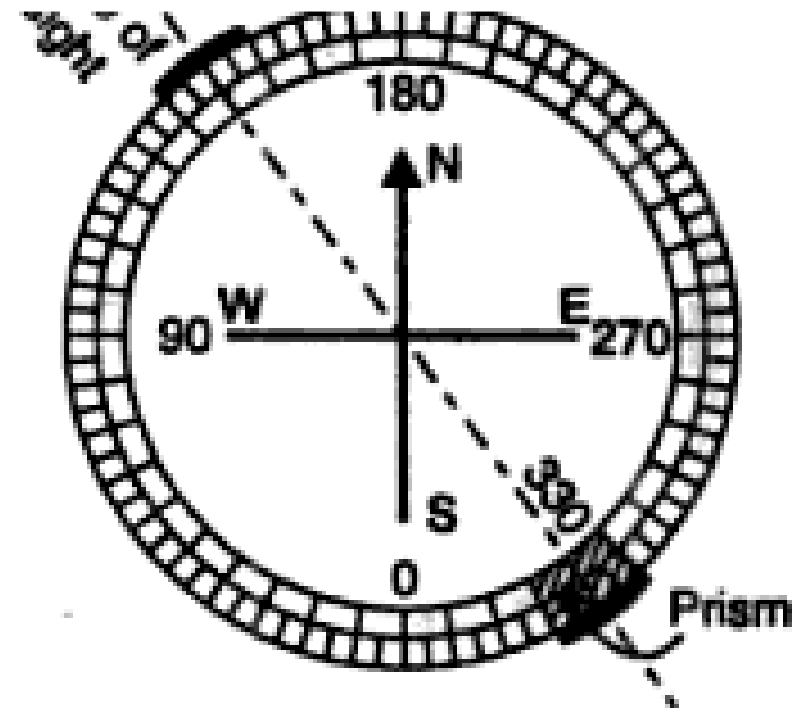
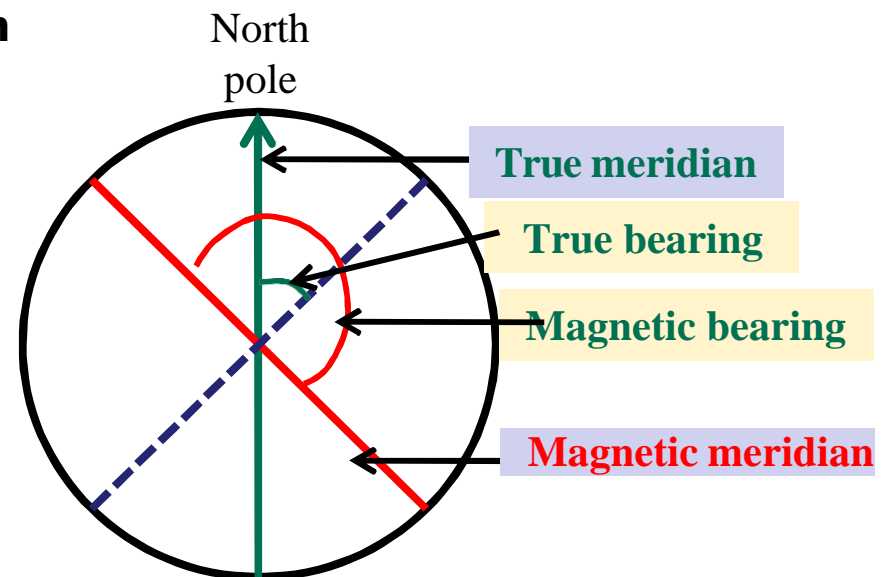


FIG. 5.12. THE PRISMATIC COMPASS.

