CE 103: Surveying

Lecture 7: Traverse Survey

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Outline

- ❑Close traverse and open traverse
- ❑Latitude, departure
- ❑Closing error
- ❑Math problem on traversing

7.1 Definition

Traversing is a type of survey where the framework is formed by a number of connected survey lines. The directions of the survey lines are measured by a direction-measuring instrument (like theodolite), while the lengths are measured by a tape (or chain).

7.2 Types of traversing

There are two types of traverse surveying.

- Closed Traverse: When the lines form a circuit which ends at the starting point it is known as closed traverse.
- Open Traverse: When the lines form a circuit which ends elsewhere excepts starting point it is known as open traverse.

7.3 Difference between chain and traverse survey

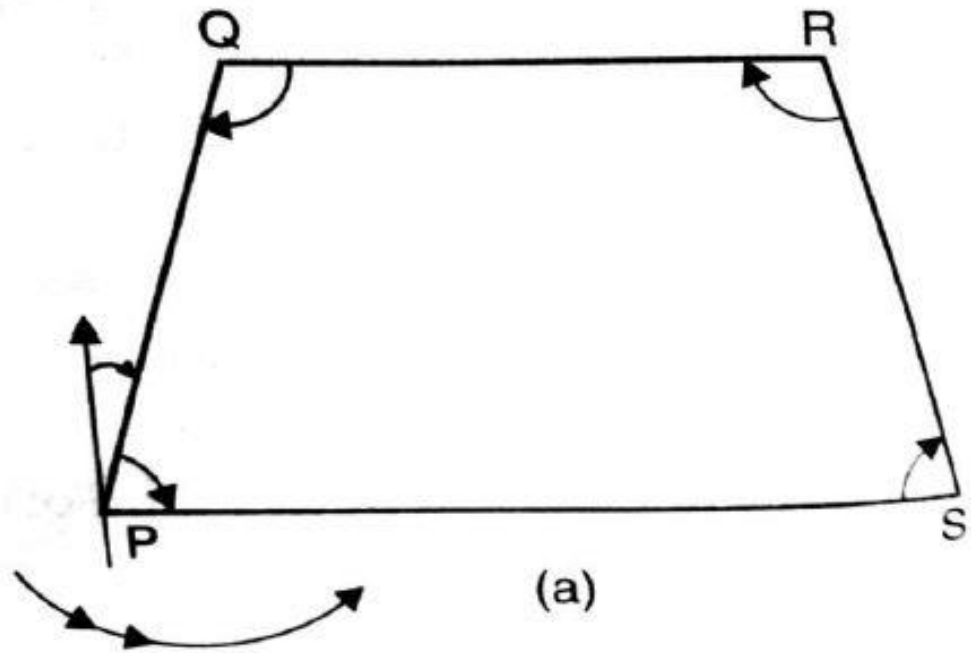
Traverse survey differs from chain surveying in that the arrangement of the survey lines is not limited to any particular geometrical figure as in chain surveying, where a system of connected triangles forms the fundamental basis of the skeleton. Also, check lines etc. are not necessary in traversing as the traverse lines may be arranged near the details. The details etc. are directly located with respect to the survey lines either by offsetting (as in chain survey) or by any other method.

7.4 Chain and Compass Traversing: Free or Loose Needle Method

In chain and compass traversing, the magnetic bearings of the survey lines are measured by a compass and the lengths of the lines are measured either with a chain or with a tape. The direction of magnetic meridian is established at each traverse station independently. The method is also known as free or loose needle method.

7.5 Traversing by fast needle method

In this method also, the magnetic bearings of traverse lines are measured by a theodolite fitted with a compass. However, the direction of the magnetic meridian is not established at each station but instead, direction of magnetic meridian established at the first station. The method is, therefore, more accurate than the loose needle method. The lengths of the lines are measured with a 20 m or 30 m steel tape.



7.7 Checks in closed traverse

- **Traverse by included angles :** (a) The sum of measured interior angles should be equal to (2N-4) right angles, where N = number of sides of the traverse.

  (b) The sum of measured exterior angles should be equal to (2N+4) right angles, where N = number of sides of the traverse.

- **Traverse by direct observation of bearings:** Difference in bearing should be 180°.

