

Angles, Directions and Angle Measuring Equipment

The title is centered and overlaid on a decorative arrangement of five circles. The top row consists of three circles: a white circle with a light blue outline on the left, a solid light blue circle in the middle, and another solid light blue circle on the right. The bottom row consists of two solid light blue circles on the left and one white circle with a light blue outline on the right.

Date: October 19th 2009

Introduction

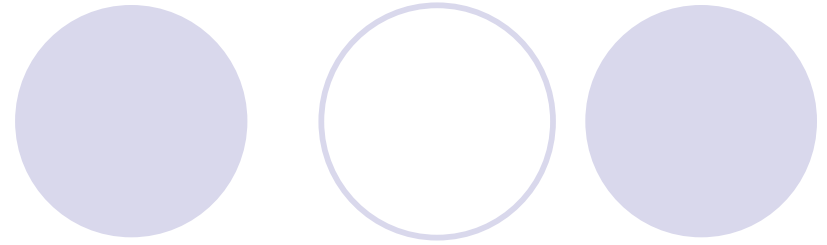


- To define the position of a point to another,
 - Distances
 - And Angles
 - Or Elevation difference are required.

Horizontal, Vertical and Zenith Angles

- Vertical Angle is measured in a vertical plane using the horizontal plane as a reference line
- It could be positive or negative. (-90 to +90)
- Zenith angle (α) is measured in a vertical plane but uses the overhead extension of plumb line as a reference line.
- Its value ranges from 0-180.

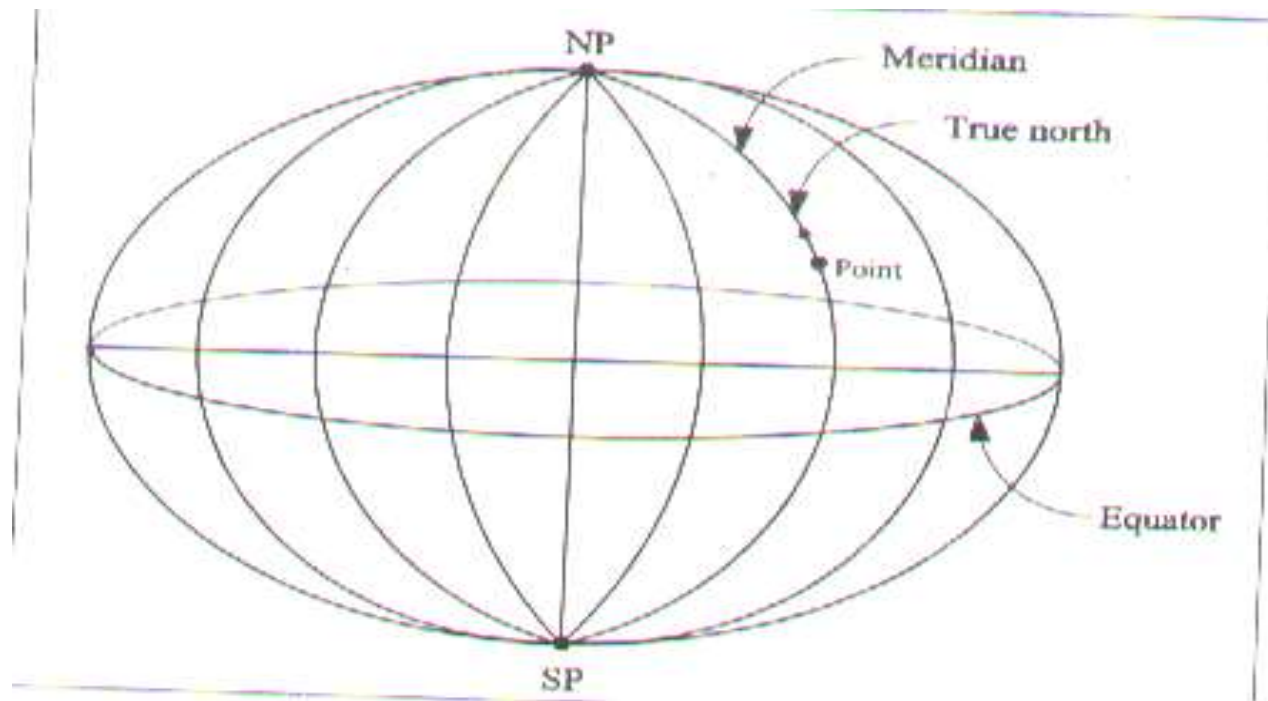
Reference direction



- The direction of a line can be defined w.r.t:
 - True, geographic north
 - Magnetic north
 - Assumed north