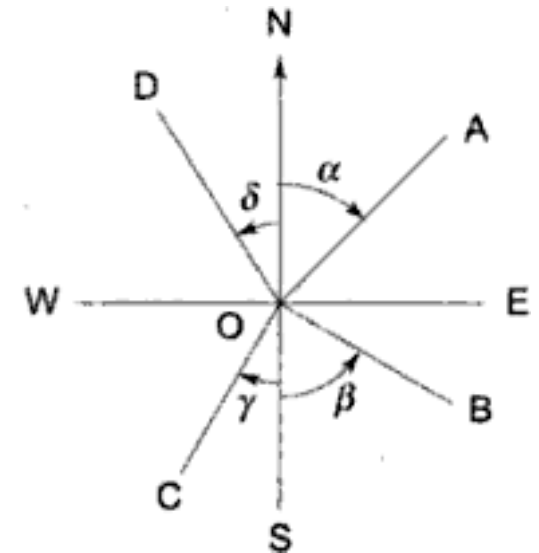
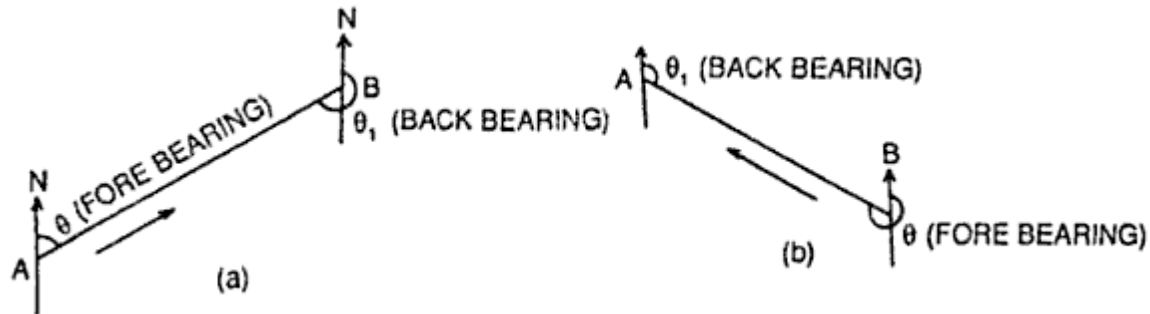
# Compass traversing: Important Definition

- **True meridian:** Line or plane passing through geographical north pole and geographical south pole
- **Magnetic meridian:** When the magnetic needle is suspended freely and balanced properly, unaffected by magnetic substances, it indicates a direction. This direction is known as magnetic meridian. The angle between the magnetic meridian and a line is known as magnetic bearing or simple bearing of the line.



- **Arbitrary meridian: Convenient direction is assumed as a meridian.**
- **Grid meridian: Sometimes for preparing a map some state agencies assume several lines parallel to the true meridian for a particular zone these lines are termed as grid meridian.**
- **Designation of magnetic bearing**
  - Whole circle bearing (WCB)
  - Quadrantal bearing (QB)
- WCB: The magnetic bearing of a line measured **clockwise from the North Pole** towards the line is known as WCB. Varies 0-360°

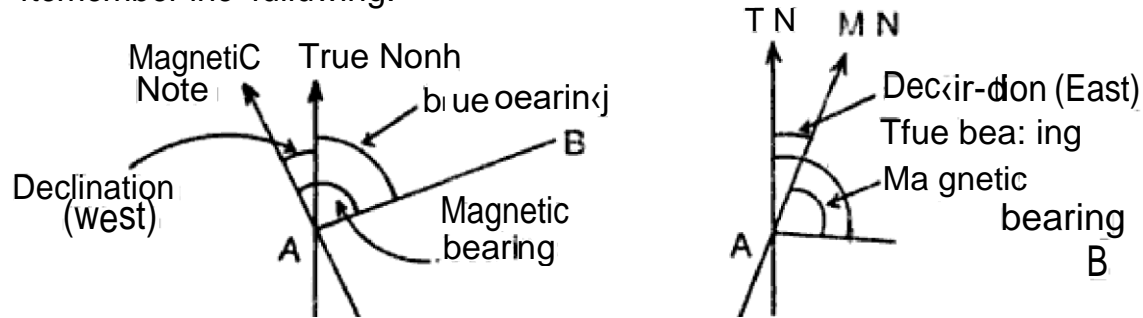
- **Quadrantal Bearing:** The magnetic bearing of a line measured clockwise or anticlockwise from NP or SP (whichever is nearer to the line) towards the east or west is known as QB. This system consists of 4-quadrants NE, SE, NW, SW. The values lie between 0-90°
  - QB of OA = N a E
- **Reduced Bearing:** When the whole circle bearing of a line is converted to quadrantal bearing it is termed as reduced bearing.
- **Fore and Back Bearing:**



- In WCB the difference between FB and BB should be exactly 180°
- $BB = FB \pm 180^\circ$
- Use the +ve sign when  $FB < 180^\circ$
- Use the -ve sign when  $FB > 180^\circ$

- **Magnetic declination:** The horizontal angle between the magnetic meridian and true meridian is known as magnetic declination.
  
