


Basic Land Measurements – Directions

Map and map use

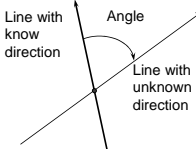
FW2050 Measuring Forest Resources

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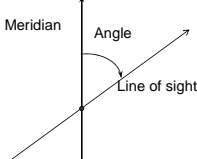


Measurement of direction


- Angular relationship between two lines (one known direction – reference line such as meridian and another line with unknown direction e.g. line of sight)



Line with know direction Angle Line with unknown direction




Meridian Angle Line of sight



Azimuth and bearing

- Azimuth or bearing has been used to measure direction
- Azimuth and bearing are synonymous of measuring direction but there is subtle difference in the way they are express or written
- There is conversion between Azimuth and bearing



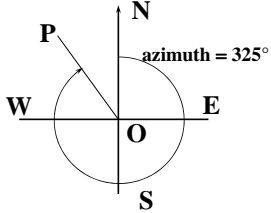
Azimuth


Angle measured clockwise due north

Measured 0-360 degree

Azimuth is mostly used in research and scientific purposes

It is also easy to understand



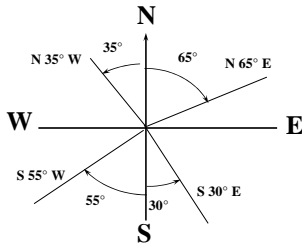



Bearing

Angle of 90° or less from either North or South (towards east or west) that falls in one of the quadrant of the compass

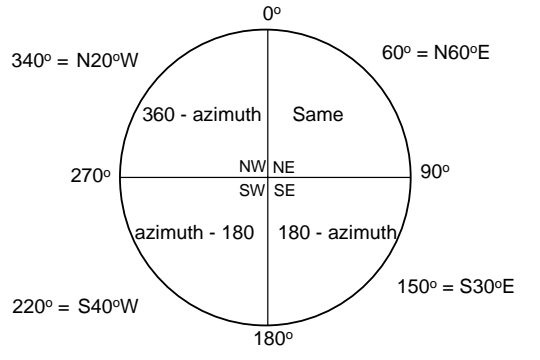
Specify initial direction (N or S), read angle in degree (between 0 and 90°) and then specify the direction (E or W)

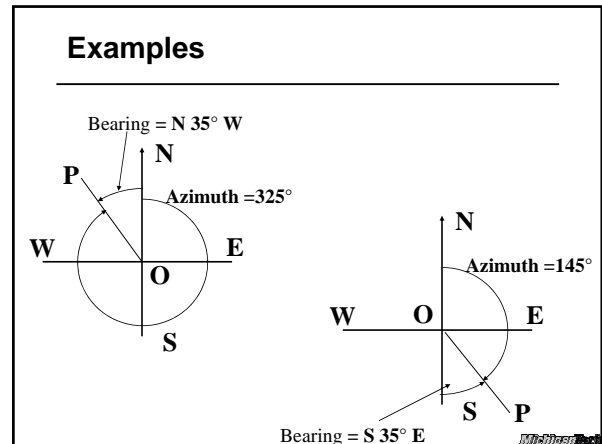
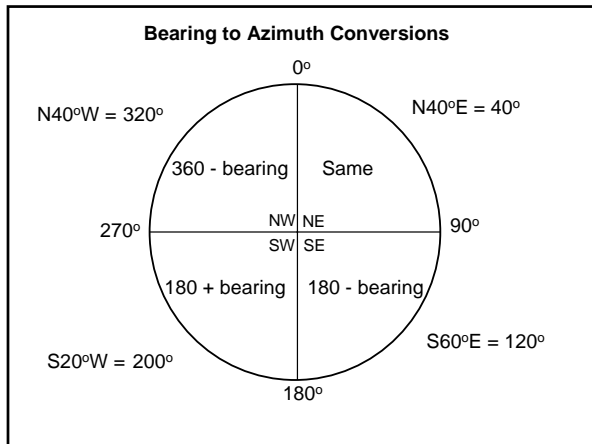
It is an indicator of direction





Azimuth to Bearing Conversions





Magnetic bearing or azimuth

- We use compass to measure the direction of a line or line of sight which we call magnetic bearing or magnetic azimuth
- A freely floating compass needle lines up with the earth's magnetic field

Forward and backward bearing or azimuth

- Forward bearing or azimuth: the original direction of line of sight
- Backward bearing or azimuth is shifting 180 degree direction from the original direction of line of sight

Examples

- If forward azimuth is $<180^\circ$, add 180° to get backward azimuth
e.g. forward azimuth = 45° , then backward azimuth = $45^\circ + 180^\circ = 225^\circ$
- If forward azimuth is $>180^\circ$, then subtract 180° to get backward azimuth
e.g. forward azimuth = 300° , then backward azimuth = $300^\circ - 180^\circ = 120^\circ$

Aspects

- Aspect is a position facing a particular direction

4 sectors 90° 8 sectors 45°

- Or you can write aspect using azimuth (0-360°)
- Azimuth is more scientific than bearing !!!

