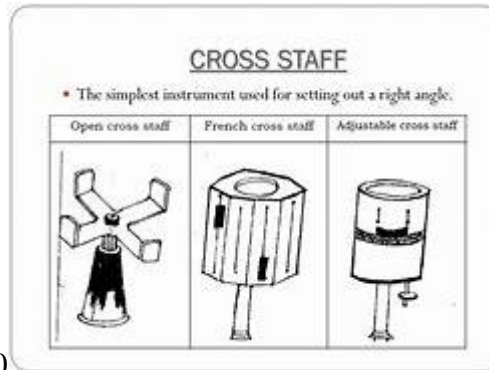




**MATS UNIVERSITY, RAIPUR (C.G.)
SCHOOL OF ENGINEERING & I.T.**



Semester : III B. Tech.
Branch : Mining Engineering.
Subject : Mining Surveying -I Laboratory
Total Theory Periods : 28



Total Tutorial Periods : 00
Total Credits : 01
Code : BT 368

LIST OF EXPERIMENTS

1. Ranging and chaining of line of 50 Meter.
2. Determination of width of an obstacle which can be seen across but can't be chained.
3. Determination of area of a field by Cross staff survey.
4. Study of various types of chained.
5. Determination of included angle with the help of a Prismatic Compass.
6. Plotting a closed traverse and elimination of errors.
7. Determination of width of an inaccessible obstacle by intersection.
8. Determination of location of instrument station by two-point problem.
9. Determination of location of instrument station by three-point problem.
10. Study of Dumpy level.
11. Determination of difference in elevation and gradient between two stations using dumpy level.

EXPERIMENT No. 1

Aim: Ranging and chaining of a line of 50m.

Apparatus:

- Measuring Tape/Chain (50 meters in length)
- Ranging Rods (2 or more)
- Plumb Bobs (for ensuring the vertical alignment of rods)
- Surveying Flags or Markers (optional)
- Field Notebook & Pencil (for recording distances and observations)

Theory:

- Chaining is the process of measuring distances along a straight line using a tape or chain. In this case, the total length of the line being measured is 50 meters.
- Ranging involves ensuring that the measured line is straight by placing intermediate markers or using sighting tools to align points along the line.

Chaining and ranging together help establish accurate, straight lines over longer distances, which are fundamental in surveying work for construction, boundary marking, and mapping.

Procedure:

A. Chaining of the 50-Meter Line:

1. **Select the Starting Point:** Identify a fixed point on the ground where the line will begin. Mark it as Point A.
2. **Place the First End of the Chain:** Place the end of the chain at Point A.
3. **Stretch the Chain:** Pull the chain taut, ensuring it is straight along the ground towards the end point.
4. **Mark the Endpoint:** When the chain reaches the end point (Point B), mark the spot. The distance between Point A and Point B should be 50 meters.
5. **Recheck the Measurement:** If the measurement is in excess of 50 meters, adjust and recheck to ensure accuracy.

B. Ranging of the 50-Meter Line:

1. **Set Up Ranging Rods:** Place the ranging rods at the starting point (Point A) and at the end point (Point B). These will act as visual reference markers for alignment.
2. **Ensure Straight Alignment:** Look through the rods at each end of the line to ensure they are aligned. If the line is not straight, adjust the rods to ensure proper alignment.
3. **Intermediate Ranging:** If the line is longer than 50 meters or requires more precision, intermediate rods can be placed between Point A and Point B to maintain straightness and adjust as necessary.
4. **Final Check:** After completing the measurements and ensuring the line is straight, confirm the accuracy by sighting through the range poles again.

Precautions:

1. Ensure the chain is taut and does not sag, as this can affect the measurement.
2. Make sure the line between the ranging rods is straight by properly aligning intermediate markers if necessary.

3. Verify that the ground is level to avoid measurement errors due to sloping surfaces.
4. When marking intermediate points, ensure they are in line with the initial and final points for accuracy.
5. If working in wet or rough terrain, be cautious of slipping or chain stretching, which may cause inaccuracies.

Result: Ranging and chaining of a line of 50m is done.

EXPERIMENT-2

Aim: Determination of width of an obstacle which can be seen across but can't be chained.

Apparatus:

- Tape Measure or Measuring Chain (for known distance measurement)
- Clinometer or Theodolite (optional, for measuring angles)
- Ranging Rods or Markers
- Protractor (for angle measurement if not using a clinometer)
- Compass (optional, for direction alignment)
- Field Notebook & Pencil (for recording observations and calculations)

Theory:

Sometimes, obstacles such as rivers, roads, buildings, or other wide gaps cannot be measured directly due to physical limitations (such as being too wide or inaccessible). In such cases, you can use indirect methods like triangulation or right-angled triangle principles to calculate the width of the obstacle.

One common approach is to form a right triangle, where:

- The base of the triangle is a known distance (the distance from the point of observation to a point directly across from the obstacle).
- The angles at the observation point and at the point across from the obstacle are measured.