- **Dip of the magnetic needle:** If the needle is perfectly balanced before magnetisation, it does not remain in the balanced position after it is magnetised. This is due to the magnetic influence of the earth. The needle is found to be inclined towards the pole. This **inclination of the needle with the horizontal** is known as dip of the magnetic needle.
  
- **Local Attraction**
- **Method of correction for traverse:**
  - **First method:** Sum of the interior angle should be equal to  $(2n-4) \times 90$ . if not than distribute the total error equally to all interior angles of the traverse. Then starting from unaffected line the bearings of all the lines are corrected using corrected interior angles.
  
  - **Second method:** Unaffected line is first detected. Then, commencing from the unaffected line, the bearing of other affected lines are corrected by finding the amount of correction at each station.

ftcmcmbr ihc fullwing:



Dctc mination of true bevinp and miignelic bearing:

(a) True bearing = magnetic bearing + declination

Note Use the positive sign when declination is east and the negative sign when declination is west

(b) Magnetic bearing = true bearing - declination

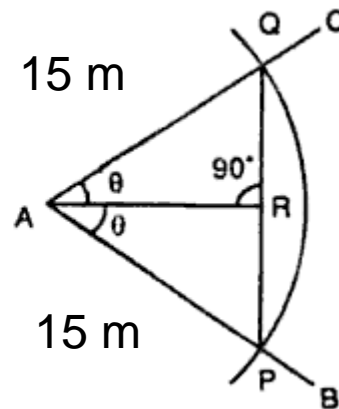
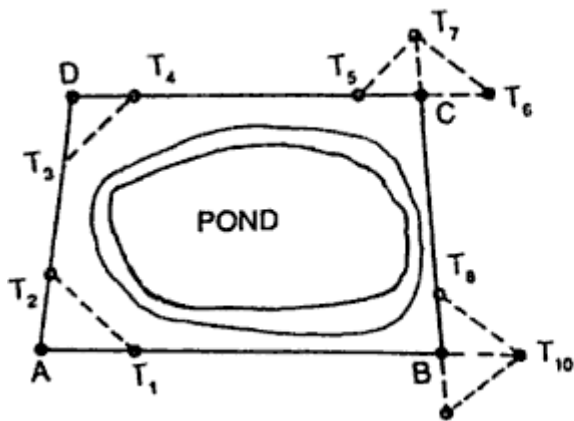
Note Use the positive sign when declination is west and the negative sign when declination is east

# PRINCIPLE OF COMPASS SURVEYING



# Methods of traversing

- **Chain traversing:**



Let  $\angle PAR = \theta$

Then  $\angle BAC = 2\theta$

Here  $AP = AQ = 15 \text{ m}$

In triangle PAR,

$$\sin \theta = \frac{PR}{AP} = \frac{2PR}{2AP} = \frac{PQ}{30}$$

$$\therefore \theta = \sin^{-1} \frac{PQ}{30}$$

- **Compass traversing:** Fore bearings and back bearings between the traverse leg are measured
- **Theodolite traversing:** Horizontal angles between the traverse legs are measured. The length of the traverse legs are measured by chain/tape or by stadia method
- **Plane table traversing:** Plane table is set at every traverse station in clockwise and anticlockwise direction and the circuit is finally closed. During traversing the

sides of the traverse are plotted according to any suitable scale.

