UNIT 03

COMPASS SURVEY

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In civil engineering, a **compass survey** refers to a method of land surveying that primarily uses a magnetic compass to determine the directions or bearings of lines. This technique is traditionally used for mapping and setting out boundaries, and is particularly useful when precise instruments like total stations or GPS devices are not available or when the survey area is relatively small.

Here's an overview of the key aspects of compass surveying:

1. Purpose:

- **Determining Directions**: It is used to measure the direction of lines in relation to a reference direction, typically the magnetic north.
- **Boundary Surveys**: Used to establish or confirm property boundaries and other features in land surveys.
- **Topographical Mapping**: Useful for preparing maps of natural features such as roads, rivers, or land contours.

2. Equipment:

- **Compass**: A magnetic compass (or prismatic compass) is used to measure angles or bearings. The compass indicates the direction of a line by pointing to magnetic north.
- **Chain or Tape**: A measuring tape or chain is used to measure the distances between survey points.
- **Tripod**: A tripod is used to stabilize the compass while taking measurements.
- **Field Book**: A book for recording measurements, notes, and observations.

3. Process:

- **Traverse Method**: In compass surveying, the traverse method is commonly used, where a series of connected lines are measured. The angles and distances between the survey points are recorded.
- **Angle Measurement**: The compass measures the angle of each line relative to a reference direction (typically magnetic north).
- **Distance Measurement**: The distance between survey points is measured using a chain or tape.

4. Types of Compass Surveys:

- **Open Traverse**: This is a survey where the starting and ending points are not connected (i.e., it is an incomplete loop). It may result in some cumulative errors that require adjustments.
- **Closed Traverse**: In a closed traverse, the starting and ending points are the same. This method is more accurate since the errors can be detected and adjusted.

BEARING IN COMPASS SSURVEY

In compass surveying, **bearing** refers to the direction of a line relative to a reference direction, typically magnetic north or true north. Bearings are used to describe the orientation of lines in relation to each other, helping surveyors plot accurate maps or determine the relative positions of survey points.

Key Points About Bearings in Compass Surveying:

1. **Types of Bearings**:

Bearings are typically expressed in two ways:

- **Magnetic Bearing**: The angle measured with respect to magnetic north. Since the Earth's magnetic field varies depending on location, the magnetic bearing can be affected by *magnetic declination*.
- **True Bearing**: The angle measured with respect to true north, which is the direction toward the North Pole. Unlike magnetic bearings, true bearings do not change based on location or time.

2. **Notation**:

Bearings are usually written as an angle from a reference direction. For example:

- **Compass Bearing**: A bearing can be expressed in terms of a quadrant, e.g., **N 45° E** (North 45 degrees East), which means the direction is 45 degrees eastward from due north.
- **Azimuth**: Another way to express a bearing is as an azimuth, which measures the angle in degrees from the north (clockwise) or south (counterclockwise). For example, a bearing of **N 45° E** is equivalent to an azimuth of **45°**.

3. **Quadrants**:

Compass bearings are often expressed in terms of four quadrants:

- **Northeast (NE)**: Between 0° to 90°
- **Southeast (SE)**: Between 90° to 180°
- **Southwest (SW)**: Between 180° to 270°
- **Northwest (NW)**: Between 270° to 360°

The bearing format is typically written as:

- **N/S** [angle] **E/W** (for example, N 30° E, or S 45° W).

4. **Measuring Bearings**:

In compass surveying, the **prismatic compass** is commonly used to measure bearings:

- **Set the compass** on a known reference point (usually the starting station).
- **Align the compass** with the line whose bearing you want to measure.
- **Read the bearing** indicated by the compass. The reading will typically be in degrees.
- **Record the bearing**: The compass shows the magnetic bearing, and corrections for magnetic declination must be applied if you need the true bearing.

5. **Magnetic Declination**:

The Earth's magnetic field is not aligned perfectly with true north, and this difference is called magnetic declination. Surveyors need to correct their measurements to account for this difference.

- If the compass indicates a magnetic bearing, the **declination** correction must be added or subtracted to find the **true bearing**.

For example:

- If the magnetic bearing is **N 30° E**, and the magnetic declination is **5° W**, the true bearing would be:
  - **N 30° E + 5° W = N 25° E.**

6. **Importance of Bearings in Compass Surveying**:

Bearings are essential for:

- **Plotting Survey Lines**: Determining the direction of lines between survey points.
- **Setting Out Boundaries**: Defining the boundaries of a land parcel.
- **Creating Maps**: Ensuring that the lines and angles are accurately represented in maps and plans.
- **Calculating Angles Between Lines**: Bearings are used to calculate the angles between different survey lines, which helps in the computation of distances and the establishment of precise coordinates.

7. Examples:

- A bearing of **N 60° E** means the line is directed 60 degrees east of due north.
- A bearing of **S 45° W** means the line is directed 45 degrees west of due south.

SYSTEM OF BEARING

In compass surveying, the **system of bearing** is a method used to express and record the direction of lines relative to a reference direction. The primary reference directions are **magnetic north** or **true north**. Bearings are essential for accurately plotting the positions of survey points and determining the relationships between those points.