7.9 Latitude and departure

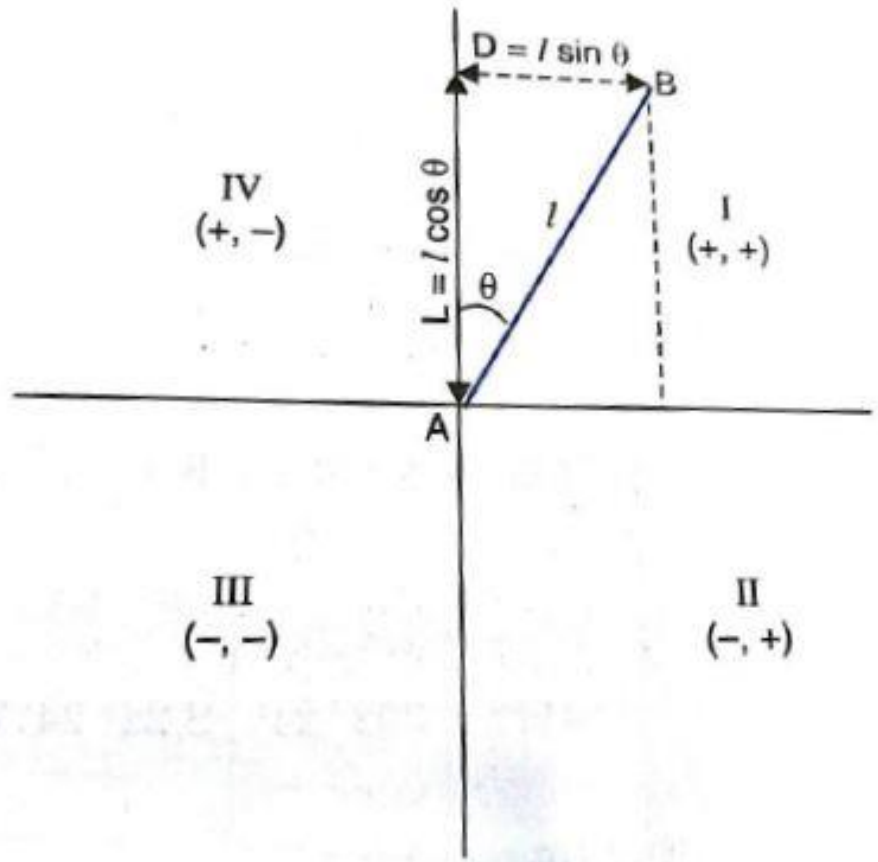


Figure 7.2

Latitude , $L = l \cos\theta$

Departure, $D = l \sin\theta$

where, l = the length of line AB = $\sqrt{L^2 + D^2}$

θ = Reduced bearing of line AB

W.C.B.	*R.B. and Quadrant*	*Sign of*	
		Latitude	*Departure*
0° to 90°	N θ E ; I	+	+
90° to 180°	S θ E ; II	−	+
180° to 270°	S θ W ; III	−	−
270° to 360°	N θ W ; IV	+	−

7.10 Closing Error

If a closed traverse is plotted according to the field measurements, the end point of the traverse will not coincide exactly with the starting point, owing to the errors in the field measurements of angles and distances. Such error is known as closing error (Fig. 7.3). In a closed traverse, the algebraic sum of the latitudes (i.e. $\sum L$) should be zero and the algebraic sum of the departures (i.e. $\sum D$) should be zero. The error of closure for such traverse may be ascertained by finding $\sum L$ and $\sum D$, both of these being the components of error e parallel and perpendicular to the meridian.