## Checks on traverse: Closed traverse

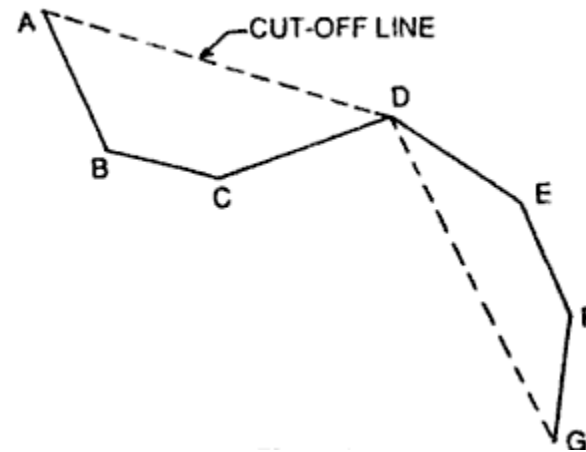
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- Check on closed traverse:
  - Sum of the measured interior angles  $(2n-4) \times 90^\circ$
  - Sum of the measured exterior angles  $(2n+4) \times 90^\circ$
  - The algebraic sum of the deflection angles should be equal to  $360^\circ$ . Right hand deflection is considered +ve, left hand deflection -ve
- Check on linear measurement
  - The lines should be measured once each on two different days (along opposite directions). Both measurement should tally.
  - Linear measurement should also be taken by the stadia method. The measurement by chaining and stadia method should tally.

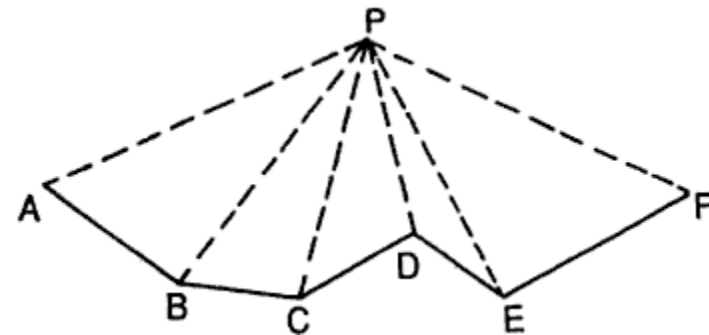
# Checks on traverse: Open traverse

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Taking cut-off lines: measured bearings and lengths of cut off lines after plotting and tally with actual values.



- Taking an auxiliary point: Take P permanent point as auxiliary point measured bearings and lengths of P from each traverse point. If survey is accurate, while plotting all the measured bearing of P should meet at P.



# Problems:

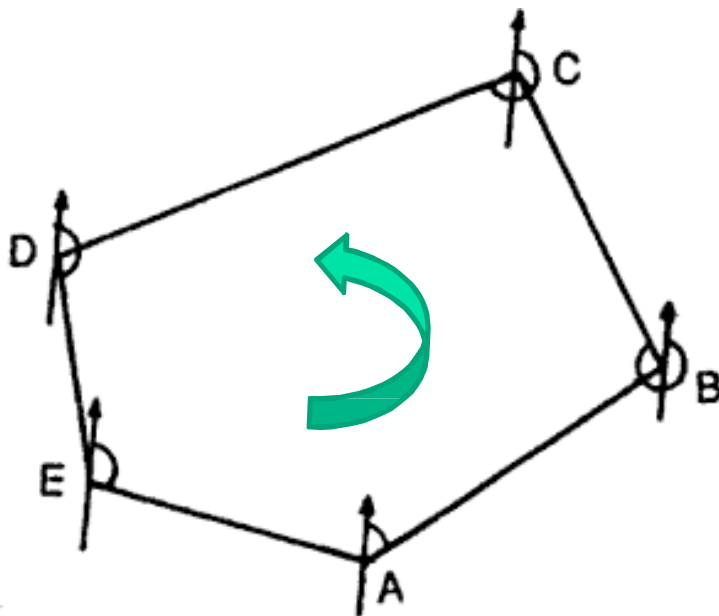
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- Convert the following WCBs to QBs
  - (a) WCB of AB =  $45^{\circ}30'$   
**(Ans  $45^{\circ}30'$ )**
  - (b) WCB of BC =  $125^{\circ}45'$   
**(Ans  $180 - 125^{\circ}45' = 54^{\circ}15'$ )**
- Fore bearing of the following lines are given. Find back bearing
  - AB = S  $30^{\circ}30'$  E
  - BC = N  $40^{\circ}30'$  W
- The magnetic bearing of a line AB is  $135^{\circ}30'$  what will be the true bearing, if the declination is  $5^{\circ}15'$  W.