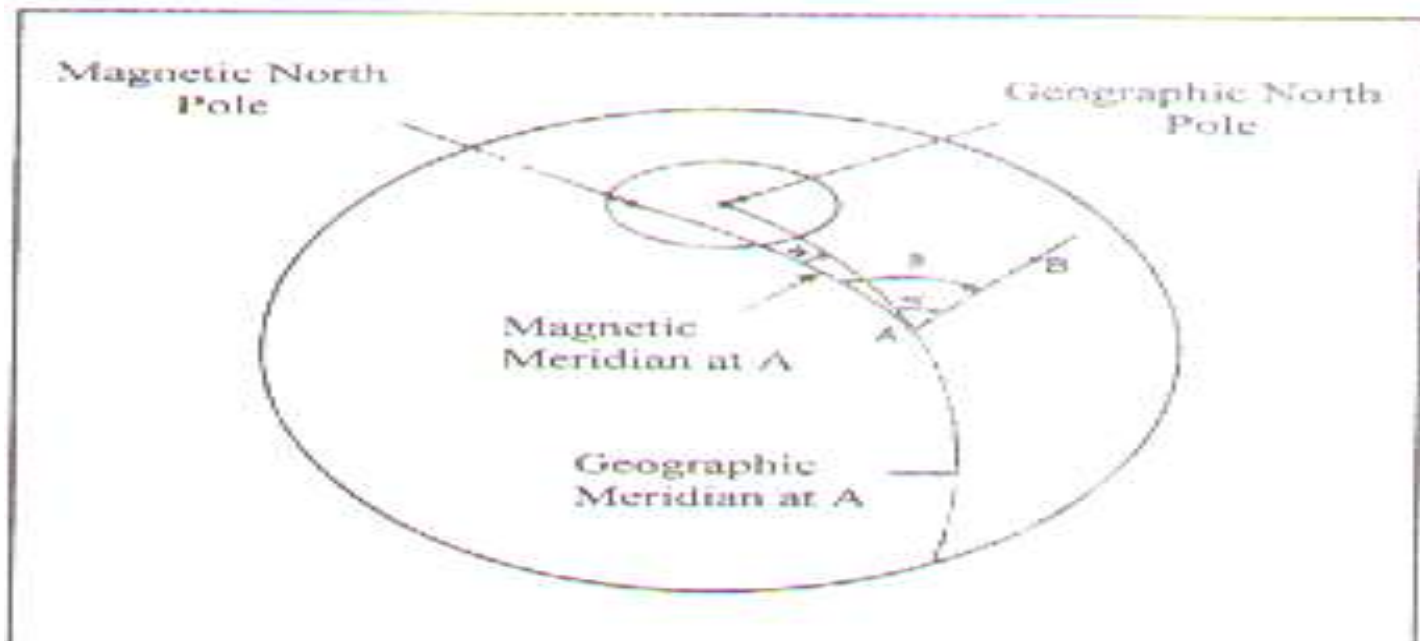
True, geographic north

- It is the direction defined by the north pole through the meridian.
- It is steady, doesn't change with time so it is preferable to be used.
- Different methods which could be approximate or precise can be used to determine it.
- Approximate methods like the watch method and the shadow method. Precise methods like GPS.

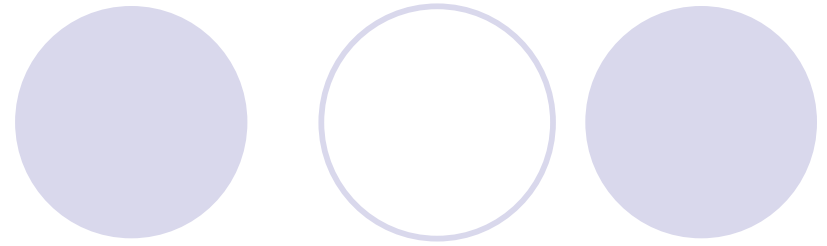


Magnetic north

- Direction is defined by the magnetic needle in earth's magnetic field.
- Magnetic meridian makes an angle γ to the east or the west of the true meridian.
- This angle differs from place to another and from time to time.
- So it is preferable to use the true but if the magnetic will be used then the time of the year when it was measured should be defined in order to relate it to the true north.



