GEO-A-CC-1-02-TH – CARTOGRAPHIC TECHNIQUES

TOPIC- Bearing: Magnetic and True, Whole-Circle and Reduced

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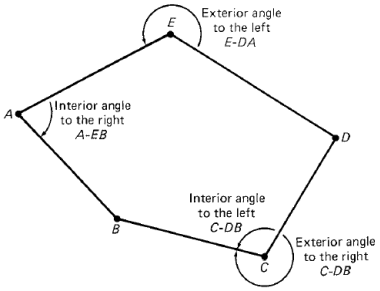
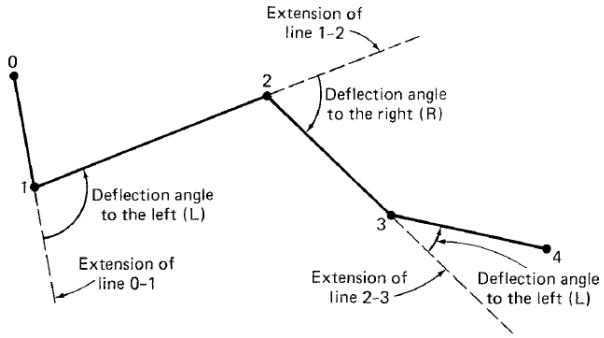
Azimuth and Bearing of a Line

- The direction of any line may be described either by its *azimuth* angle or by its *bearing.* Azimuth directions are usually preferred by surveyors; they are purely numerical and help to simplify office work by allowing a simple routine for computations.
- Bearings, on the other hand, require two letter symbols as well as a numerical value, and each bearing computation requires an individual analysis with a sketch.

Horizontal Angles and Directions

- An angle *turned* (measured) in a clockwise direction, from the "rear" to the "forward" point or station, is called an *angle to the right.* Stations are commonly labelled consecutively in the direction of the survey with numbers or letters.
- Pointing the instrument toward the rear station may be called the *backsight* and toward the forward station, the *foresight*; this terminology is similar to that used for levelling.





Deflection angle

A deflection angle must be designated as being either an angle to the Left (L) or an angle to the right (R). diagram above

Azimuths

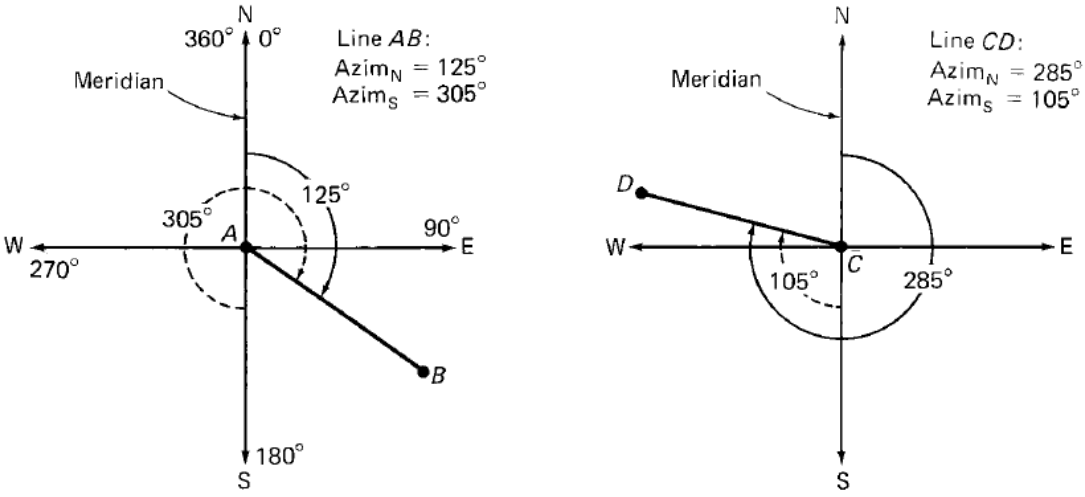
- The azimuth of a line is the ***clockwise*** horizontal angle between the line and a given **reference direction** or meridian. Usually, north is the reference direction; south is sometimes used as a reference for geodetic surveys that cover large areas. An azimuth angle should be identified as being measured from the north (AzimN)
- Any azimuth angle will have a positive value between 0 and 360°

Bearings

- A bearing of a line is the angle from the north (N)*or* the south (S) end of the meridian, *whichever is nearest*, to the line; it has the added designation of east (E) or west (W), whichever applies.
- The directions *due east* and *due west* are, of course, perpendicular to the north–south meridian.
- A line may fall in one of four *quadrants:* northeast (NE), southeast (SE), southwest (SW), or northwest (NW)
- A bearing may be measured either in a clockwise or in a counter-clockwise direction, depending on which quadrant the line is in. A bearing angle is *always* an acute angle, that is, less than 90°.

