CE 103: Surveying

Lecture 5: Contouring and Compass

Course Instructor: Saurav Barua (SB)

Assistant Professor, Dept. of Civil Engineering, DIU

Email: saurav.ce@diu.edu.bd

Phone: 01715334075

Outline

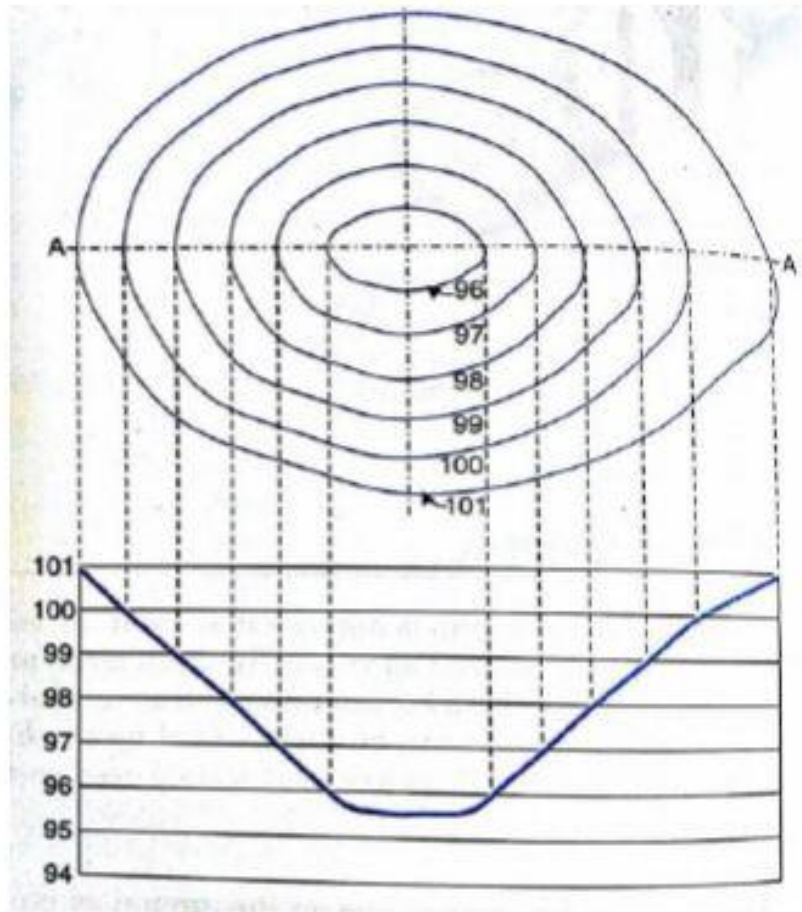
- ❑Contour intervals
- ❑Characteristics of contour
- ❑True meridian, magnetic meridian
- ❑Whole circle bearing and reduced bearing

Contour :

Imaginary lines joining points of equal elevation (R.L.)

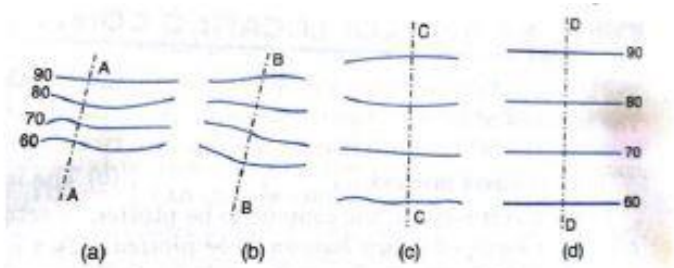
Contour Intervals :