There are two main systems for expressing bearings in compass surveying:

1. Quadrantal Bearing System (or Conventional Bearing System)

This is the most commonly used system in compass surveying. It divides the compass into four quadrants, each spanning 90 degrees. Bearings are expressed in terms of the **angle** relative to the **north or south** directions, followed by the **east or west** direction.

Key Features:

- Bearings are given in terms of **N/S** and **E/W**.
- It follows the pattern: **N/S [angle] E/W**.

Quadrants:

- **First Quadrant (0° to 90°)**: From North to East (NE) or from South to West (SW)
- **Second Quadrant (90° to 180°)**: From North to West (NW) or from South to East (SE)
- **Third Quadrant (180° to 270°)**: From North to West (NW) or from South to East (SE)
- **Fourth Quadrant (270° to 360°)**: From North to East (NE) or from South to West (SW)

Examples:

- **N 30° E**: 30 degrees East of North (between North and East).
- **S 45° W**: 45 degrees West of South (between South and West).
- **N 75° W**: 75 degrees West of North (between North and West).

This system allows for a straightforward description of the direction of lines with respect to North or South, making it easy to understand the orientation of a line.

In **compass surveying**, the **Whole Circle Bearing (WCB)** system is a method for expressing the direction of a line relative to a reference direction, typically **true north** or **magnetic north**. It is a type of **azimuth** system where bearings are measured in a continuous range from **0° to 360°** in a clockwise direction.

Key Features of Whole Circle Bearing (WCB):

1. **Continuous Range from 0° to 360°**:
   - The direction of the line is expressed as an angle measured from **true north** (0°), moving in a **clockwise direction**.
   - In the WCB system, there are no quadrants. Instead, the bearings cover the entire 360° circle, so you get one value for each direction of a line, from **0° to 360°**.
2. **360° System**:
   - The bearing of the line is measured clockwise starting from **north** (0°).
   - **East** is 90°, **South** is 180°, and **West** is 270°.
   - Any other direction will be expressed as an angle in this 360° range.

In **compass surveying**, **Reduced Bearing (RB)** is another way to express the direction of a line, commonly used to simplify and organize bearing information. It is a system that describes the angle of a line relative to either **north** or **south**, but within the **first 90 degrees** of the compass, using the format **N/S [angle] E/W**.

Key Features of Reduced Bearing:

1. **Expression of Bearings**:
   - **Reduced Bearing** is typically written in the format: **N/S [angle] E/W**.
   - Bearings are always given as an angle within **90°** of the north or south direction, making it a simpler and more compact way to express directions.
2. **Reference Directions**:
   - The direction is described using either **north** or **south** as the reference direction (starting point).
   - The angle is measured from this reference point, either towards **east** or **west**.
3. **Quadrants**:
   - Reduced Bearings divide the compass into four quadrants:
     - **First Quadrant**: **N 0° to 90° E** and **S 0° to 90° E**
     - **Second Quadrant**: **N 0° to 90° W** and **S 0° to 90° W**

COMPOMENTS OF PRISMATIC COMPASS

In **civil engineering**, a **prismatic compass** is an essential instrument used for measuring bearings and directions of survey lines. It is often employed for conducting **compass surveys**, particularly for small-scale surveying projects or when higher precision instruments are not available. The **prismatic compass** uses a magnetic needle to find directions relative to magnetic north, and it features several components that allow for precise measurements.

Components of a Prismatic Compass:

1. **Magnetic Needle**:
   - The magnetic needle is the key component of the compass that aligns with the Earth's magnetic field, pointing towards **magnetic north**.
   - The needle is mounted on a pivot and is free to rotate in response to the Earth's magnetic field.
2. **Graduated Circle (or Graduated Dial)**:
   - The graduated circle is typically made of metal or durable material and is marked with angular divisions.
   - The circle is graduated in **degrees (0° to 360°)**, allowing the user to measure the bearing of a line with respect to **magnetic north**.
   - The circle is often divided into **360°**, or sometimes **4 quadrants** (0° to 90°), depending on the type of compass.

Summary of Components:

Component	Purpose
Magnetic Needle	Aligns with Earth's magnetic field, pointing to magnetic north.
Graduated Circle	A circle marked with degrees (0°–360°) for measuring the bearing.
Sight Vanes	Used to aim at the target or reference point while taking the measurement.
Prism	Reflects the graduated circle's image for easier reading of the bearing.
Base Plate	The stable platform for positioning the compass during measurements.
Leveling Screws	Ensures the compass is level when taking measurements.
Compass Box/Housing	Holds and protects the compass components.
Needle Pivot	Allows the magnetic needle to rotate freely.
Declination Adjustment	Allows for correction of magnetic declination to obtain true bearings.
Vernier Scale	Provides finer increments for more precise measurements (in some models).

In **civil engineering**, the **prismatic compass** plays a critical role in performing compass surveys, which are essential for determining directions and bearings of survey lines, aligning boundaries, and setting out infrastructure. It is a simple yet effective instrument for measuring horizontal angles and directions relative to **magnetic north** or **true north**. The primary function of a prismatic compass is to provide accurate **directional measurements** during field surveys.