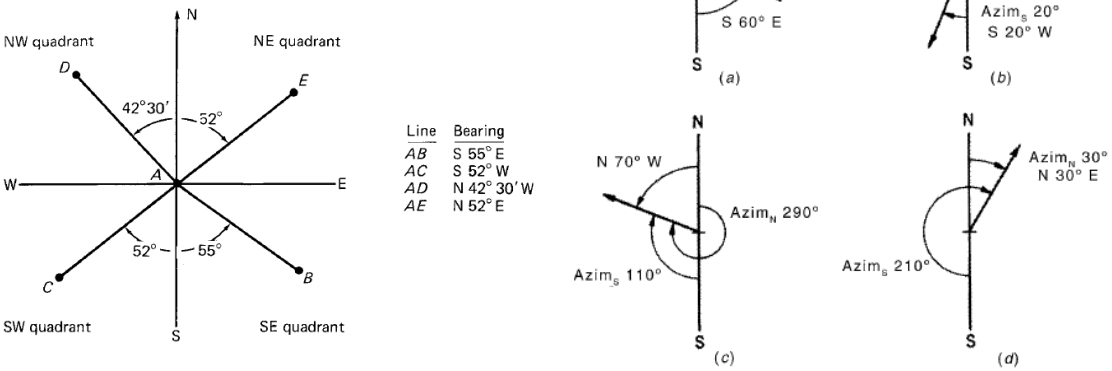
Convert directions from azimuths to bearings

- It is often necessary to convert directions from azimuths to bearings, or vice versa. Although a systematic set of rules can be used for this, it is usually best to first make a sketch of the line and its meridian.
- In the NE quadrant, the numerical values of bearing and AzimN are always identical.
- In the other quadrants, the conversion involves either a simple addition or subtraction with 180° or 360°.The azimuth of a line is usually referenced to the north end of the meridian. That is, AzimN differs from AzimS by 180°.



Equivalent Azimuths and Bearings

	$Azimuth_N$		$Azimuth_S$		Bearing
(*a*)	120°	=	300°	=	S60° E
(*b*)	200°	=	20°	=	S20° W
(*c*)	290°	=	110°	=	N70° W
(*d*)	30°	=	210°	=	N30° E



Line	Bearing
AB	S 55° E
AC	S 52° W
AD	N 42° 30′ W
AE	N 52° E

True Meridian

- A *true meridian* at a point is an imaginary line that passes through that point and the geographic north and south poles of the earth; the poles, of course, lie on the axis of rotation of the earth.
- At any given point, the *direction of the true meridian is fixed;* it does not change over time.
- True north may be established in the field by precise instrument observations and angular measurements of the sun, the North Star (Polaris), or any other bright star of known position.
- A special *gyroscope theodolite* may be used to obtain true north. But establishing true north is not a routine task for most surveyors in private practice.

Magnetic Meridian

- A *magnetic meridian* is the direction taken by a pivoted, freely swinging magnetic needle, suspended in a device called a *compass.* The compass needle aligns itself with the horizontal component of the earth's magnetic field.
- The magnetic field of the earth can be approximately described as the field that would result if a huge bar magnet were embedded within the earth, with one end located far below the surface in the Hudson Bay region and the other end in a corresponding position in the southern hemisphere.
- The lines of magnetic force follow somewhat irregular paths, running from the south magnetic pole to the north magnetic pole.

Magnetic declination

- The earth's magnetic poles are not at the same location as the true geographic poles; they are separated by a significant distance. In addition, the field slowly changes in general direction over time.
- *The magnetic meridian is not necessarily parallel to the true meridian.* A magnetic needle will therefore point exactly true north **only by chance**.
- The declination is an angle east or west of the **true meridian**. For example, when the needle points 10° west of true north (N 10° W), the declination is said to be 10° west (10°W). If the needle points N 5°30 E, its declination is 5°30 E.
- The magnetic declination varies with location on the earth's surface. The USGS periodically publishes an **isogonic chart**, which shows lines of equal declination.
- ***Isogonic lines*-** Lines of equal magnetic declination.
- **A*gonic* line-** Line of zero magnetic declination i.e. at locations on that line, a magnetic needle points true north.

Changes in Magnetic Declination

- At a given location, the magnetic declination changes with time. Changes in the earth's magnetic field cause the following four types of *variations* in declination:
- 1. **Secular variation**: a long-term change in declination, with a cycle of approximately 300 years.
    - In the United States, the maximum rate of secular variation is about 7.5 minutes of arc per year. This amounts to several degrees over the years, and over the 300-year cycle, the declination at a given location may vary as much as 35° from east to west.
- 2. **Annual variation**: a magnetic meridian swing of at most 1 minute (01´) of arc, back and forth, during the year.
- 3. **Diurnal variation**: a swing of approximately 4–10 minutes of arc, depending on the locality.At night the needle is quiescent in its mean position. It swings east 2–5 minutes in the morning and west 2–5 minutes in the afternoon.
- 4. **Irregular variation**: During some of the magnetic disturbances associated with sunspots, there may also be significant irregular variations of declination

Source:

- **Nathanson, Jerry A. Surveying fundamentals and practices / Jerry Nathanson, Michael T. Lanzafama, Philip Kissam.6th ed.**