

Basic land surveying techniques using total station Tutorial

Basic land surveying techniques using total station are fundamental skills for surveyors, engineers, architects, and construction professionals. The total station is an advanced electronic device that combines the functions of a theodolite and an electronic distance measurement (EDM) instrument. It allows for precise measurement of angles and distances, facilitating accurate mapping and layout of land features. Mastering these techniques ensures efficient project planning, boundary determination, and site development. In this guide, we will explore the essential methods and best practices for conducting land surveys using a total station, providing a comprehensive overview suitable for beginners and experienced practitioners alike.

Understanding the Total Station and Its Components

Before diving into surveying techniques, it's crucial to understand the main components of a total station and their functions.

Key Components of a Total Station

- **Electronic Theodolite:** Measures horizontal and vertical angles with high precision.
- **Electronic Distance Measurement (EDM):** Measures distances electronically using laser or infrared signals.
- **Microprocessor and Data Storage:** Processes measurements and stores data for later processing.
- **Telescope:** For sighting and aiming at targets or benchmarks.
- **Control Panel and Display:** Allows surveyors to input commands and view measurements.

Preparing for Land Surveying with a Total Station

Proper preparation ensures accuracy and efficiency during the survey process.

Pre-Survey Planning

- **Define Survey Objectives:** Clarify what needs to be mapped or measured, such as boundaries, features, or construction sites.
- **Review Legal Boundaries and Permits:** Ensure you have the necessary permissions and

understand legal boundaries.

- **Gather Existing Data:** Collect maps, plans, and previous survey data for reference.
- **Plan Survey Benchmarks and Control Points:** Identify fixed points to serve as reference stations.

Equipment Setup and Calibration

- **Transport Equipment Safely:** Handle the total station carefully to avoid damage.
- **Set Up on a Stable Platform:** Use a tripod on firm, level ground to ensure stability.
- **Level the Instrument:** Use the built-in bubble or electronic levels for precise leveling.
- **Calibrate the Total Station:** Perform calibration checks as recommended by the manufacturer to ensure measurement accuracy.

Basic Land Surveying Techniques Using Total Station

Now, let's explore the core techniques involved in land surveying with a total station.

1. Establishing Control Points and Benchmarking

Control points serve as fixed references that help maintain accuracy throughout the survey.

- **Identify or Set Control Points:** Use known coordinates or establish new benchmarks with precise measurements.
- **Station Setup:** Position the total station over a control point, ensuring stability and proper leveling.
- **Record Coordinates:** Use the total station to record the position of the control point for future reference.

2. Taking Horizontal and Vertical Angles

Angles are fundamental for locating points relative to the station.

- **Aiming at a Target:** Use the telescope to sight the point of interest.
- **Measuring Horizontal Angle:** Rotate the theodolite horizontally to the target, and record the angle reading.
- **Measuring Vertical Angle:** Tilt the telescope vertically to the target, and record the vertical angle.
- **Multiple Readings:** Take multiple measurements to improve accuracy and mitigate errors.

3. Measuring Distances

Accurate distance measurement is vital for mapping land features.

- **Target Setup:** Place a prism or reflector at the point to be measured.
- **Electronic Distance Measurement (EDM):** Aim the total station at the reflector and send a laser or infrared signal to measure the distance.
- **Record Data:** Save the distance measurement in the device's memory.
- **Repeat Measurements:** Take multiple readings to ensure accuracy and average the results if needed.

4. Computing Coordinates of Survey Points

Using the measured angles and distances, surveyors calculate the precise coordinates of points.

- **Apply Trigonometry:** Use the measured angles and distances to compute the X, Y, and Z coordinates.
- **Coordinate Calculation:** Use the following formulas:
 - $X = \text{Distance} \times \cos(\text{Vertical Angle}) \times \sin(\text{Horizontal Angle})$
 - $Y = \text{Distance} \times \cos(\text{Vertical Angle}) \times \cos(\text{Horizontal Angle})$
 - $Z = \text{Distance} \times \sin(\text{Vertical Angle})$
- **Record Coordinates:** Store the calculated coordinates for mapping or further analysis.

Data Management and Processing

Efficient data management ensures the accuracy and usability of survey results.