By applying trigonometric principles, the width of the obstacle can be calculated.

Procedure:

1. Setting up the Measurement:

1. **Select Observation Points:** Choose two points on the same side of the obstacle (Point A and Point B). These points should be aligned in such a way that they form a straight line parallel to the edge of the obstacle. Ensure that both points are at known, measurable distances apart.
 - Point A: Observation point (first point on one side of the obstacle)
 - Point B: Second observation point (on the same side of the obstacle, but away from Point A by a known distance)
2. **Measure the Distance Between Points A and B:** Measure and record the distance between Point A and Point B. This will be the base of the triangle.
3. **Angle Measurement:**
 - Using a theodolite or a clinometer, measure the angles at which the lines of sight from Point A and Point B intersect the opposite side of the obstacle.
 - If using a protractor or simple angle measurement tools, sight across the obstacle from both points (A and B) and measure the angles (let's call them Angle A and Angle B).
 - Ensure that both angles are measured accurately, as they are critical to the calculation.

Precautions:

1. Ensure the angles are measured as accurately as possible to avoid calculation errors.
2. Use a level instrument when measuring angles to avoid tilting or errors in elevation.

3. If the terrain is uneven, make sure the observation points are aligned correctly relative to the obstacle.
4. If the distance between observation points is large, use high-quality equipment like a theodolite or total station for better accuracy.
5. Ensure that the measuring tape or chain used for the base distance is properly tensioned and straight.

Result:

The width of an obstacle which can be seen across but can't be chained is determined & found to be ___ meter.

EXPERIMENT No. 3

Aim: Determination of area of a field by Cross staff survey.

Apparatus:

- Cross Staff (or similar angle-measuring instrument)
- Chain or Measuring Tape (for measuring distances)
- Ranging Rods or Markers (to mark points along the boundary)
- Plumb Bob (to ensure the correct vertical alignment of the Cross Staff)
- Field Notebook and Pencil (for recording distances and angles)
- Theodolite (optional, for higher precision in angle measurements)

Theory:

The Cross Staff Survey method is used to measure distances and angles in the field for determining the area, especially when dealing with irregularly shaped plots. The area of the field is often calculated using a Traverse method, which involves dividing the field into smaller triangles or polygons, where the distances between points are measured and the angles between them are calculated.

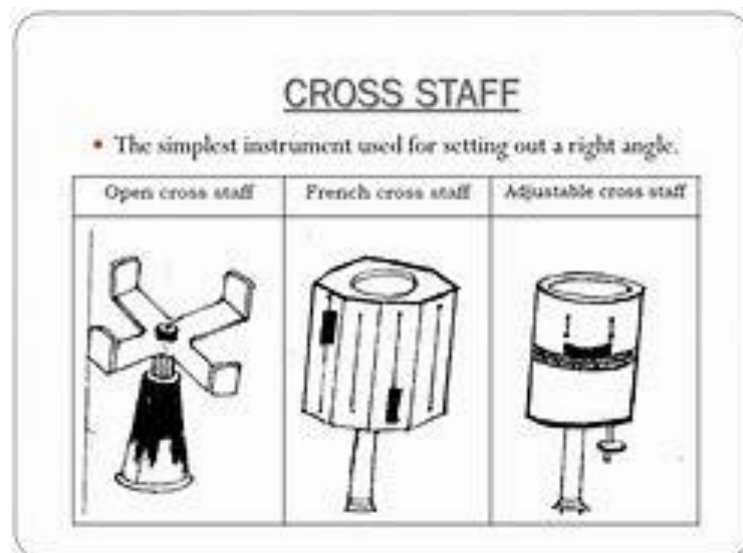


Fig.: Cross Staff

The basic principle involves:

1. Setting up reference lines: Establishing a baseline by measuring the lengths of the sides of the field.
2. Using the Cross Staff to measure angles at key points on the boundary of the field.
3. Using geometric calculations: Once the angles and distances are known, various methods (such as the Trapezoidal Rule or Triangular Area Formula) are used to calculate the total area of the field.

Procedure:**A. Setting up the Field:**

1. **Mark the Field Boundary:** Mark the key points of the field with Ranging Rods or Markers to outline the boundary. The field is usually divided into smaller sections or triangles for easier calculation.
2. **Select a Starting Point:** Choose a point (Point A) on one corner of the field to begin the survey.

B. Measuring the Sides and Angles:

1. **Place the Cross Staff:** Position the Cross Staff at the starting point (Point A). The Cross Staff is used to measure right angles or to establish directions for the boundary lines.
2. **Measure the First Side:** From Point A, measure the first side of the field (Line AB) using a measuring tape or chain. Record the distance.
3. **Use the Cross Staff to Measure Angles:** After the first side is measured, use the Cross Staff to measure the angle at the boundary where the next side begins (for example, the angle at Point B). The Cross Staff helps measure the horizontal angles between adjacent sides.
4. **Proceed Along the Field's Boundary:** Move to the next point (e.g., Point B), place the Cross Staff, and measure the next side and angle. Continue this process around the entire field, ensuring to record both distances and angles between points.