Thus, in Fig. 7.3,

$$\text{Closing error } e = AA' = \sqrt{(\sum L)^2 + (\sum D)^2}$$

The direction of closing error is given by

$$\tan\delta = \frac{\sum L}{\sum D}$$

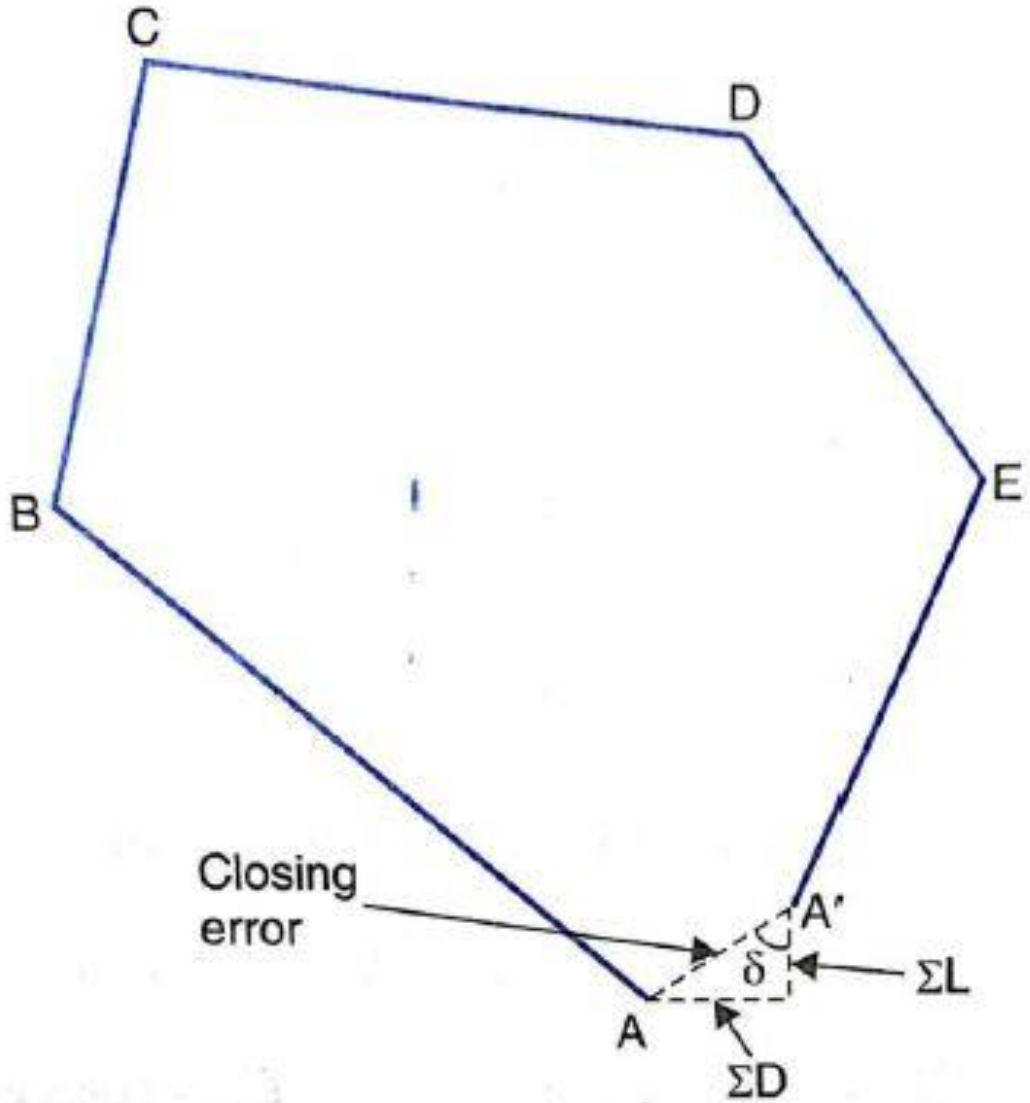


Figure 7.3

Mathematical Problem

Calculate the length and bearing of the closing side DA of a closed traverse ABCDA from following data.

Side	Length (ft)	W.C.B.
AB	300	260°15'
BC	900	190°30'
CD	600	80°45'

Solution:

Side	Length (ft.)	W.C.B.	R.B.
AB	300	260°15'	**S80°15'W**
BC	900	190°30'	**S10°30'W**
CD	600	80°45'	**N80°54'E**
DA	**?**	**?**	**?**

Side	Length (ft)	Latitude	Departure
AB	300	$300 \times \cos 80°15' = 50.8$	$300 \times \sin 80°15' = 295.7$
BC	900	$900 \times \cos 10°30' = 884.9$	$900 \times \sin 10°30' = 164$
CD	600	$600 \times \cos 80°54' = 94.9$	$600 \times \sin 80°54' = 592.4$