# Problems

**Problem 5** A closed traverse is conducted with five stations A, B, C, D and E taken in anticlockwise order, in the form of a regular pentagon. If the FB of AB is  $30^{\circ}0'$ , find the FBs of the other sides.

$$\text{Interior angle of pentagon} = \frac{(2N - 4) \times 90^{\circ}}{5} = \frac{540^{\circ}}{5} = 108^{\circ}$$



$$\text{FB of AB} = 30^{\circ}0'$$

$$\begin{aligned}\text{FB of BC} &= \text{BB of AB} + \angle B \\ &= (30^{\circ}0' + 180^{\circ}0') + 108^{\circ}0' \\ &= 210^{\circ}0' + 108^{\circ}0' = 318^{\circ}0'\end{aligned}$$

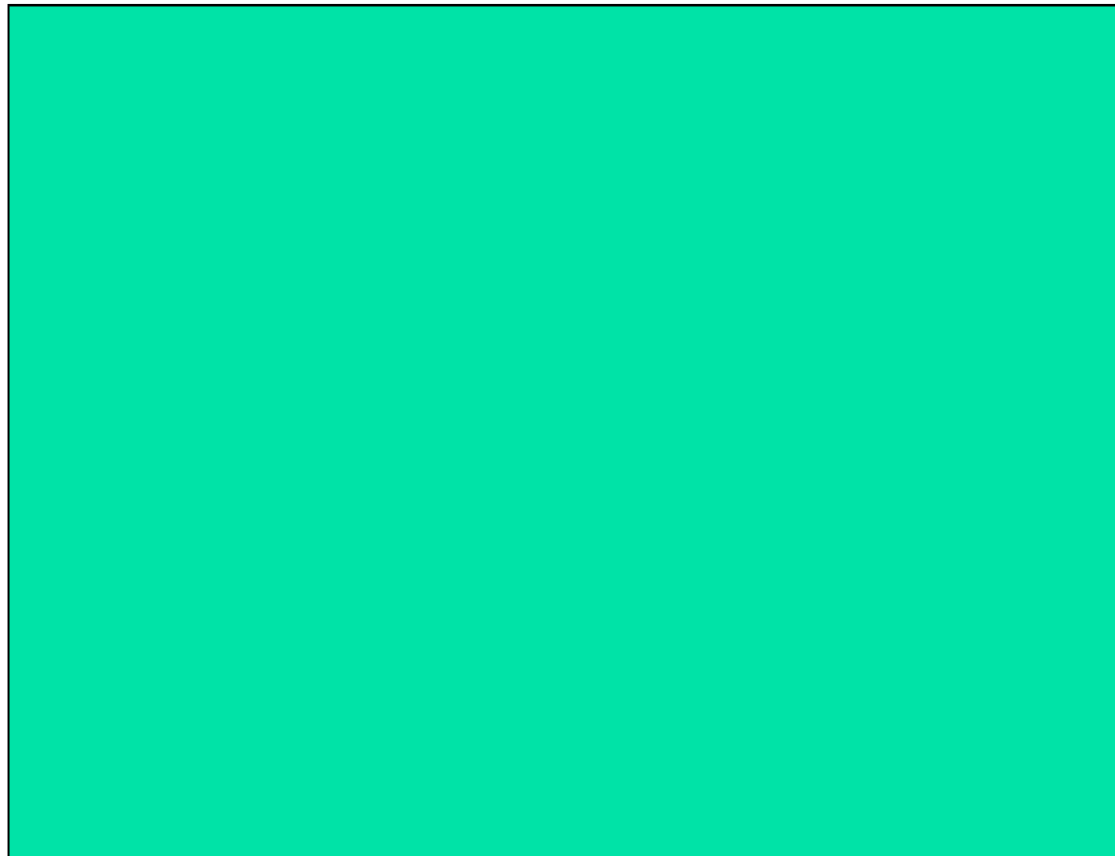
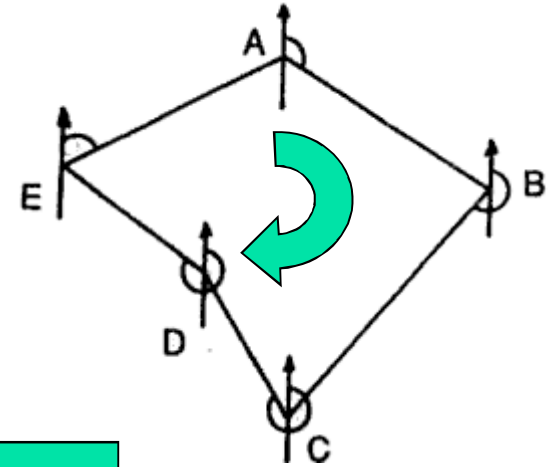
$$\begin{aligned}\text{FB of CD} &= \text{BB of BC} + \angle C \\ &= (318^{\circ}0' - 180^{\circ}0') + 108^{\circ}0' \\ &= 138^{\circ}0' + 108^{\circ}0' = 246^{\circ}0'\end{aligned}$$