Assumed north

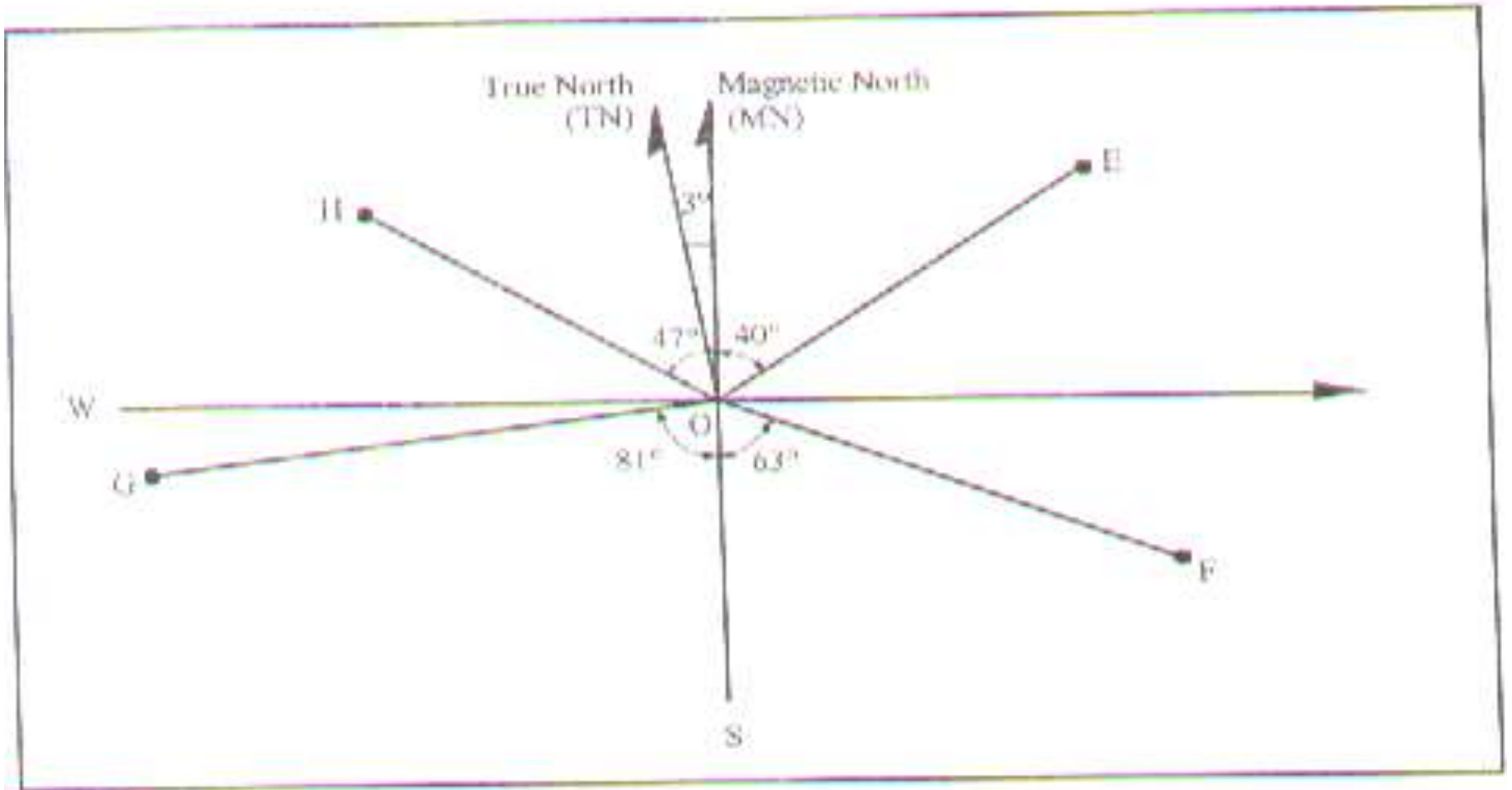


- If there is not any mean to measure the north , then
- Any reference line to which the measurements can be related can be used, then later it can be corrected.