Side	Latitude	Departure
AB	-50.8	- 295.7
BC	- 884.9	- 164
CD	+ 94.9	+ 592.4
	$\sum L = -840.8$	$\sum D = 132.7$

As , $\sum L = 0$

Or, -840.8 + Latitude of DA = 0

Or, Latitude of DA =+ 840.8

Again, $\sum D = 0$

Or, 132.7 + Departure of DA = 0

Or, Departure of DA = -132.7

Let , length of DA = l

and Reduced bearing of DA = θ

So, $l \cos\theta = +840.8$ .....(1)

$l \sin\theta = -132.7$ .....(2)

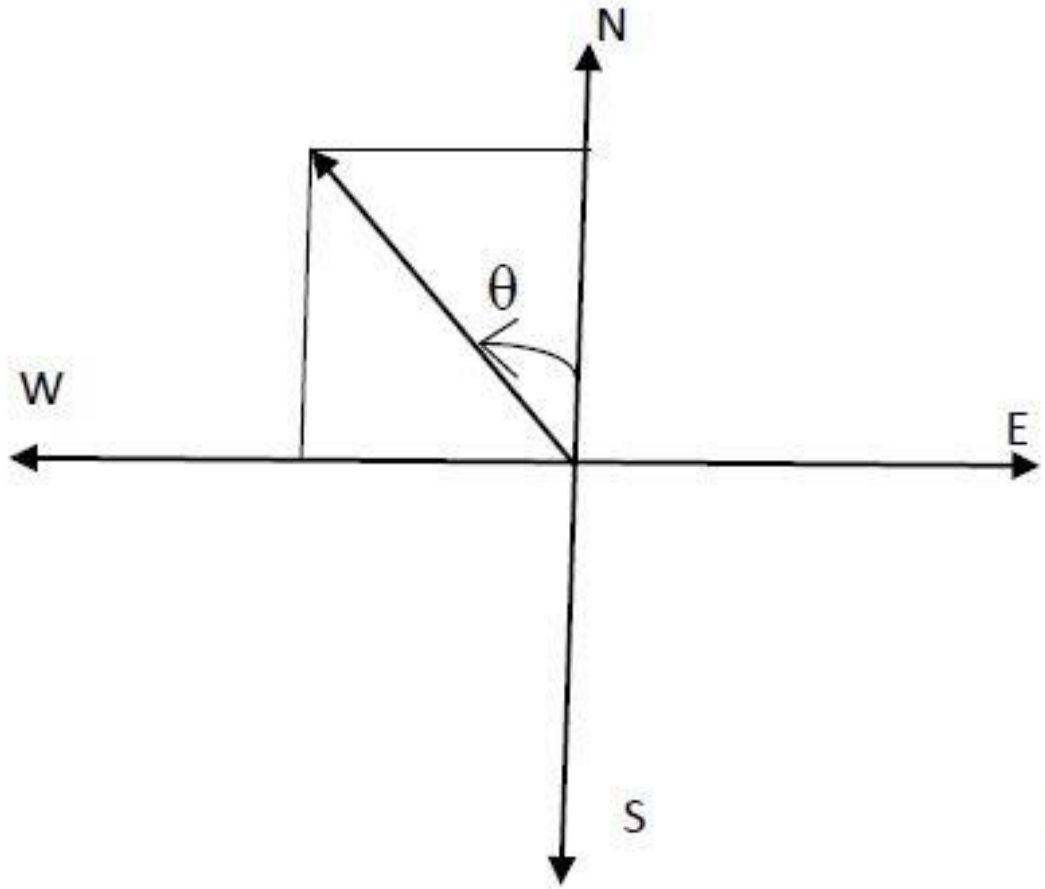
from equation (1) and (2),

$$l = \sqrt{(840.8)^2 + (-132.7)^2} = 851.2'$$

$$\tan\theta = \frac{132.7}{840.8} \text{ (neglecting negative sign)}$$

$$\text{or, } \theta = tan^{-1}\left(\frac{132.7}{840.8}\right) = 8.97°$$

W.C.B. of line DA = 360° -8.97° = 351.03°



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