Data Transfer and Storage

- **Download Data:** Transfer measurements from the total station to a computer or data collector using USB, Bluetooth, or Wi-Fi.
- **Organize Data:** Label points systematically with codes or descriptions for easy identification.

Processing and Mapping

- **Use Survey Software:** Import data into CAD or GIS software for mapping and analysis.
- **Check for Errors:** Validate data consistency and identify anomalies.
- **Create Maps and Plans:** Generate detailed land maps, topographical plans, or layout drawings based on the survey data.

Best Practices for Accurate Land Surveying

Adherence to best practices enhances the reliability of survey results.

- **Ensure Proper Calibration:** Regularly calibrate the total station according to manufacturer guidelines.
- **Maintain Clear Sight Lines:** Remove obstructions between the instrument and targets for accurate measurements.
- **Repeat Measurements:** Take multiple readings and average them to reduce errors.
- **Use Stable Benchmarks:** Rely on fixed, well-established control points to minimize positional errors.
- **Document Everything:** Keep detailed field notes, including conditions, instrument settings, and observations.

Conclusion

Mastering basic land surveying techniques using a total station is essential for producing precise and reliable land measurements. From establishing control points and measuring angles and distances to processing data and ensuring accuracy through best practices, these techniques form the backbone of successful surveying projects. As technology advances, staying updated with the latest equipment features and software capabilities will further enhance the quality and efficiency of land surveys. Whether you are undertaking boundary determination, construction layout, or topographical mapping, a thorough understanding of these fundamental techniques will ensure your work is accurate, efficient, and compliant with industry standards.

Basic Land Surveying Techniques Using Total Station: A Comprehensive Guide

Land surveying is a fundamental aspect of construction, land development, and mapping projects. With advancements in technology, the use of total stations has revolutionized traditional surveying methods, providing greater accuracy, efficiency, and versatility. Whether you are a novice surveyor or a seasoned professional, understanding the basic land surveying techniques using total station is essential for producing reliable data and completing your projects successfully.

Understanding the Total Station: The Modern Surveying Instrument

Before delving into specific techniques, it's important to grasp what a total station is and how it functions.

What is a Total Station?

A total station is an electronic/optical instrument that combines an electronic theodolite with an electronic distance measurement (EDM) device. It allows surveyors to measure angles and distances simultaneously, enabling precise determination of positions and elevations on the land.

Key Features of a Total Station

- Angular measurement: Measures horizontal and vertical angles.
- Distance measurement: Uses EDM technology to determine the distance to a specific point.
- Data collection: Stores measurements digitally, often integrated with software for processing.
- Targeting system: Includes a telescope with crosshairs and often a laser or infrared beam for aiming.

Preparing for Land Surveying with a Total Station

Proper preparation ensures accurate results and efficient workflow.

Equipment Checklist

- Total station and tripod
- Reflector or prism pole
- Staff or ranging rod
- Data collector or compatible device
- Leveling tools (spirit level, plumb bob)
- Surveying markers (stakes, flags)
- Field notebook and pencils
- Batteries and chargers

Pre-Survey Planning

- Obtain and review existing land records or maps.
- Define the survey scope and objectives.
- Identify control points for establishing a coordinate system.
- Plan station locations considering line-of-sight and terrain.

- Ensure all equipment is calibrated and functioning.

Basic Land Surveying Techniques Using Total Station

The fundamental steps involve setting up the instrument, establishing control points, and collecting data systematically.

1. Setting Up the Total Station

- Selecting the station point: Choose a stable, accessible location with an unobstructed view of the survey area.
- Tripod setup: Extend the tripod legs evenly on firm ground, ensuring stability.
- Leveling: Use the leveling bubble or electronic level to make the instrument perfectly horizontal. Accurate leveling is critical for precise measurements.
- Centering: Position the instrument exactly over the station point, using a plumb bob or optical plummet.
- Focusing: Adjust the telescope to clearly view the target points.

2. Establishing Control Points

Control points serve as reference markers that define the coordinate system for the survey.

- Backsight measurement: Sight to a known point or a previously established control point.
- Recording coordinates: Measure the horizontal and vertical angles and the distance to the control point.
- Coordinate computation: Use the measured data to calculate the precise position of the station.
- Mark control points: Physically mark the control points with stakes or markers for future reference.