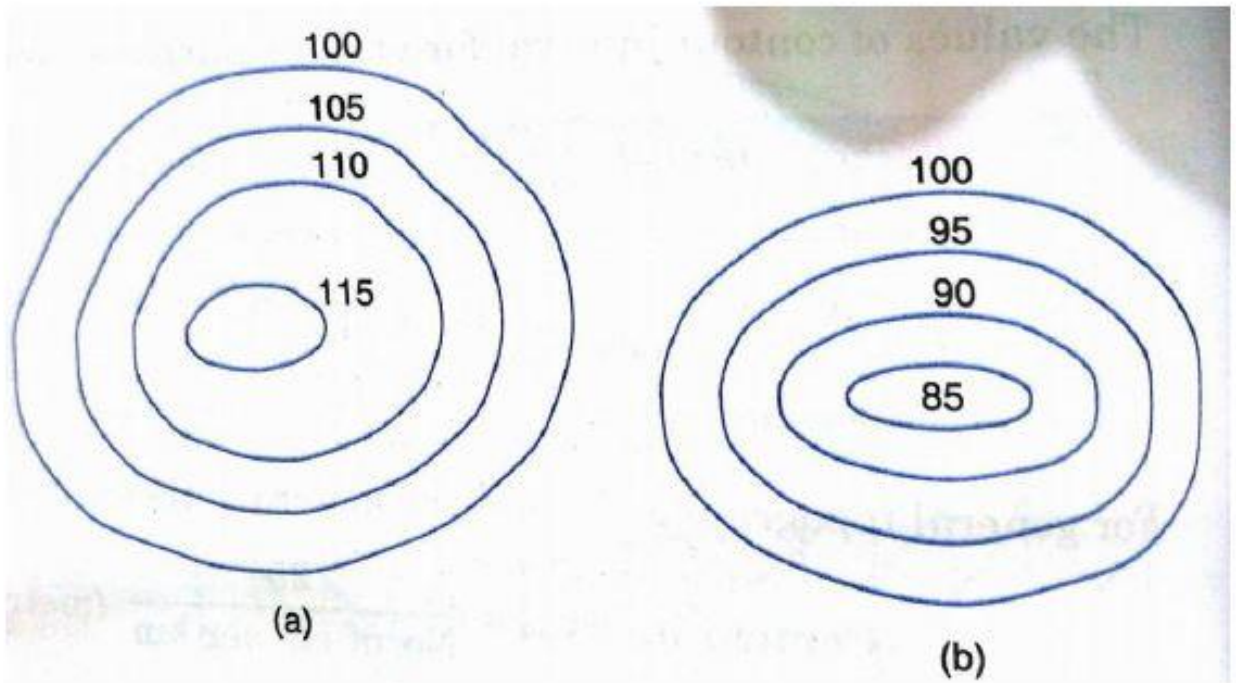
Elevation difference between successive contours.



Characteristics of Contours:

- Two contour lines of different elevation cannot cross each other.
- Two contour lines of different elevation cannot touch each other.
- Closely spaced contour lines represents steep slope, while far apart contour lines represent gentle slope.
- If contours are uniformly spaced, they represent uniform slope.
- The direction of steepest slope at a point on a contour is at right angles to the contour.
- A contour must close itself or go off the map.
- A closed contour line with one or more higher ones inside it represents a hill; similarly , a closed contour line with one or more lower ones inside indicate a depression.


90
80
70
60
A
A
B
B
C
C
D
D
90
80
70
60
(a)
(b)
(c)
(d)


100
105
110
115
(a)
100
95
90
85
(b)

Methods of Contouring:

There are two main methods. They are-

i) Direct Method

ii) Indirect Method

Direct Method:

- Contours to be plotted is directly traced on the ground surface.
- Slow and tedious method (Staff is removed around till desired reading is obtained).
- Used for small areas where greater accuracy is required.
- Field work consists of (a) location of contour points by levelling (b) location of those points by chain, traverse or plane table surveying.

Indirect Method:

- Elevation are measured at fixed points along system of straight lines or points of topographic importance so that contours can represent salient topographic features.
- Contours are drawn by linear interpolation by assuming uniform slope between adjacent points where staff readings have been taken.
- There are two methods for indirect technique-
  i) Square/Grid Method
  ii) Radial System

(a) Square/Grid Method:

- Suitable for small relatively flat areas, where the area is divided into a grid containing squares. The square size may be varied depending on topographic features. Square size used range from 10 ft to 100 ft.
- Staff readings are taken at corners of squares.

(b) Radial system:

- Several radial lines from a suitable point are set out.
- Staff readings are taken at suitable intervals along radial lines.