Key Functions of a Prismatic Compass in Civil Engineering:

1. **Measuring Bearings**:
    - The **prismatic compass** is primarily used for measuring **bearings** of survey lines. Bearings indicate the direction of one point relative to another, often expressed as an angle from a fixed reference point (usually **magnetic north** or **true north**).
    - Bearings are crucial for establishing **directional relationships** between different points in the survey area, which helps in **plotting maps** or determining the alignment of survey lines.
2. **Surveying and Mapping**:
    - A prismatic compass is used extensively in **land surveying**, particularly for tasks like **boundary surveys**, **topographical surveys**, and **route surveys**. It helps measure the direction of lines between survey stations, which can then be used to create maps and plans.
    - It assists in setting out **roads**, **buildings**, **canals**, **pipelines**, and other **infrastructure projects** by ensuring that the lines are accurately aligned with the required bearing.

3. **Establishing Property Boundaries**:
    - In **land boundary surveys**, the prismatic compass helps measure and record the direction of boundary lines to ensure they are correctly established and documented. It is vital for determining the precise orientation of property lines when subdividing land or marking ownership boundaries.
    - Accurate bearing measurements are needed for **land title surveys** and **real estate development**, making the prismatic compass an essential tool in **land management**.
4. **Compass Surveying**:
    - A **compass survey** uses a prismatic compass to establish **directional relationships** between survey stations. This method is often employed when surveying relatively small areas or when working in regions where high-precision instruments like total stations or theodolites are not required.
    - The prismatic compass can be used to measure the **azimuth** or **reduced bearing** between points, aiding in the creation of a **survey network**.

5. **Measuring Horizontal Angles**:
    - A prismatic compass can measure **horizontal angles** between two survey lines. These angles help in determining the relative positions of different survey points. This function is crucial for triangulation surveys, where multiple survey stations are set up to define positions and elevations in a region.
    - By measuring the **angles between survey lines**, the compass helps in triangulating the locations of new survey points, facilitating more accurate mapping and infrastructure planning.
6. **Checking Line Orientation**:
    - The prismatic compass is used to **check the orientation of survey lines** during construction projects. When building roads, railways, or pipelines, the compass ensures that the construction aligns with the intended direction.
    - It provides a quick and portable means to check the **horizontal alignment** of various structures during the setting-out phase of construction.
7. **Determining True North**:
    - In areas where magnetic declination is a factor (the difference between **magnetic north** and **true north**), the prismatic compass can help correct for **magnetic declination**. Some models come with an adjustment mechanism that allows the user to **align the compass** with **true north**, ensuring more accurate directional measurements.

Compass Traversing is a method used in **surveying** to establish the relative positions of a series of points by measuring **angles** (bearings) between successive survey lines using a **compass**. This method is commonly employed in land surveys and for projects that require the layout of boundaries, roads, or other infrastructure. It involves a sequence of survey stations, and the bearings of the lines between them are measured using a **prismatic compass**. The technique helps in plotting the **survey network** by determining the direction and distances between points.

Key Concepts of Compass Traversing:

1. **Traverse**:
    - A **traverse** is a series of survey lines that connect a series of points (called stations). These lines are connected to form a polygonal chain, typically consisting of **angles** and **distances**.
    - There are two types of traverses:
        - **Open Traverse**: The survey network does not form a closed loop. In this case, there is a starting point and an endpoint, and it's not necessary to return to the original point.
        - **Closed Traverse**: The survey network forms a closed loop where the start and end points coincide, which allows for error checking and correction.

2. **Measuring Bearings**:
    - The bearings of the lines in a compass traverse are measured with respect to **magnetic north** (or **true north**, if adjustments for magnetic declination are made).
    - The **prismatic compass** is used to measure the **horizontal angles** or **bearings** between successive survey lines, typically expressed in **degrees** from **north** or **south** to **east** or **west** (i.e., **reduced bearings** or **whole circle bearings**).
3. **Distance Measurement**:
    - The **distances** between successive points (stations) in the traverse are typically measured using a **tape**, **chain**, or more modern methods like **electronic distance measuring devices**.
4. **Closure and Error Adjustment**:
    - In a **closed traverse**, the sum of the internal angles should ideally add up to a specific value (for example, **(n-2) × 180°**, where **n** is the number of sides of the traverse). If there is a discrepancy, the closure error can be distributed across the angles or distances to correct the survey.
    - In an **open traverse**, there is no requirement to close the loop, but the survey may need to be checked against other known reference points.

Types of Compass Traversing:

1. **Closed Traverse**:
    - In a closed traverse, the survey forms a loop, meaning the starting point and ending point are the same. This provides a way to check for errors in measurement.
    - For example, if there are **four stations** in a closed traverse, the sum of the internal angles should be **360°** (for a quadrilateral). Any discrepancy can be used to **adjust** the angles or distances.
2. **Open Traverse**:
    - In an open traverse, the start and end points do not meet. The traverse is used to establish the positions of several points, but there is no requirement to close the loop.
    - It is often used for long linear features like roads, pipelines, or railways, where closure is not a critical concern.

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