6. Measuring Angles

Print

Angles can be measured with a magnetic compass, of course. Unfortunately, the Earth's magnetic field does not yield the most reliable measurements. The magnetic poles are not aligned with the planet's axis of rotation (an effect called **magnetic declination**), and they tend to change location over time. Local magnetic anomalies caused by magnetized rocks in the Earth's crust and other geomagnetic fields make matters worse.

For these reasons, land surveyors rely on **transits** (or their more modern equivalents, called **theodolites**) to measure angles. A transit consists of a telescope for seeing distant target objects, two measurement wheels that work like protractors for reading horizontal and vertical angles, and bubble levels to ensure that the angles are true. A theodolite is essentially the same instrument, except that some mechanical parts are replaced with electronics.

Figure 5.7.1 Transit.

Credit: Raisz, 1948. Used by permission.

Surveyors express angles in several ways. When specifying directions, as is done in the preparation of a property survey, angles may be specified as bearings or azimuths. A **bearing** is an angle less than 90° within a quadrant defined by the cardinal directions. An **azimuth** is an angle between 0° and 360° measured clockwise from North. "South 45° East" and "135°" are the same direction expressed as a bearing and as an azimuth. An **interior angle**, by contrast, is an angle measured between two lines of sight, or between two legs of a **traverse** (described later in this chapter).

The Nature of Geographic Information

Search

Chapters

- Chapter 1: Data and Information
- Chapter 2: Scales and Transformations
- Chapter 3: Census Data and Thematic Maps
- Chapter 4: TIGER, Topology and Geocoding
- Chapter 5: Land Surveying and GPS
  - 1. Overview
  - 2. Geospatial Data Quality
  - 3. Error and Uncertainty
  - 4. Systematic vs. Random Errors
  - 5. Survey Control
  - **6. Measuring Angles**
  - 7. Measuring Distances
  - 8. Horizontal Positions
  - 9. Traverse
  - 10. Triangulation
  - 11. Trilateration
  - 12. Vertical Positions
  - 13. Global Positioning System
  - 14. Space Segment

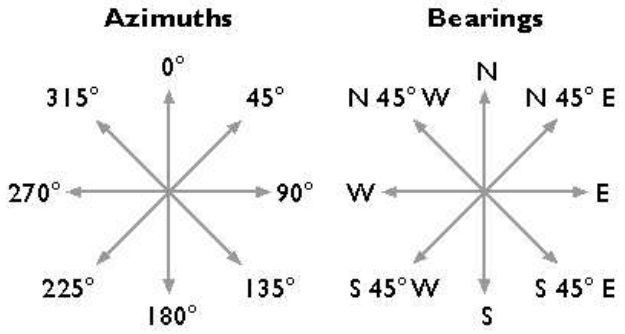

Figure 5.7.2 Azimuths and bearings.

In the U.S., professional organizations like the American Congress on Surveying and Mapping, the American Land Title Association, the National Society of Professional Surveyors, and others, recommend minimum accuracy standards for angle and distance measurements. For example, as Steve Henderson (personal communication, Fall 2000, updated July 2010) points out, the Alabama Society of Professional Land Surveyors recommends that errors in angle measurements in "commercial/high risk" surveys be no greater than 15 seconds times the square root of the number of angles measured.

To achieve this level of accuracy, surveyors must overcome errors caused by faulty instrument calibration; wind, temperature, and soft ground; and human errors, including misplacing the instrument and misreading the measurement wheels. In practice, surveyors produce accurate data by taking repeated measurements and averaging the results.

‹ 5. Survey Control | up | 7. Measuring Distances ›

- 15. Control Segment
- 16. User Segment
- 17. Satellite Ranging
- 18. GPS Error Sources
- 19. User Equivalent Range Errors
- 20. Dilution of Precision
- 21. GPS Error Correction
- 22. Differential Correction
- 23. Real-Time Differential Correction
- 24. Post-Processed Differential Correction
- 25. Summary
- 26. Bibliography

Chapter 6: National Spatial Data Infrastructure I

Chapter 7: National Spatial Data Infrastructure II

Chapter 8: Remotely Sensed Image Data

Chapter 9: Integrating Geographic Data

Navigation

- login
- Search

Author: David DiBiase, Senior Lecturer, John A. Dutton e-Education Institute, and Director of Education, Industry Solutions, Esri. Instructors and contributors: Jim Sloan, Senior Lecturer, John A. Dutton e-Education Institute; Ryan Baxter, Senior Research Assistant, John A. Dutton e-Education Institute, Beth King, Senior Lecturer, John A. Dutton e-Education Institute and Assistant Program Manager for Online Geospatial Education, and Adrienne Goldsberry, Senior Lecturer, John A. Dutton e-Education Institute; College of Earth and Mineral Sciences, The Pennsylvania State University.

The John A. Dutton Institute for Teaching and Learning Excellence is the learning design unit of the College of Earth and Mineral Sciences at The Pennsylvania State University.

Navigation

- Home
- News
- About
- Contact Us
- People
- Resources
- Services
- Login

EMS

- College of Earth and Mineral Sciences
- Department of Energy and Mineral Engineering
- Department of Geography
- Department of Geosciences
- Department of Materials Science and Engineering
- Department of Meteorology and Atmospheric Science
- Earth and Environmental Systems Institute
- Earth and Mineral Sciences Energy Institute

Programs

- Online Geospatial Education Programs
- iMPS in Renewable Energy and Sustainability Policy Program Office
- BA in Energy and Sustainability Policy Program Office

Related Links

- Penn State Digital Learning Cooperative
- Penn State World Campus
- Web Learning @ Penn State

2217 Earth and Engineering Sciences Building, University Park, Pennsylvania, 16802
Contact Us