C. Dividing the Field into Triangular Sections:

Once you have enough measured sides and angles, divide the irregular field into smaller, more manageable triangles. Each triangle's area can be determined using trigonometry or the trapezoidal method, depending on the shape of the triangles.

Precautions:

1. **Ensure Accurate Angle Measurements:** The Cross Staff must be used correctly to ensure that angles are measured accurately.
2. **Straight Lines:** When measuring distances, ensure that the measuring chain or tape is straight and taut to avoid errors in measurement.
3. **Level the Cross Staff:** The Cross Staff should be held vertically, and the plumb bob should be used to ensure it is aligned correctly.
4. **Avoid Obstacles:** Ensure that the measurement line is not obstructed by trees, buildings, or other obstacles, which can affect accuracy.
5. **Correct Placement of Ranging Rods:** The ranging rods must be positioned precisely at the correct locations, and the field boundary should be clearly marked.

Result: The area of a field was determination by Cross staff survey & the we found ____m.

EXPERIMENT No. 4

Aim: Study of various types of chain.

Chain:

Chains are the measuring instrument used in surveying formed by the 100 links of 4mm galvanized mild steel wire. These links are joined by 3 circular or oval wire rings. These rings provide the flexibility to the chains. Every aspect of the life requires some measuring units. Measurements are used to do the work precisely and accurately. Let it be from kitchen to office, everywhere measurements are used. So as in engineering calculation or measurements holds a very greater role in construction or surveying or any other aspect. There are various units of measurements such as meters, centimeters, feet, inches, acre, yards and the list goes on. Same as units there are various instrument used in the measurements of any entity. One of the instruments used in measurement are chains.

➤ **Parts of Chains used in Surveying:**

The chain consists of many small parts used for handling or reading the measurements.

- At the ends chain is provided with brass handle with swivel joint so that it can be easy to roll or unroll the chain without twisting and knots.
- At every 10th link is provided with a tally of one teeth, 20th link with a tally of two teeth and so on till 40th link. This is provided for the easy reading of measurements.
- At the center of the chain is provided with a circular talley used for easy reading

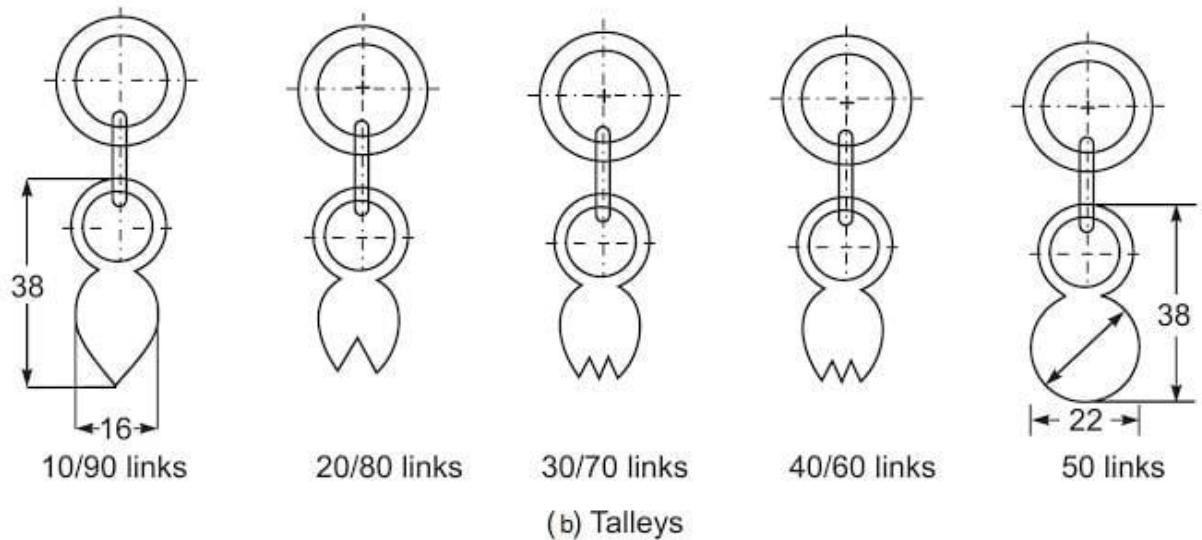
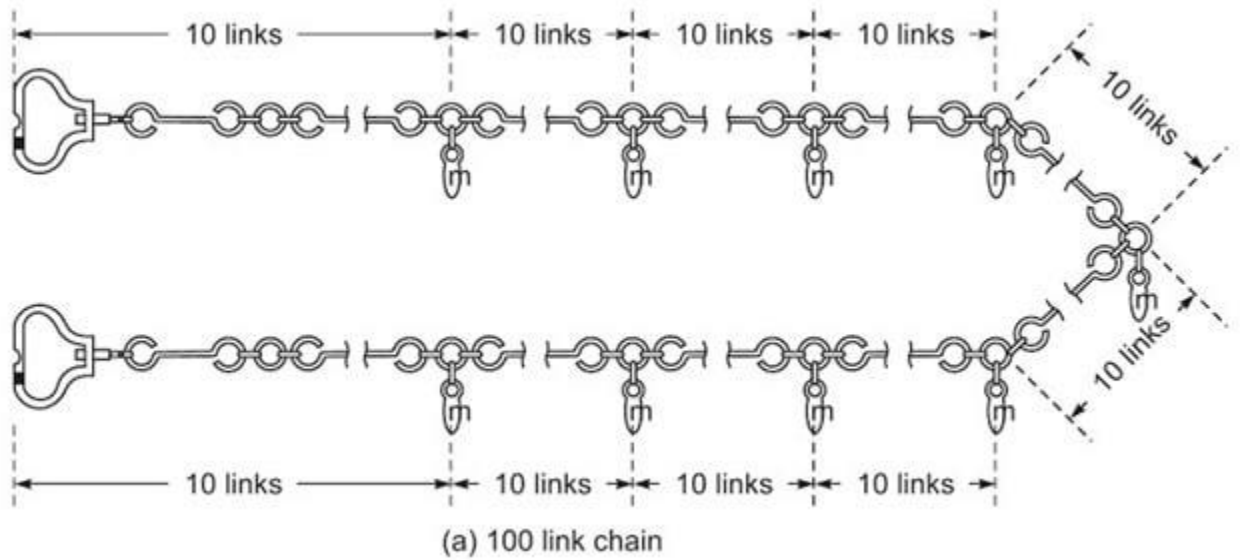