3. Taking Measurements of Land Features

Once control points are established, proceed to measure the features of interest.

- Targeting points: Use the reflector or prism to aim at specific points such as corners, boundaries, or features.
- Measuring angles and distances: Record horizontal and vertical angles, as well as distances, for each point.
- Data logging: Save measurements digitally or record manually for post-processing.

4. Traversing and Loop Closure

Traversing involves moving from one point to another, creating a network of measurements.

- Open traverse: Moving through the survey area, measuring angles and distances at each station.
- Closed traverse: Returning to the starting point, allowing for error checking and adjustment.
- Loop closure: Comparing the calculated positions with known coordinates to verify accuracy.

5. Data Processing and Mapping

Post-fieldwork, process the collected data to produce maps, plans, or reports.

- Data transfer: Upload data to surveying software.
- Adjustment and correction: Apply necessary corrections for instrument errors, atmospheric conditions, and curvature.
- Drawing plans: Generate detailed maps indicating land features, boundaries, and elevations.
- Verification: Cross-check measurements against control points to confirm accuracy.

Best Practices for Accurate Land Surveying with Total Station

Achieving reliable results requires attention to detail and adherence to best practices.

- Ensure proper calibration: Regularly calibrate the total station according to manufacturer specifications.
- Maintain line-of-sight: Clear obstructions between instrument and target points to prevent measurement errors.
- Use stable control points: Mark control points firmly to avoid movement or disturbance.
- Double-check measurements: Take multiple readings for critical points and average the results.
- Record environmental conditions: Note weather factors such as temperature and humidity that can influence measurements.
- Follow safety protocols: Wear high-visibility clothing and be cautious around construction sites or traffic.

Conclusion: Mastering Land Surveying Techniques with Total Station

Using a total station for land surveying combines precision, efficiency, and versatility. By understanding its core functions and following systematic procedures for setup, measurement, and

data processing, surveyors can produce accurate land records essential for construction, mapping, and land management projects. While mastering these techniques requires practice and attention to detail, the investment in learning and equipment maintenance pays off through reliable results and streamlined workflows. As technology continues to evolve, staying updated with new features and software enhancements will further enhance your surveying capabilities and ensure professional excellence in your projects.

Question What are the fundamental steps involved in land surveying using a total station? The fundamental steps include setting up the total station on a stable point, calibrating the instrument, taking precise measurements of angles and distances, recording data, and then processing the measurements to create accurate land maps or plots. **Answer** How do you set up a total station correctly for land surveying? Setup involves choosing a stable and known point, leveling the total station with the built-in bubble levels, centering the instrument precisely over the station point using a plumb bob or optical plummet, and then performing a calibration check to ensure accuracy. What is the importance of station calibration in total station surveying? Calibration ensures that the total station's internal measurements are accurate, preventing errors in angles and distances, which is critical for producing reliable survey data and precise land measurements. How do you measure angles and distances using a total station? Angles are measured by aiming the instrument at a point and recording the horizontal and vertical angles. Distances are measured using electronic distance measurement (EDM) by targeting a reflector or prism and emitting a laser or infrared signal to determine the distance based on the return time. What are common sources of error in total station land surveying and how can they be minimized? Common errors include instrument misalignment, environmental factors like temperature and wind, and human error. They can be minimized by proper setup and calibration, taking multiple measurements, using reflectorless modes cautiously, and applying correction factors for environmental conditions. How do you record and process data collected from a total station? Data can be recorded directly into the total station's onboard memory or external data collectors. Once collected, the data is transferred to software for processing, where it is used to create detailed maps, CAD drawings, or 3D models. What are the advantages of using a total station over traditional surveying methods? Total stations provide high accuracy, faster data collection, integration of angular and distance measurements, and the ability to store large amounts of data, making land surveying more efficient and precise. Can a total station be used for both topographic and cadastral surveys? Yes, a total station is versatile and can be used for both topographic surveys, which map natural and built features, and cadastral surveys, which establish property boundaries, due to its precision and flexibility. What safety precautions should be taken when using a total station in the field? Safety precautions include being aware of your surroundings, avoiding setting up on unstable ground, using safety gear, ensuring the equipment is properly secured, and avoiding direct exposure to laser beams, especially near eyes.

