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B.Eng. Geomatic Engineering
UNZA

Topic 5: Orientation and Position

Contents

- ✓ Azimuth
- ✓ Declination Compass traversing
- ✓ Local attraction

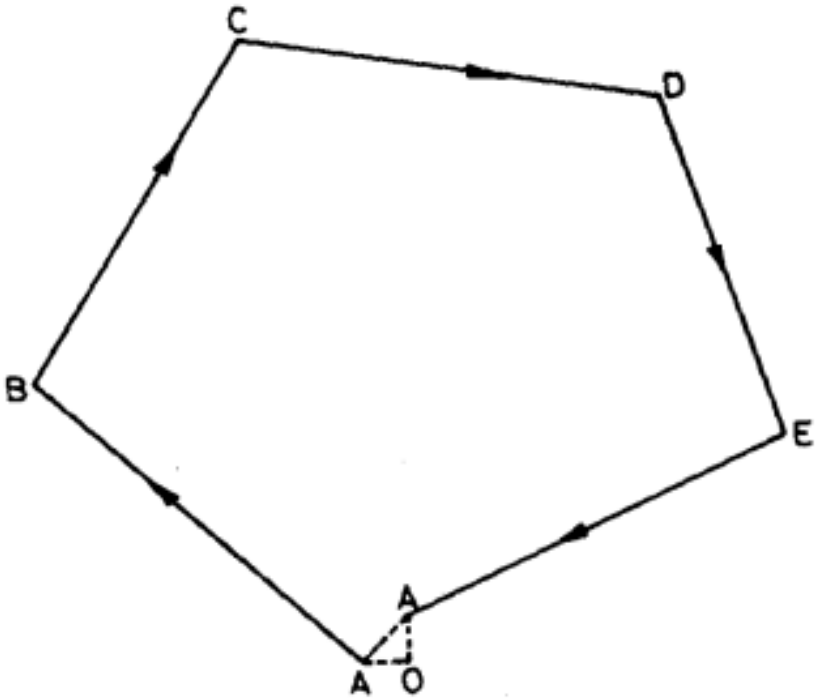
Introduction

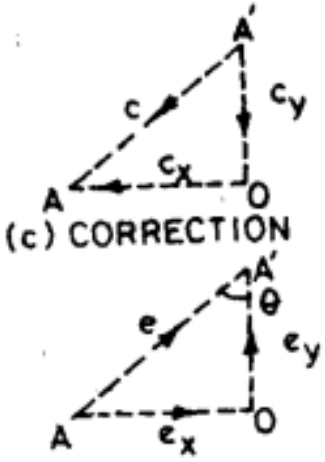
In traverse surveying the direction of survey lines are fixed by angular measurements and not by forming a network of triangles as is done in chain surveying.

A traverse may be (a) Closed or (b) Unclosed. This will be discussed further in the next topic.

If a closed traverse is plotted according to the field (procedure) measurements and if the end of traverse will not coincide exactly at the starting point. This discrepancy is due to the errors in the field observations i.e. **magnetic bearings** and **linear distances**. Such error is known as closing error.

Introduction





Introduction

In order to plot a survey line on paper, its length and direction must be known.

The direction of a survey line may be defined either

- by the horizontal angle between the line and the line adjacent to it, or
- by the angle called the bearing, between the fixed line of reference called the meridian, and the line.

For measuring angles in survey work, the instruments commonly used are (i) the compass, and (ii) the theodolite.

Bearing of lines

The bearing of a line is the horizontal angle which the line makes with some reference direction or meridian. The reference direction employed in surveying may be

1. a true meridian
2. a magnetic meridian or
3. an arbitrary or assumed meridian.

Magnetic meridian is used in plane surveys.

Bearing of lines

✓ The true meridian:

The true meridian passing through a point is the line in which the earth's surface is intersected by a plane through the north and south poles and the given point.

✓ Magnetic Meridian

The magnetic meridian of a place is the direction indicated there by a freely floating and properly balanced magnetic needle, uninfluenced by local attractive forces. Magnetic meridian does not coincide with true meridian except in certain localities, and the horizontal angle between the two directions is termed as Magnetic Declination of the needle.

Bearing of lines

✓ Arbitrary Meridian

For small surveys, especially in a mapped country, any convenient direction may be assumed as a meridian. This artificial meridian is usually the direction from a survey station either to some well defined and permanent point or to an adjoining station.