➤ **Types of Chains used in Surveying:**

Depending upon the length of the chain, these are divide into following types,

1. Metric chains
2. Steel band or Band chain

3. Gunter's chain or surveyor's chain
4. Engineer's chain
5. Revenue chain



A. Metric chains:

Metric chains are the most commonly used chain in India. These types of chains comes in many lengths such as 5, 10, 20 and 30 meters. Most commonly used is 20m chain. Tallies are provided at every 2m of the chain for quick reading. Every link of this type of chain is 0.2m. The total length of the chain is marked on the brass handle at the ends.

B. Steel band or Band chain:

These types of chain consist of a long narrow strip of steel of uniform width of 12 to 16 mm and thickness of 0.3 to 0.6 mm. this chain is divides by brass studs at every 20cm or instead of brass studs, band chain may have graduated engraving as centimetre. For easy use and workability band chains are wound on steel crosses or metal reels from which they can be easily unrolled. These steel bands are available in 20m and 30m length and the width of about 12-16mm.

C. Gunter's chain or surveyor's chain

“Gunter chain comes in standard 66ft. These chain consists of 100links, each link being 0.66ft or 7.92inches. The length 66ft is selected because it is convenient in land measurements. 10 square Gunter's chains = 1 Acre 10 Gunter chains = 1 Furlong 80 Gunter chains = 1 mile

D. Engineer's chain

This chain comes in 100ft length. Its consist of 100 links each link being 1ft long. At every 10 links a brass ring or tags are provided for indication of 10 links. Readings are taken in feet and decimal.

E. Revenue Chain :

The standard size of this type of chain is 33ft. The number of links are 16, each link being $2\frac{1}{16}$ ft. This chain is commonly used in cadastral survey.

➤ Testing and Adjustment of Chain:

As the chain is a metal made, it may undergo many changes due to temperature effect or human error and etc. So for all lengths of chain a tolerance is given, 5m chain = + or – 3mm 10m chain = + or – 3mm 20m chain = + or – 5mm 30m chain = + or – 8mm

Chain length shorten due to:

1. Bending of links.
2. Sticking of mud in the rings

Chain length increases due to:

- Opening of small rings.
- Wearing of surfaces.

Chains may be tested with respect to:

- Steel tape
- Permanent test gauge
- Pegs driven in the field at required distances
- Permanent test gauge made with dressed stones

If chain is found long, then

- Close the joins of the rings
- Reshape the elongated rings
- Remove one or two rings
- Replace worn out rings

If chain is found short, then

- Straighten the links
- Replace the small rings with big one
- Insert additional rings
- Flattening the circular rings

Result: Various types of chain are studied.

EXPERIMENT No. 5

Aim: Determination of included angle with the help of a **Apparatus:**

- Prismatic Compass
- Field book
- Surveying chain or tape (for measuring distances, if needed)
- Plotting paper (optional, for recording angles)

Theory:

A prismatic compass is a surveying instrument used to measure horizontal angles and bearings. It consists of a magnetic needle, a graduated scale, and a prism for sighting. The compass can measure angles between two lines, commonly known as the included angle. The principle involves determining the bearing of two survey lines, calculating the difference between these bearings, and adjusting the angle if necessary to obtain the smallest angle between them.