Related keywords: land surveying, total station, measuring angles, distance measurement, leveling, topographic survey, land mapping, survey instruments, data collection, survey accuracy

Basic surveying free book

Basic Surveying Free Book: Your Comprehensive Guide to Learning Surveying Skills

In the realm of civil engineering, construction, and land development, surveying plays a vital role in ensuring accurate measurements, proper planning, and successful project execution. For students, professionals, or enthusiasts seeking to grasp the fundamentals of surveying without incurring hefty costs, a basic surveying free book can be an invaluable resource. This article explores the significance of free educational materials in surveying, highlights essential topics covered in such books, and provides guidance on how to access quality free surveying resources online.

Understanding the Importance of a Basic Surveying Free Book

Surveying is the science of measuring and mapping the environment to determine the positions of points on the Earth's surface. It forms the backbone of many engineering and land development projects. While formal education and professional training are crucial, self-learning through well-structured books offers a flexible and cost-effective way to build foundational knowledge.

A basic surveying free book serves multiple purposes:

- Accessible Learning: Removes financial barriers, allowing anyone interested to learn at their own pace.
- Comprehensive Coverage: Provides detailed explanations of fundamental surveying concepts.
- Practice-Oriented: Includes exercises, diagrams, and examples to reinforce understanding.
- Resource for Instructors: Acts as a supplementary teaching tool in academic settings.

Key Topics Covered in a Basic Surveying Free Book

A well-crafted free surveying book typically covers a broad spectrum of topics essential for understanding the discipline. Here are some core areas you can expect to find:

1. Introduction to Surveying

- Definition and scope of surveying
- Historical development of surveying techniques
- Applications of surveying in various industries

2. Principles of Measurement

- Accuracy and precision
- Units of measurement
- Error types and correction methods

3. Types of Surveying

- Land surveying
- Engineering surveying
- Construction surveying
- Geodetic surveying

4. Equipment and Instruments

- Theodolites
- Total stations
- Levels and leveling instruments
- GPS and GIS technology
- Chains, tapes, and measuring wheels

5. Basic Surveying Techniques

- Chain surveying
- Compass surveying
- Plane table surveying
- Triangulation and trilateration

6. Leveling and Contouring

- Differential leveling
- Profile leveling
- Contour mapping

7. Coordinate Systems and Map Projections

- Latitude and longitude
- UTM coordinate system
- Map projection principles

8. Data Analysis and Representation

- Plotting survey data
- Drawing maps and plans
- Using CAD software basics

9. Surveying Standards and Legal Aspects

- Boundary determination
- Legal boundaries and land rights
- Survey documentation and reports

Advantages of Using a Free Surveying Book

Choosing a free resource offers several benefits:

- Cost-Effective Learning: No financial investment needed, making education accessible to all.
- Self-Paced Study: Learn at your convenience without the constraints of classroom schedules.
- Supplemental Material: Can be used alongside practical training to deepen understanding.
- Up-to-Date Content: Many free online books are regularly updated, reflecting current standards and technology.

Where to Find Reliable Basic Surveying Free Books

Accessing quality free surveying books requires knowing where to look. Here are some reputable sources:

1. Open Access Educational Platforms

- OpenStax: Offers free textbooks on various subjects, including engineering basics.
- LibGen: A vast repository of free books, including technical manuals.
- BookBoon: Provides free engineering and technical books.

2. University and Educational Institution Websites

Many universities publish open courseware and free textbooks:

- MIT OpenCourseWare
- NPTEL (National Programme on Technology Enhanced Learning)
- Coursera (some free courses include downloadable materials)

3. Government and Professional Bodies

- USGS (United States Geological Survey): Offers free technical guides.
- Surveying associations: Often provide free resources or recommended reading lists.

4. Specific Titles to Look For

- "Surveying for Civil Engineering Students" (by various authors)
- "Elementary Surveying" by Charles G. Thomas
- "Basic Surveying" by S.K. Duggal

Always ensure the materials are up-to-date and aligned with current standards in your country or region.

How to Make the Most Out of a Basic Surveying Free Book

To maximize your learning experience, consider the following tips:

- Create a Study Plan: Divide topics into manageable sections and set achievable goals.
- Practice Regularly: Apply theoretical knowledge through exercises and practical activities.
- Use Supplementary Resources: Watch instructional videos, join forums, or participate in online communities.
- Engage in Field Work: Whenever possible, practice with actual surveying instruments or software.
- Seek Clarification: Join online discussion groups or forums to resolve doubts.