Reduced Bearing of a line

- The reduced bearing of a line is the acute angle that the line makes with the reference meridian (whether being geographic or magnetic).
- It is expressed as north or south so many degrees to east or west.
- The true reduced bearing of a line never exceeds 90 and is never referenced to east or west line.
- The magnetic reduced bearing of a line is the acute angle that the line makes with the magnetic meridian

Example

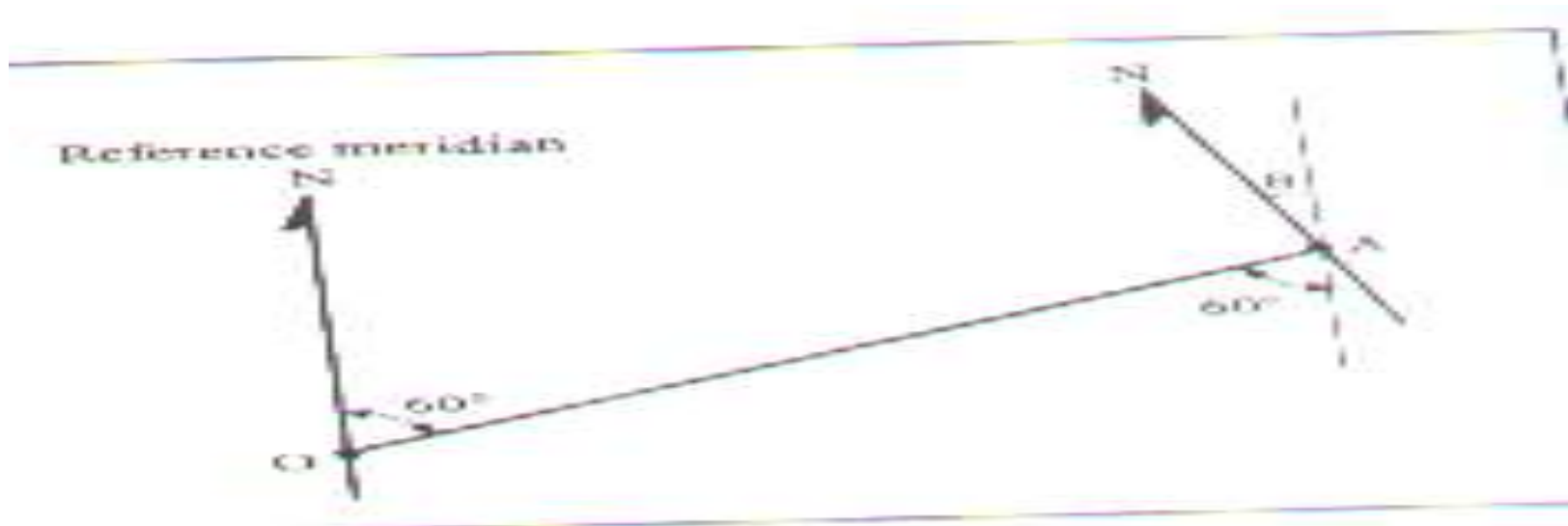


Azimuth or whole circle Bearing

- It is the angle measured from the true north with clock wise direction
 - It could reach 360

Back reduced bearing and back azimuth

- If the reduced bearing or the azimuth of line OA measured at O, then the Back is measured at A.
 - θ is an angle due to convergence of the meridians.
 - Its magnitude depends on the east-west distance between the 2 end points and the average latitude along the line.



Principle elements of an angle –measuring instrument

- The basic elements:
 - The line of sight
 - Horizontal axis
 - Vertical axis
 - A graduated horizontal circle for measuring H. Angles.
 - A graduated vertical circle for measuring V. Angles.
- The following conditions should exist:
 - Line of sight should be perpendicular to the Horizontal axis
 - Horizontal axis should be perpendicular to the Vertical axis
 - Horizontal axis should be perpendicular to the Vertical circle
 - the Vertical axis should be perpendicular to the horizontal circle

Measurements of a horizontal Angle

- Theodolite at B read A then rotate clockwise to read C. (direct or F.R)
- Theodolite at B read C then rotate counter clockwise to read C. (reverse or F.L)
- You have to setting up the instrument and the rod very carefully.