The included angle between two lines is given by:

$$\text{Included Angle} = | B2 - B1 |$$

where:

- B1 = Bearing of the first line
- B2 = Bearing of the second line

If the calculated angle exceeds 180° , adjust it as follows:

$$\text{Included Angle} = 360^\circ - | B2 - B1 |$$



Fig.: Prismatic Compass

Procedure:

1. Set up the Prismatic Compass

- Place the prismatic compass on a flat, level surface.

- Ensure the compass is aligned with the magnetic north for proper reading. You may need to adjust for magnetic declination if surveying in areas with known magnetic deviation.

2. Measure the Bearing of the First Line (Line 1)

- Align the compass with the first survey line.
- Look through the prism and sight along the line to ensure the compass is pointing directly in line with the first direction.
- Read the bearing on the graduated scale where the needle aligns with the reference mark.
- Record this bearing as B1 in the field book.

3. Measure the Bearing of the Second Line (Line 2)

- Rotate the prismatic compass to align with the second line.
- Sight along the second line and adjust the compass until the needle aligns with the reference mark.
- Record the bearing of the second line as B2.

4. Calculate the Included Angle

- Subtract the bearing of the first line B1 from the bearing of the second line (B2):

$$\text{Included Angle} = | B2 - B1 |$$

5. Record the Results

- Write down the included angle in your field book or lab report.

6. Repeat for Accuracy

- If necessary, repeat the measurement and calculations for accuracy.
- If multiple angles are to be determined, continue with the next set of survey lines, recording each bearing and included angle.

Precautions:

- Ensure that the prismatic compass is level before taking readings.
- Always record bearings carefully to avoid errors in calculations.
- Avoid magnetic interference by keeping the compass away from metallic objects.
- Check the compass for any mechanical issues, such as a stuck needle, before use.
- If working in areas with significant magnetic declination, adjust the readings accordingly to ensure accuracy.

Result: We have determined the included angle with a Prismatic Compass & found _____.

EXPERIMENT No. 6

Aim: Plotting a closed traverse and elimination of errors.

Apparatus:

- Surveying Instrument: Theodolite, prismatic compass, or any instrument for measuring angles and distances.
- Graph Paper or Tracing Paper: For plotting the traverse.
- Scale: To maintain proportionality between the actual distances and the plotted distances.
- Pencil: For drawing and making adjustments.
- Protractor: For measuring angles.
- Field Book: For recording the survey data.
- Computational Tools: Calculator for arithmetic calculations.
- Paper Tracing Sheet (optional): For error elimination steps.

Theory:

A traverse is a series of connected lines whose lengths and angles are measured, and the system forms a polygon. A closed traverse is a traverse in which the starting point and the endpoint are the same, thus forming a loop. It is commonly used in surveying for mapping and calculating areas.

When plotting a closed traverse, errors can arise due to measurement inaccuracies in distance or angles. These errors need to be identified and corrected to ensure the accuracy of the plotted data.

Common Errors in Traversing:

1. Closure Error (Linear Error): The discrepancy between the starting and ending point in a closed traverse.
2. Angular Error: The error in measured angles due to instrument misalignment or improper angle measurement.
3. Instrumental Errors: Due to the calibration or mechanical inaccuracies of the instruments.
4. Personal Errors: Errors due to human factors such as incorrect reading or recording of data.

Procedure:

1. Survey the Traverse

- Conduct the survey by measuring distances and angles using a theodolite or prismatic compass.
- Record the bearing/azimuth of each line and the length (distance) between points in your field book.
- Ensure that the traverse forms a closed loop, with the starting point and endpoint being the same.