Conclusion

A basic surveying free book is an essential resource for anyone interested in understanding the

fundamentals of surveying without financial constraints. It provides foundational knowledge, practical techniques, and insights into modern surveying technology, empowering learners to develop their skills effectively. By accessing reliable free materials online and applying best practices in self-study, aspiring surveyors can build a solid base that prepares them for advanced learning or professional work.

Whether you're a student beginning your journey in civil engineering or a professional looking to refresh your knowledge, free surveying books are a valuable tool to support your educational goals. Start exploring today and take the first step toward mastering the art and science of surveying!

Basic Surveying Free Book: An Essential Resource for Beginners

Embarking on a journey into the world of surveying can be both exciting and overwhelming, especially for newcomers. Fortunately, a well-structured, comprehensive, and free resource like a basic surveying free book can serve as an invaluable guide, laying a solid foundation for understanding fundamental surveying principles and techniques. This review delves deep into what makes such a book a must-have for students, professionals, and hobbyists alike, exploring its content, structure, usability, and overall value.

Introduction to the Significance of a Basic Surveying Free Book

Surveying is the backbone of land development, construction, cartography, and many engineering projects. It involves the measurement and mapping of the physical features of the Earth's surface. For beginners, grasping the core concepts of surveying is essential before progressing to more advanced topics. A free book dedicated to basic surveying offers several advantages:

- Accessibility: No cost barrier makes high-quality education available to a broader audience.
- Comprehensiveness: Often curated to cover foundational topics thoroughly.
- Self-paced Learning: Allows learners to study at their own convenience.
- Resource for Instructors: Serves as a supplementary material in academic settings.

The importance of such a resource cannot be overstated, especially in regions where access to paid textbooks or professional training programs may be limited.

Content Overview of a Typical Basic Surveying Free Book

A well-crafted free surveying book is structured to progressively introduce concepts, building from fundamental principles to practical applications. Typically, the content is organized into several core sections, each vital for comprehensive understanding.

1. Introduction to Surveying

- Definition and Scope: Explains what surveying entails, its historical evolution, and its applications.
- Types of Surveying: Differentiates between various methods such as land surveying, topographical, engineering, cadastral, and hydrographic surveying.
- Importance of Surveying: Discusses its role in planning, design, and legal boundary determination.

2. Basic Principles and Units

- Measurement Units: Details on units like meters, feet, chains, and links.
- Errors in Surveying: Types of errors (systematic and accidental) and methods to minimize them.
- Accuracy and Precision: Definitions and significance in surveying work.

3. Surveying Instruments and Tools

- Chain and Tape: For linear measurements.
- Theodolites: For angular measurements.
- Levels and Dumpy Levels: For height and elevation measurements.
- Total Stations: Modern electronic measuring devices.
- GPS Devices: For satellite-based positioning.

4. Basic Surveying Techniques

- Chain Surveying: Principles, procedures, and calculations.
- Compass Surveying: Use of magnetic compass measurements.
- Levelling: Differential and barometric levelling techniques.
- Triangulation and Trilateration: For extensive area surveys.

5. Coordinate Systems and Map Projections

- Coordinate Systems: Cartesian, polar, and local coordinate systems.
- Map Projections: Common projections used in surveying maps.

6. Data Recording and Plan Preparation

- Field Books and Record Management: Proper recording techniques.
- Plotting and Map Making: Basics of drafting and modern digital mapping tools.

7. Practical Applications and Case Studies

- Real-life examples illustrating survey planning, execution, and analysis.
- Application scenarios in construction, urban planning, and land management.

Features That Enhance Learning in a Free Surveying Book

A quality basic surveying free book often incorporates several features to facilitate effective learning:

- Illustrations and Diagrams: Visual aids to clarify complex concepts.
- Step-by-step Procedures: Detailed instructions for conducting different surveys.
- Sample Problems and Solutions: Practice exercises to reinforce understanding.
- Glossary of Terms: Definitions of technical terminology.
- Summary Sections: Concise recaps of each chapter.
- References and Further Reading: Links to additional resources and advanced texts.