THE COMPASS

6.1 Bearing

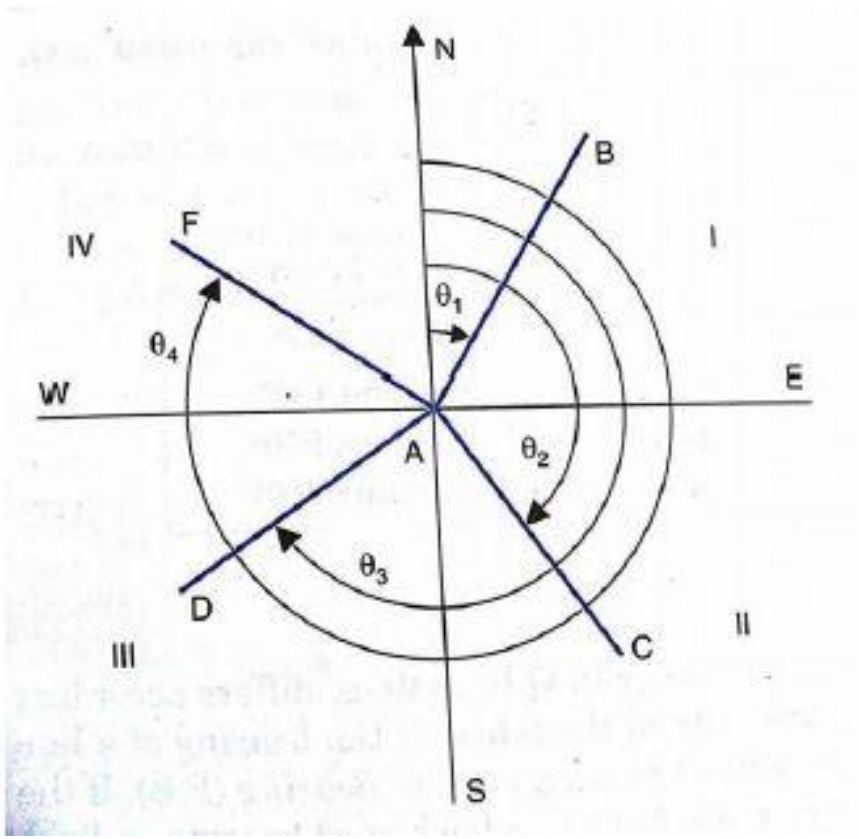
Bearing: Bearing of a line is its direction relative to a given meridian. A meridian is direction such as (1) True Meridian (2) Magnetic Meridian (3) Arbitrary Meridian.

1. **True Meridian**: True meridian through a point is the line in which a plan, passing that point and the north and south poles, intersects with surface of the earth. It, thus, passes through the true north and south. The direction of true meridian through a point can be established by astronomical observations.
   True Bearing: True bearing of a line is the horizontal angle which it makes with the meridian through one of the extremities of the line. Since the direction of true meridian through a point remains fixed, the true bearing of a line is a constant quantity.
2. **Magnetic Meridian**: Magnetic meridian through a point is the direction shown by a freely floating and balanced magnetic needle free from all other attractive forces. The direction of magnetic meridian can be established with the help of a magnetic compass.
   Magnetic Bearing: The magnetic bearing of a line is the horizontal angle which makes with the magnetic meridian passing through one of the extremities of the line. A magnetic compass is used to measure it

3. **Arbitrary Meridian:** Arbitrary meridian is any convenient direction towards permanent and prominent mark or signal, such as a church spire or top of a chimney. Such meridians are used to determine the relative positions of lines in a small area
   Arbitrary Bearing: Arbitrary bearing of a line is the horizontal angle which it makes with any arbitrary meridian passing through one of the extremities. A theodolite or sextant is used to measure it.

(a) The Whole Circle Bearing:

In this system, the bearing of a line is measured with magnetic north in clockwise direction. The value of the bearing thus varies from 0° to 360°. Prismatic compass is graduated on this system. In India and U.K., the W.C.B. is measured clockwise with magnetic north.
Referring to Fig. 6.1, the W.C.B. of *AB* is θ_1, of *AC is* θ_2, of *AD is* θ_3 and of *AF is* θ_4.