2. Prepare the Plotting Sheet

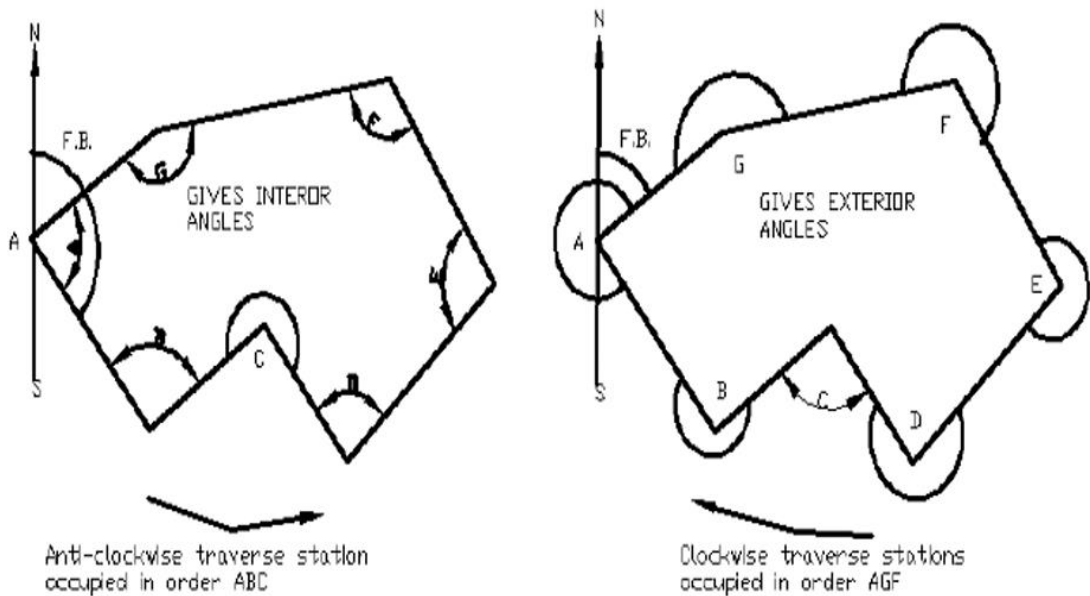
- Set up graph paper or tracing paper, ensuring you have a blank sheet with an adequate scale for plotting the traverse.

- Choose a suitable scale for your plot. For example, if each meter in the field corresponds to 1 cm on the paper, the scale would be 1:100.
- Mark the starting point (known as the reference point) on the graph as Point A.

3. Plot the Traverse

- Using the bearings and distances recorded in your field book, plot the traverse step by step.

Plotting Process:



1. Start at Point A: Place a dot on the paper for the starting point of the traverse.
2. Plot the First Line: Measure the first distance and draw the first line according to the bearing from the reference point.
3. Plot Successive Lines: Using the recorded bearings and distances for each consecutive point, plot each line in sequence. Use a protractor or angle measurement tool to plot the direction accurately.
4. Complete the Traverse: Connect the last point to the starting point. In a perfect traverse, this line should exactly coincide with the first line. Any discrepancy will be the closure error.

Point	Distance (m)	Bearing (°)	X-coordinate	Y-coordinate
A	0	-	0	0
B	100	45	70.71	70.71
C	150	135	0	150
D	120	225	-70.71	70.71
E	100	315	0	0

Precautions:

- Ensure that the survey instruments are calibrated correctly before use.
- Always check for errors in distance measurement, such as sloping ground, tension in the chain, or sagging of the tape.
- Ensure proper angular measurement to avoid errors from parallax.
- Record all measurements carefully and double-check them for accuracy before plotting.

Results:

- The traverse was plotted successfully on graph paper.
- The closure error was calculated and found to be 3 meters.
- The corrections were applied to the distances and angles, and the traverse was replotted. The final closure error was minimized to 0.2 meters.

EXPERIMENT No. 7

Aim: Determination of width of an inaccessible obstacle by intersection.

Apparatus:

- Theodolite or Prismatic Compass (for measuring angles)
- Tape Measure or Measuring Chain (for measuring the baseline distance)
- Field Book (for recording data)
- Graph Paper or Plotting Sheet (for plotting the lines of intersection)
- Ranging Poles (or any markers for reference points)
- Calculator (for angle and distance calculations)

Theory:

The method of intersection is used in surveying to determine the width or distance across an inaccessible obstacle by measuring angles from two different points on the same side of the obstacle. This method relies on the principle of triangulation. The idea is to form a triangle with known sides (the baseline) and measured angles from two points on the baseline, then use trigonometric principles to determine the width or distance to the opposite side of the obstacle.

The procedure typically involves:

1. Taking angular measurements from two known points on the same side of the obstacle.
2. Plotting these measurements on a map or graph paper.
3. Using trigonometric formulas to calculate the width of the obstacle.

Procedure:

1. Set up the Survey

- Select two points A and B on the same side of the obstacle. These points should be far enough apart to allow accurate angular measurement but should not be too far that the angles become difficult to measure.
- Mark these points clearly on the ground, using ranging poles or other markers.
- Measure the baseline distance AB (denoted as d) between these two points. Record this distance accurately in the field book.

2. Measure the Angles

- From point A, use a theodolite or prismatic compass to measure the angle θ_1 to the point C (the point directly across the obstacle whose width is to be determined).
- From point B, use the theodolite or prismatic compass to measure the angle θ_2 to the same point C.
- Ensure that the angles are measured accurately to avoid errors in the calculation.

3. Record the Data

- Record the baseline distance and the measured angles in your field book for future reference:
 - Baseline distance: d
 - Angle at point A: θ_1
 - Angle at point B: θ_2

4. Plot the Data (Optional)

- If required, plot the points on a graph or paper. You can represent point C as the intersection of the two lines drawn from points A and B, based on the measured angles.

5. Calculate the Width of the Obstacle

- Use the law of sine or trigonometric methods to calculate the width of the obstacle:

$$w = d \cdot \sin(\theta_2) / \sin(\theta_1 + \theta_2)$$

- Substitute the known values of d, θ_1 and θ_2 into the equation to determine the width w.