Advantages of Using a Free Surveying Book

Utilizing a free resource offers multiple benefits:

- Cost-Effective Education: No financial investment required.
- Accessibility: Available to anyone with internet access.
- Up-to-Date Content: Many free books are regularly updated or come from reputable sources.
- Complementary Learning: Can be used alongside practical training or coursework.

Additionally, open-source and freely available materials often foster a sense of community and shared learning, encouraging discussion and knowledge exchange.

Assessing the Quality and Reliability of a Free Surveying Book

While free resources are highly beneficial, it's crucial to evaluate their quality:

- Authorship and Credibility: Prefer books authored by recognized experts or affiliated with educational institutions.

- **Publication Date:** Ensure information is current, especially regarding technology like GPS and electronic measuring devices.
- **Peer Reviews and Feedback:** Look for reviews or ratings from other learners or professionals.
- **Compatibility with Curricula:** Check if the content aligns with your learning objectives or academic requirements.

Reliable free books often come from established organizations such as universities, government agencies, or professional surveying bodies.

Practical Tips for Using a Basic Surveying Free Book Effectively

Maximizing the benefits of a free surveying book involves strategic approaches:

- **Structured Study Plan:** Follow the chapters systematically.
- **Hands-On Practice:** Complement reading with fieldwork whenever possible.
- **Note-Taking:** Highlight key concepts and create summaries.
- **Engage in Discussions:** Participate in online forums or study groups.
- **Supplement with Multimedia:** Use videos, tutorials, or software simulations for better understanding.
- **Regular Review:** Periodically revisit concepts to reinforce learning.

Limitations and Considerations

While free books are invaluable, they may have certain limitations:

- **Depth of Content:** May not cover advanced topics or niche areas.
- **Lack of Certification:** Self-study materials do not provide formal accreditation.
- **Variable Quality:** Not all free resources are peer-reviewed or accurate.
- **Technological Gaps:** Some may lack interactive components found in paid courses.

It's advisable to supplement free books with practical experience, mentorship, or paid courses if advanced knowledge or certification is required.

Top Resources for Free Basic Surveying Books

Several platforms and organizations offer high-quality free surveying materials:

- **Open Educational Resources (OER):** Websites like OER Commons, OpenStax, and Coursera.

- University Repositories: Many universities upload course materials freely.
- Government Agencies: Departments of land management or geospatial agencies often publish manuals and guides.
- Professional Organizations: ISPRS, FIG, and other bodies sometimes provide free technical handbooks.

Always verify the credibility and update status of these materials before relying on them.

Conclusion: Why a Basic Surveying Free Book Is Indispensable

A basic surveying free book is an essential starting point for anyone interested in understanding the foundational aspects of land measurement and mapping. Its comprehensive coverage, accessibility, and practicality make it an ideal resource for students, educators, and professionals seeking to build or refresh their surveying knowledge without financial barriers. When selected carefully for quality and relevance, such a book can serve as a reliable roadmap guiding learners through the complexities of surveying, ultimately fostering competence and confidence in fieldwork and analysis.

Investing time in studying from a well-designed free resource not only saves costs but also cultivates self-discipline and curiosity—traits vital for success in the dynamic field of surveying. Whether you are just beginning or seeking to reinforce your basics, embracing a basic surveying free book is a strategic step toward mastering this critical discipline.

Question Where can I find a free basic surveying book online? You can find free basic surveying books on educational platforms like OpenStax, PDF Drive, and Scribd, as well as university repositories that offer open-access resources. **Is there a comprehensive free book available for learning basic surveying techniques?** Yes, many universities and organizations publish comprehensive free textbooks on surveying techniques, such as the 'Basic Surveying' by the Indian Society of Geomatics available online. **Can I use a free book to learn basic surveying for professional purposes?** Absolutely, free books on basic surveying often cover fundamental concepts and techniques that are suitable for beginners and can serve as a solid foundation for professional learning. **Are there any free online courses that complement a free surveying book?** Yes, platforms like Coursera, edX, and YouTube offer free courses in surveying that complement the material found in free books, providing practical demonstrations and tutorials. **What topics are typically covered in a free basic surveying book?** A free basic surveying book usually covers topics such as principles of surveying, measurement techniques, leveling, triangulation, traversing, map making, and the use of surveying instruments.

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