Designation of Bearings

The bearings are designated by the following two systems:

- 1. Whole circle system,
- 2. The quadrantal system

Local Attraction

The magnetic needle does not record the direction of magnetic meridian when it is under the influence of attractive bodies in its surroundings such as steel structures, electric cables carrying current etc. Such a disturbing influence is called local attraction. Local attraction causes deflection of compass needle.

Detection of the Local Attraction:

Unless the local attraction at a place is found out and corrected, the bearings taken from a compass can not be regarded as correct. To test for local attraction, it is necessary to observe the bearing of each line from both its ends. If the fore bearing and back bearing of a line differ by 180° , it may be taken for granted that no local attraction exists at either station, provided the compass is free from the instrumental error. If the back and fore bearings of a line do not differ by 180º then the deviation may be due to observational error or the local attraction.

Local Attraction

Detection of the Local Attraction:

The reading should be again taken and verified. If they do not agree then the local attraction may be at one or both the stations. The observed bearings of the lines may be corrected for local attraction by finding out the amount of error and its nature and applying the same to affected bearings of sides

Local Attraction

Example

Following is the data regarding a closed compass traverse PQRS taken in a clockwise direction:

(i) *Fore bearing and back bearing at station P = 55^0 and 135^0, respectively*

(ii) *Fore bearing and back bearing of line RS = 211^0 and 31^0, respectively*

(iii) *Included angles $\angle Q = 100^0$ $\angle R = 105^0$*

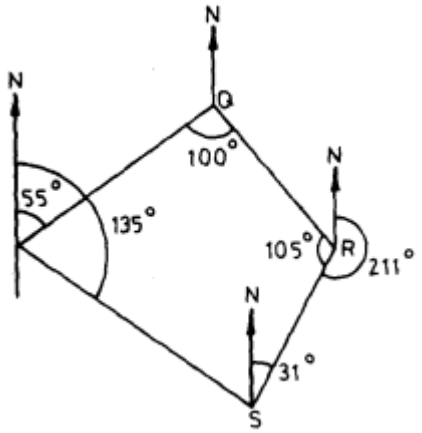
(iv) *Local attraction at station R = $2^0 W$*

(v) *All the observations were free from all the errors except local attraction.*

From the above data

(i) *Calculate the local attraction at station P and S.*

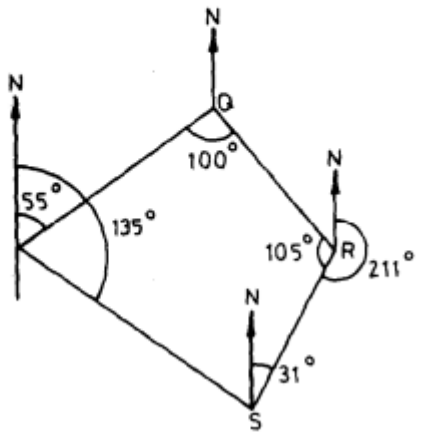
(ii) *Calculate the corrected bearings of all the lines and tabulate the same.*



Local Attraction

Solution

Given figure shows the traverse with the given data. As FB and BB of the line RS differ by 180^0, stations R and S are either free from local attraction or affected by it equally. As the station R is affected, the station S is also affected. Therefore, the local attraction at S is also 2^0W. In other words, all the bearing at R and S are increased by 2^0 due to local attraction.



Therefore, corrected FB of RS = $211^0 - 2^0 = 209^0$

Angle QPS = $135^0 - 55^0 = 80^0$

Local Attraction

$$\angle PSR = 360^0 - (80^0 + 100^0 + 105^0) = 75^0$$

The bearings of all the lines can be determined from the included angles and the corrected bearing of the line RS equal to 209^0.