Precautions:

1. Ensure that the baseline AB is accurately measured and as long as possible for greater precision.
2. The points A and B should be located at a sufficient distance from the obstacle, but within a range that ensures accurate angle measurement.
3. The angles θ_1 and θ_2 should be measured with high accuracy using a theodolite or a prismatic compass.
4. The intersection of the two lines should be sharp and clear, ensuring no errors in reading the angles.

Result:

- The width of the inaccessible obstacle was successfully determined using the intersection method. The calculated width is ____m.

EXPERIMENT No. 8

Aim: Determination of location of instrument station by two-point problem.

Apparatus:

- Theodolite or Total Station (for measuring angles)
- Measuring Tape or Measuring Chain (for baseline measurement)
- Field Book (for recording data)
- Ranging Poles (or markers for reference points)
- Protractor (for measuring angles, if required)
- Graph Paper or Plotting Sheet (for plotting data and solving graphically)
- Calculator (for performing trigonometric calculations)

Theory:

The Two-Point Problem is a method in surveying to determine the position of an unknown point (instrument station) by measuring the angles from the two known reference points to the unknown station. In this problem:

- Two known points A and B are established.
- The angles of elevation (or horizontal angles) are measured from points A and B to the unknown instrument station P.

Using these angles, the location of the instrument station P can be determined by either graphical or analytical methods.

Procedure:

1. Setting Up the Instrument Station

- Choose a location for the instrument station, and set up your theodolite or total station there.
- Mark two known reference points A and B on the ground. These points should be sufficiently far apart (e.g., 50 to 100 meters) to ensure accuracy but should be visible from the instrument station.

2. Measure the Angles

- Measure the angle θ_1 from the instrument station to reference point A using the theodolite or total station.
- Measure the angle θ_2 from the instrument station to reference point B.

3. Measure the Distance Between the Known Points (AB)

- Measure the distance between points A and B accurately using a tape measure or total station.
- Record this distance as d_3 in your field book.

4. Apply Trigonometric Calculations (Analytical Method)

- Using the measured angles θ_1 , θ_2 and the distance between points A and B (d_3), you can use the Law of Sine or Law of Cosine to determine the unknown distances d_1 and d_2 (distances from the instrument station to points A and B).

If using the Law of Sine:

$$\sin(\theta_1)/d_1 = \sin(\theta_2)/d_2$$

You can solve this system of equations to find the unknown distances d_1 and d_2 .

5. Plot the Data (Graphical Method)

- On graph paper, plot the known reference points A and B and the distance between them.
- Using a protractor, plot the angles θ_1 and θ_2 from points A and B to the instrument station. This will form two lines of sight.
- The intersection of these two lines represents the location of the instrument station P.

6. Determine the Location

- The intersection of the lines drawn from points A and B using the measured angles represents the position of the instrument station.
- Measure the distances d_1 and d_2 on the plot to verify the correctness of the location of the instrument station.

7. Verify and Check for Consistency

- After plotting the instrument station, verify that the distances and angles are consistent with your calculations.
- If there is any discrepancy, recheck your measurements or recalculate the angles and distances.

Result: We have determined the location of instrument station by two-point problem.

EXPERIMENT No. 9

Aim: Determination of location of instrument station by three-point problem.

Apparatus:

- Theodolite or Total Station (for measuring angles)
- Measuring Tape or Measuring Chain (for baseline measurement)
- Field Book (for recording data)
- Ranging Poles (or markers for reference points)
- Protractor (for measuring angles if required)
- Graph Paper or Plotting Sheet (for plotting the reference points and angles)
- Calculator (for performing trigonometric calculations)

Theory:

The Three-Point Problem is used to determine the location of an unknown instrument station by measuring the angles from three known points to the station. The three known points are generally referred to as A, B, and C. By measuring the angles from the instrument station to these three points, the location of the station can be determined using either analytical or graphical methods.

Steps for the Three-Point Problem:

1. Measurement of Angles: Measure the angles from the instrument station to the three known points.
2. Plotting the Known Points: On a map or graph paper, plot the positions of the three known points.
3. Drawing the Angles: Using the measured angles, draw the lines of sight from the instrument station to the known points.
4. Solving for Position: The intersection of the three lines of sight gives the location of the instrument station.

Procedure:

1. Setting Up the Instrument Station

- Select the location of the instrument station, and set up your theodolite or total station there.
- Mark three known reference points A, B, and C on the ground. These points should be widely spaced for better accuracy, typically at least 50 to 100 meters apart.
- Measure the distances between the known points, i.e., AB, BC, and CA, using a tape measure or total station. Record these distances accurately in the field book.

2. Measure the Angles

- From the instrument station, measure the angle θ_1 to reference point A.
- Measure the angle θ_2 to reference point B.
- Measure the angle θ_3 to reference point C.
- Record these angles in the field book. Ensure that the instrument is calibrated properly and that all angles are measured accurately.