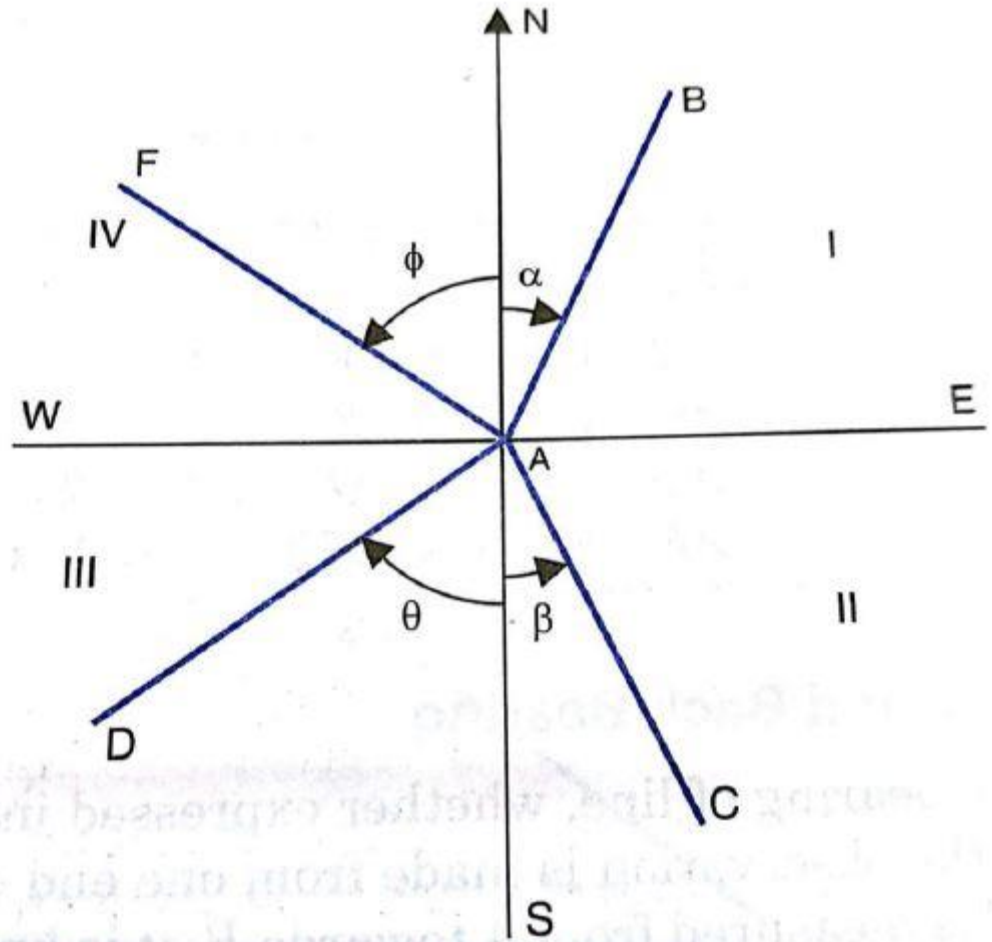


Figure 6.2: Q.B. System

6.3 Conversion of Bearings from one system to other:

Conversion from W.C.B. to R.B. with reference to Figure 6.1 is given below:

Line	W.C.B. (Between)	Quadrant	R.B.
AB	0° to 90°	NE	R.B. = W.C.B.
AC	90° to 180°	SE	R.B.=180°-W.C.B.
AD	180° to 270°	SW	R.B. =W.C.B.-180°
AF	270° to 360°	NW	R.B. = 360°-W.C.B.

Conversion from R.B. to W.C.B. with reference to Figure 6.2 is given below:

Line	R.B.	Rule for W.C.B	W.C.B between
AB	N α E	W.C.B. = R.B.	0° to 90°
AC	S β E	W.C.B. = 180°-R.B.	90° to 180°
AD	S θ W	W.C.B. = 180° + R.B.	180° to 270°
AF	N ϕ W	W.C.B. = 360°-R.B.	270° to 360°

6.4 Fore and Back bearing

Backward Bearing (B.B.): If the bearing of a line **AB** is measured from **B** toward **A**, it is known as **Backward Bearing** or **Back Bearing**.

Forward Bearing(F.B.): If the bearing of a line **AB** is measured from **A** toward **B**, it is known as **Forward Bearing** or **Fore Bearing**.