Magnetic declination

- Magnetic north is not true north
- Magnetic declination is the angle formed between magnetic north and true north (geographic north)
- Magnetic declination changes over time because magnetic north pole changes over time.
- Magnetic north pole is currently on north west of Hudson Bay in Canada which is about 500 mile from true north pole of the earth
- Determining magnetic declination
 - Published source – e.g. maps
 - Check this website <http://www.ngdc.noaa.gov/seg/geomag/jsp/Declination.jsp>
 - By taking azimuth of line with known direction

Isogonic Chart of United States



FIGURE 4-3
Magnetic declination chart of the conterminous United States, epoch 2000. (Figure produced by L. R. Newitt, Geological Survey of Canada, Natural Resources Canada, using data from Geomagnetic Reference Field 2000.)

Isogons are the lines connecting points having equal declination.

West declination

- Magnetic N is west of true N (Eastern US)
- Magnetic azimuth – west declination = true azimuth
(determining azimuth to an object)
- Houghton is currently about **4° W declination**

East declination

- Magnetic N is east of true N (Western US)
- Magnetic azimuth + east declination = true azimuth
(determining azimuth to an object)

Best to set declination directly on compass (if compass has this adjustment)

Local attraction

- Magnetite objects that causes the magnetic needle to deviate as a result it does not point real magnetic north
- Iron deposits
- Wire fence
- Overhead electric wire
- Glasses with metal frame, wristwatch, zipper and any other metal that you are carrying

Back sighting would be useful to identify local magnetic attraction

Compass reading



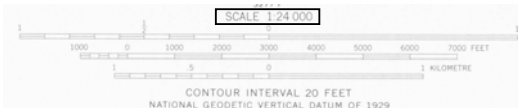
- Compass is level, and target is lined up with the sighting notch
- Line through center of mirror passes through center of compass
- N end of magnetic needle and orienting marks are aligned
- Mirror is at a 50 to 70 degree angle

Maps and Map Use

I. Topographic Quadrangle Maps (USGS quad maps)

A. Map scale

1. Located at the bottom of USGS quad maps
2. Show equivalent distances equal to miles and kilometers
3. Show representative fraction (RF)
RF = map distance:ground distance
example 1:24,000 (1 unit on map = 24,000 units on ground)
4. Scale reciprocal = SR = 1/RF
for RF = 1:24,000, SR = 24,000)



B. USGS map series

1. 7 1/2 minute series

- quadrangle size =
7 1/2 minutes latitude x 7 1/2 minutes longitude
(1 degree = 60 minutes)
- RF = 1:24,000
- most commonly used USGS series

2. 15 minute series

- quadrangle size =
15 minutes latitude x 15 minutes longitude
- RF = 1:62,500

C. Map features

1. Contours

- a. lines connecting points of equal elevation
- b. contour interval
 - number of feet of elevation change between contour lines
 - typically indicated below map scale



c. contours help delineate geographical features

- hills (contours often in concentric circles at top)
- depressions (contours in concentric circles with hatch-lines facing center of circle)



c. contours help delineate geographical features

- flat areas (contours widely spaced)
- slopes (parallel contours, the more closely spaced, the steeper)



3. Grid coordinates

- a. located along the margins of the map
- b. uniquely identify a location on the Earth's surface
- c. latitude/longitude
 - Forestry building is at 47° 06' 57" N latitude, 88° 32' 51" W longitude
 - minutes (') are 1/60 of a degree, seconds (") are 1/60 of a minute
- d. Universal Transverse Mercator (UTM)
 - Forestry building is at 16 382595 E, 5218968 N
 - units are meters from the UTM origin point
- e. Grid coordinates are very useful for finding exact locations using GPS (global positioning satellite systems) to travel to a specific location

4. Roads and trails

5. Lakes, streams, swamps (indicated in blue)



D. Determining areas (acreage) on maps

1. Rectangular areas

- determine length and width in ground units and multiply
- area is 0.5 in x 1 in on a map with a 1:24,000 scale

$$\text{Area} = 1,000 \text{ ft} \times 2,000 \text{ ft} = 2,000,000 \text{ ft}^2$$

$$\frac{2,000,000 \text{ ft}^2}{43,560 \text{ ft}^2/\text{ac}} = 46 \text{ ac}$$



$$0.5'' \text{ on map} = 24,000 \times 0.5'' \text{ on ground} = 12,000 \text{ in} = 1,000 \text{ ft}$$

$$1.0'' \text{ on map} = 24,000 \times 1.0'' \text{ on ground} = 24,000 \text{ in} = 2,000 \text{ ft}$$

D. Determining areas (acreage) on maps

2. Dot grids

- a quick useful method that can be performed in the field

3. GIS

- extensively use of computer aid program in the office