Angles, Bearings, and Azimuths

Learning Objectives for this Lecture

1. Know the two types of angles
2. Know the three requirements for turning an angle
3. Know the different angle types
4. Know the different directions of lines
5. Be able to compute azimuths from bearings
6. Be able to compute bearings from azimuths
7. Be able to compute angles by the tangent method
8. Be able to compute interior angles from direction
9. Be able to compute direction from angles

Introduction

- Location of a line is done with angles and direction
- Two types of angles
  - Horizontal
Three requirements for turning an angle:

- Reference line
- Turning direction
- Angle value

Example: We want to turn the angle ABC

1. Establish the reference line
2. Establish the turning direction

3. Compute the angle value

Angle Types

- Interior angles
  - Used in polygons or closed traverses
  - Exterior angle + interior angle = $360^\circ$ = check

- Angles to the right
  - Turned clockwise normally
  - Turned from rear station to the forward station
- Deflection Angles
  - Turned as an extension of the back line to the forward station
  - Normally used on open traverses or linear surveys
  - Important to note direction turned

**Directions of lines**

Angles are referenced to a control meridian line of some sort – generally north-south.
Two types of directions:

- **Bearings**
- **Azimuths**

**Bearings**

Bearings are expressed by quadrant with respect to the reference line.

- Measured as the acute angle between the reference line and the line itself
- Measured either north or south
- Referenced additionally to the east or west
- Referenced to the direction of the survey

Example: Traverse ABC

Line AB – Bearing = S 45° E

![Diagram of traverse ABC with line AB at 45° south of east]

Line BC – Bearing = N 55° E

![Diagram of traverse ABC with line BC at 55° north of east]
Field process

Bearings are measured *ahead* or *forward* and then checked *back*.

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<th>Brg AHD</th>
<th>Brg BCK</th>
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Azimuths

Azimuths are expressed clockwise with reference to the reference line.

- Measured as the total angle between the reference line and the line itself clockwise
- Generally measured from north
- No referencing from the east or west

Example: Traverse ABC

Line AB – Azimuth = $135^\circ$
Line BC – Azimuth = $55^0$

Computing angles by the Tangent Method also called a Tangent Offset

Used on very long lines that have little room for angular error or for layout off of an existing line.

\[ \tan A = \frac{a}{b} \]
Example:

We need to run a line at $72^0 18' 30''$ but our instrument is only good to $1^0$

We can run a line 500’ along b from our starting point O
Compute the 900 offset distance a

$\tan A = a/b$

$\tan 0^0 18' 30'' = a/500'$

$(\tan 0^0 18' 30'') * 500' = a$

$a = 2.69'$

Computing Bearings

**DRAW A SKETCH!!!**

It is quite often necessary to compute bearings from angles
Again, the three requirements for turning an angle:

- Reference line
- Turning direction
- Angle value

Example problem: Line AB has been set at S 45° 30’ E. Angle B was turned at 120° 30’. What is the bearing of BC?

Line AB = line BA = N 45° 30’ W

Bearing BC then = 120° 30’ - 45° 30’ = 75° 00’ = N 75° 00’ E

Computing Azimuths

**DRAW A SKETCH!!!
Example problem: Line AB has been set at $134^0 30'$. Angle B was turned at $120^0 30'$. What is the azimuth of BC?

$120^0 30' - (360^0 00' - 314^0 30') =$

$120^0 30' - 45^0 30' = 75^0 00'$
Additional problems

(90 - 69° 15') = 20° 45'

88° 45’ - 20° 45’ = 68° 00’

90 - 68° 00’ = 22° 00’

S22° 00’ E

(90 - 69° 15’) = 20° 45’

(90 - 20° 45’ ) = 110° 45’

(151° 15’ - 110° 45”) = 40° 30’

S40° 30’W
Additional problems

\[(69^0 15' + 69^0 15') = 138^0 30'\]

\[(90 - 69^0 15') = 20^0 45'\]

\[(90 + 20^0 45' + 24^0 15' ) = 135^0 00'\]