BB of RS $= 209^0 - 180^0 = 29^0$

FB of SP $= 29^0 + (360^0 - 75^0) = 314^0$

BB of SP $= 314^0 - 180^0 = 134^0$

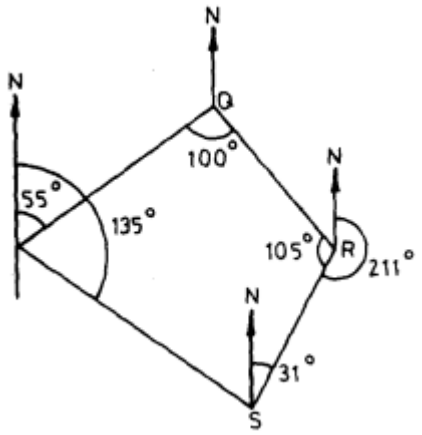
FB of PQ $= 134^0 - 80^0 = 54^0$

BB of PQ $= 54^0 + 180^0 = 234^0$

FB of QR $= 234^0 - 100^0 = 134^0$

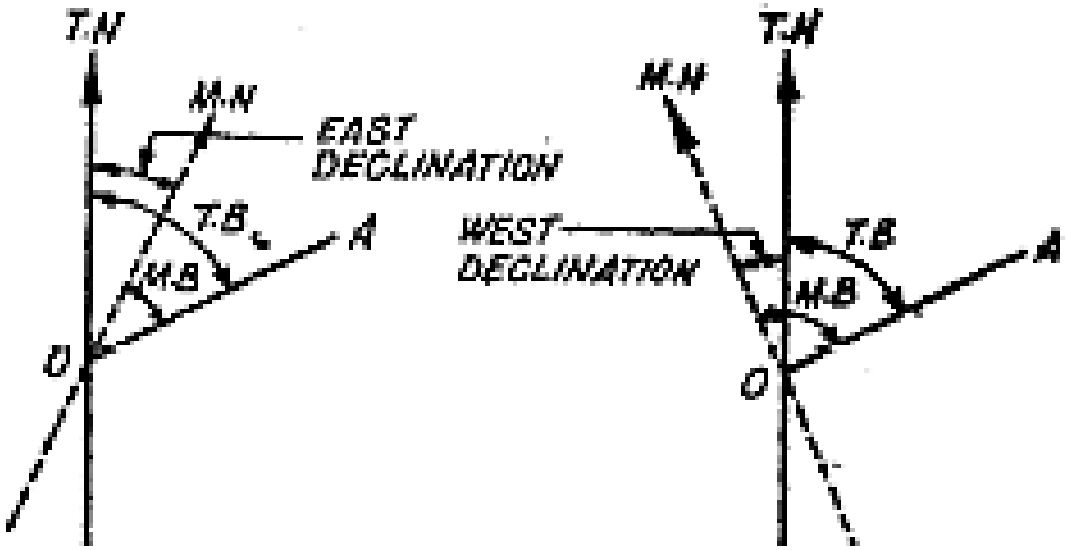
BB of QR $134^0 + 180^0 = 314^0$

FB of RS $314^0 - 105^0 = 209^0$ (O.K.)



Magnetic Declination

- The magnetic meridian at a place does not coincide with the true meridian at that place except in few places. The horizontal angle which the magnetic meridian makes with the true or geographical meridian is knows as the magnetic declination.



Magnetic Declination

When the north end of the needle points to the east of the true meridian, the declination is said to be east(n° E); when the north end of the needle points to the west, of the true meridian, the declination is said to be west(n° W).

Determination of True Bearing.

True bearing of a line = magnetic bearing of the line ± declination

Use + sign when declination is east, and minus sign when it is west. This rule is applicable to W.C.B.

Determination of Magnetic bearing

Magnetic bearing of a line = true bearing of the line minus/plus magnetic declination. Use the minus sign when the declination is east, and plus sign when it is west. This rule is applicable to W.C.B.

Magnetic Declination

Example

The magnetic bearing of a line is 197^0. Find its true bearing if the magnetic declination is 3^0 W.

Solution

Since the magnetic meridian is deflected towards west of the true meridian, true bearing of the line will be magnetic bearing – declination = $197 - 3 = 194^0$.

Example

If the magnetic bearing of a line is N 37^0 W and the magnetic declination is 2^0 E, find true bearing.

Solution

True bearing = magnetic bearing – declination = N $(37 - 2)$ W = N 35^0 W

Note: In this problem it is advisable to draw a figure indicating given magnetic bearing and declination and then find true bearing. Because here, above given rules will not be applicable as these rules are applicable to W.C.B.

Summary

- The magnetic meridian, which is the line taken by the compass needle outside the range of any uncompensated masses of magnetized material, lies approximately N-S, and the angle between it and the true meridian is known as the declination.
- This varies from one locality to another and in any given locality it also varies with time.
- Variations in the strength of the magnetic field at any one place produce the following variations in the declination on a time basis:

Summary

- **Secular variation:**

  the full cycle of which takes several centuries. The annual amount of this change is 5' – 9' at Greenwich. When magnetic bearings are given, the date, the declination, and the annual rate of change for the locality should also be given

- **Diurnal Variations:**

  Which are more or less regular changes in the needle about its mean position during the course of the day. The maximum change on a daily basis is about 10'.

- **Annual variations:**

  In which the period of variation is a year; these are so small that may be ignored.