$$\begin{aligned}\text{FB of DE} &= \text{BB of CD} + \angle D \\ &= (246^{\circ}0' - 180^{\circ}0') + 108^{\circ}0' \\ &= 66^{\circ}0' + 108^{\circ}0' = 174^{\circ}0'\end{aligned}$$

$$\begin{aligned}\text{FB of EA} &= \text{BB of DE} - \text{exterior } \angle E \\ &= (174^{\circ}0' + 180^{\circ}0') - (360^{\circ}0' - 108^{\circ}0') \\ &= 354^{\circ}0' - 252^{\circ}0' = 102^{\circ}0'\end{aligned}$$

**Problem 8** The following are the bearings observed in traversing, with a compass, an area where local attraction was suspected. Calculate the interior angles of the traverse and correct them if necessary.

Line	FB	BB
AB	150°0'	330°0'
BC	230°30'	48°0'
CD	306°15'	127°45'
DE	298°00'	120°00'
EA	49°30'	229°30'



Contd...

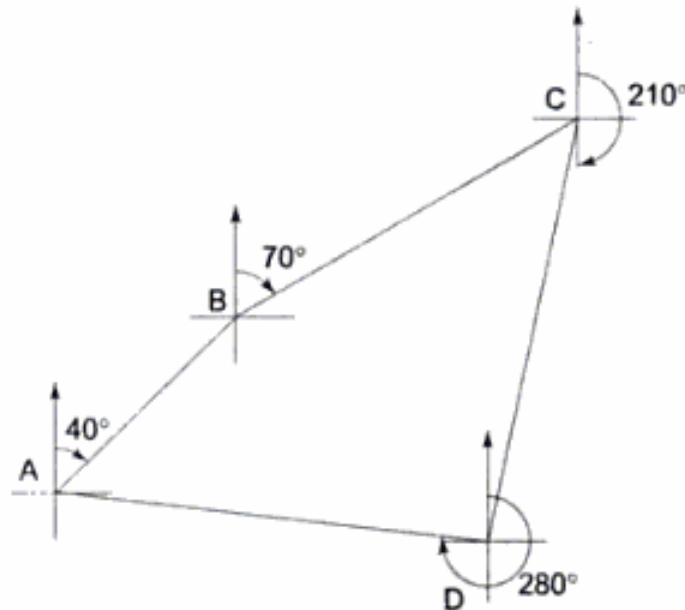




# Problems

**Example 3.2** Determine the value of included angles in a closed compass traverse ABCD (Fig. 3.11) conducted in clockwise direction, given the following fore bearings of the respective lines.

Line	F.B.
AB	40°
BC	70°
CD	210°
DA	280°



Included angle at A =  $280 - 180 - 40 = 60$   
= FB of DA - 180 - FB of AB

Included angle at B =  $40 + 180 - 70 = 150$   
= FB of AB + 180 - FB of BC

Included angle at C =  $70 + 180 - 210$   
= FB of BC + 180 - FB of CD

**Formula: FB of previous line +/- 180 - FB of next line**

**Example 3.3** following the bearings taken in a closed compass traverse.

Line

AB	S37°30'E	N37°30'W
BC	S43°13'V	N&°151
CD	N73°0'W	S2°15'T
DE	N12°45'E	S13°15'W
EA	NdO°fO'R	S59°00'W

Compute the interior angles and correct the same for observational errors.

SAuñon Rcfoto Fig. 3.12. Coavcn the qusdmz & arings to whole circle bearings.

Line»

AB	142°20'	322°31'Y
BC	22S°15'	44°15'
CD	2s7 <sup>e</sup> r	i07°45'
DE	12°45'	193°15*
EA		239°00'