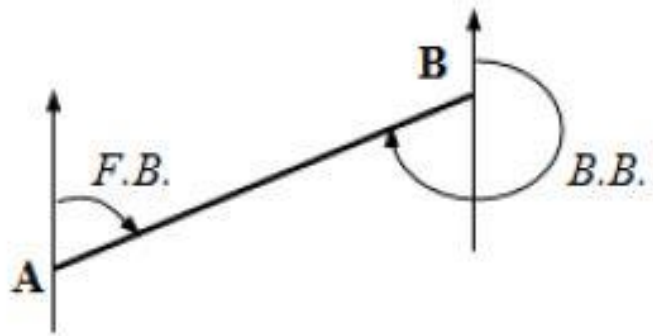
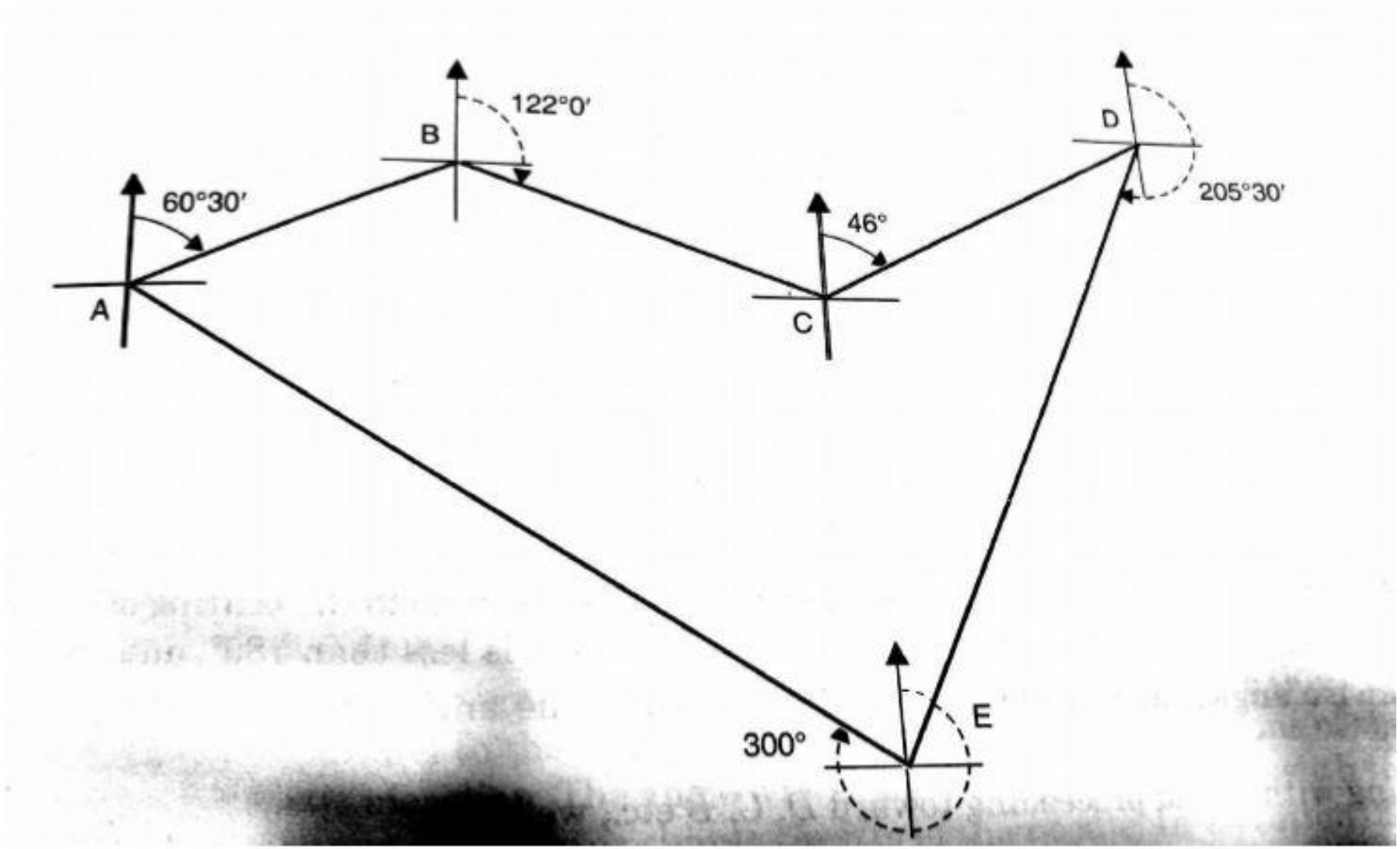


Figure 6.3: Forward and Back bearing

Example 5.3:

The following bearings were observed with a compass. Calculate the interior angles.

Line	Fore Bearing
AB	60°30'
BC	122°0'
CD	46°0'
DE	205°30'
EA	300°0'


A
60°30′
B
122°0′
C
46°
D
205°30′
E
300°

Bearing of AE = 300°-180° = 120°

< A = Bearing of AE - Bearing of AB = 120°-60°30' = 59°30'

Bearing of BA = 180° + 60°30' = 240°30'

< B = Bearing of BA - Bearing of BC = 240°30' - 122° = 118°30'

Bearing of CB = (180°+122°) = 302°

<C = Bearing of CB - Bearing of CD = 302°- 46° = 256°

Bearing of DC = 180°+ 46° = 226°

< D = Bearing of DC - Bearing of DE = 226° - 205°30' = 20°30'

Bearing of ED = 205°30' - 180° = 25°30'

< E = (360°- Bearing of EA) + Bearing of ED = 360°-300° + 25°30' = 85°30'

Check:

<A + <B + <C + <D + <E = 540°

For a pentagon summation of interior angles = (2n -4)* 90° = (2*5-4)*90° = 540°