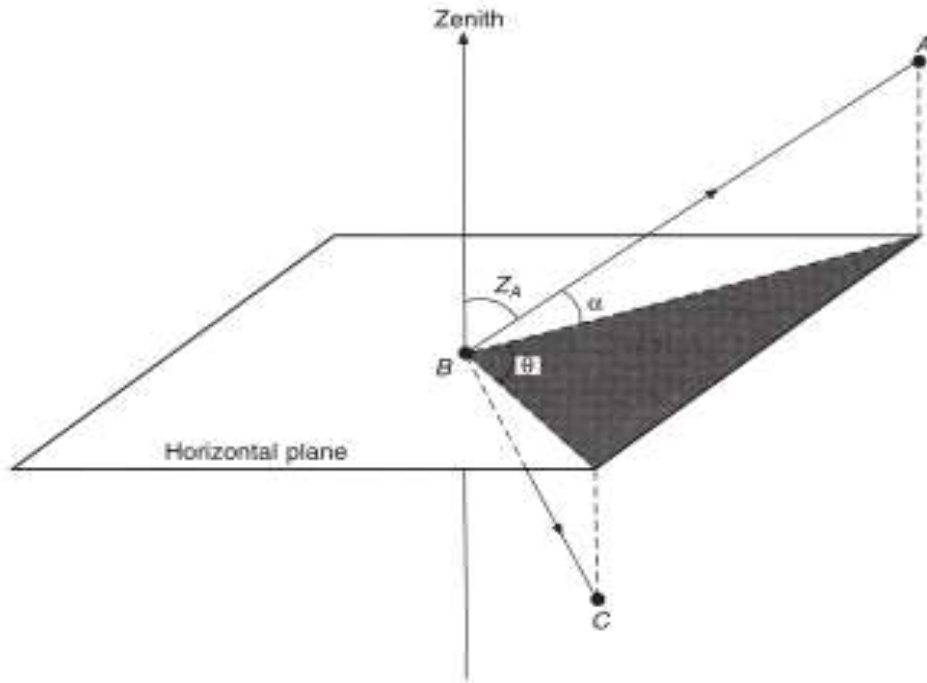
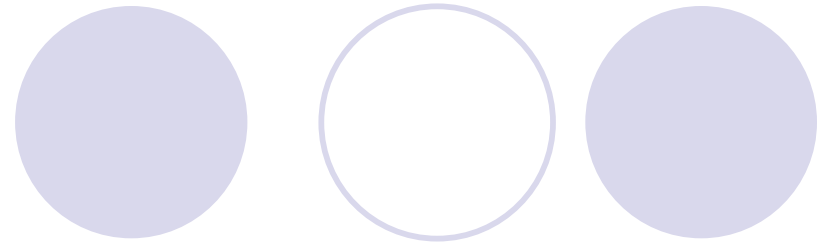
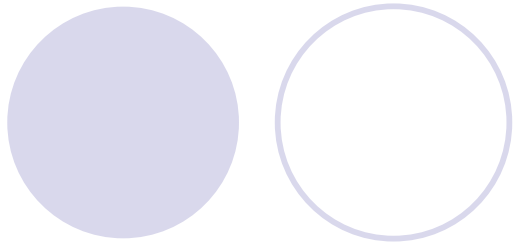


Fig. 5.1 Horizontal, vertical and zenith angles

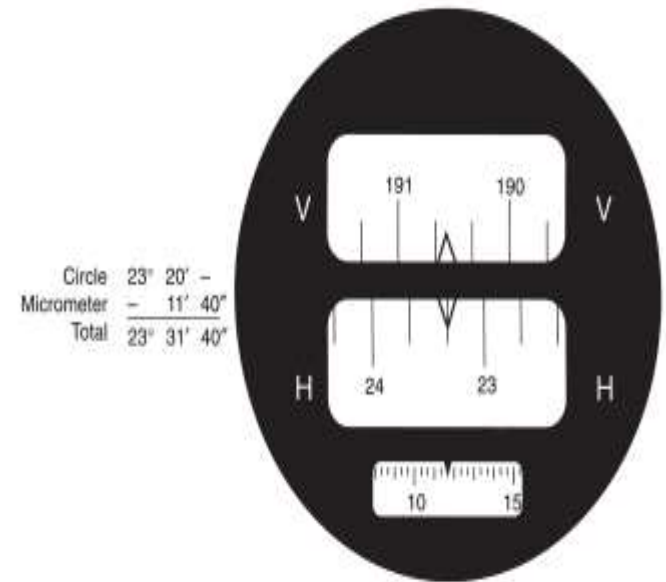


Fig. 5.6 Watts Microptic No 1 theodolite reading system