3. Plotting the Data (Graphical Method)

- On graph paper or a plotting sheet, plot the known points A, B, and C based on the measured distances between them. Ensure the scale is consistent.
- Use a protractor to measure and draw the angles θ_1 , θ_2 , and θ_3 from each of the reference points A, B, and C.
- Extend the lines of sight from each reference point based on the corresponding angles. The lines should intersect at the location of the instrument station.

5. Verifying the Position

- After plotting the lines of sight, check the intersection of the lines. The point where all three lines intersect is the location of the instrument station.
- Measure the distances from the intersection point to the reference points. These should match the calculated or expected values, confirming the accuracy of your result.

6. Final Check

- Ensure that the angles and distances are consistent across the three points. If there is any discrepancy, recheck the angle measurements or recalculate the distances.

Result: The location of the instrument station is successfully determined.

EXPERIMENT No. 10

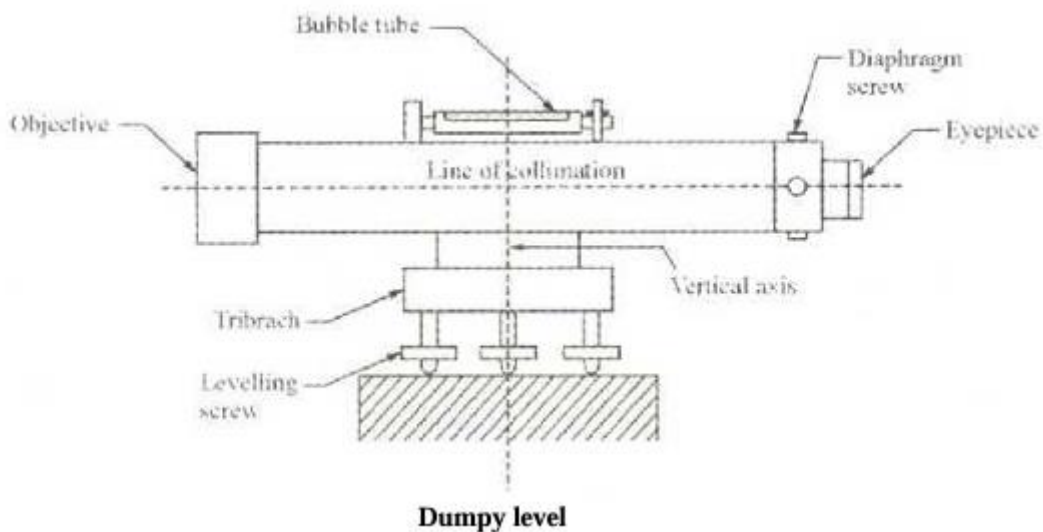
Aim: Study of Dumpy level.

Apparatus:

- Dumpy Level (the instrument used for leveling)
- Tripod Stand (to support the Dumpy Level)
- Levelling Staff (used to measure the difference in elevation between points)
- Measuring Tape or Chain (for measuring distance between points if necessary)
- Field Book (for recording observations)
- Plumb Bob (for ensuring the level instrument is vertical)
- Hand Level (optional, for preliminary rough leveling)
- Spirit Level (for checking instrument's horizontal positioning)

Theory:

The Dumpy Level is an optical instrument used to establish or check points in the same horizontal plane. It is used in leveling operations to measure the difference in elevation between points. The instrument consists of a telescope that can rotate about a horizontal axis, a spirit level to ensure the instrument is level, and a graduated scale on the leveling staff to measure the height difference.



The principle of the dumpy level is based on the concept of horizontal sight lines and vertical height differences. The instrument is set up at a known point, and the line of sight is made horizontal by adjusting the leveling screws. By reading the graduated staff at various points, we can determine the height difference between them.

Working Principle of Dumpy Level:

1. Setting up the instrument: The dumpy level is mounted on a tripod, and the instrument is set up over a station point.

2. Levelling the instrument: The instrument's spirit level is adjusted using leveling screws so that the line of sight of the telescope is perfectly horizontal.
3. Taking readings: A levelling staff is held vertically at the point where the height is to be determined. The operator reads the scale on the staff through the telescope. The readings taken from different points provide the elevation differences between those points.
4. Measurement: The difference between the readings taken from the leveling staff at different points will give the height difference.

Procedure:

1. Setting up the Dumpy Level:

- Set up the Dumpy Level on the tripod stand at a known location between the two points whose height difference is to be measured.
- Adjust the tripod legs so that the instrument is approximately at eye level.
- Check the spirit level to make sure that the instrument is approximately horizontal. Fine-tune the leveling using the leveling screws (two or three screws located at the base).
- Use the plumb bob to ensure that the instrument is aligned vertically over the desired point.

2. Establishing a Line of Sight:

- Rotate the telescope of the Dumpy Level horizontally until you can view the leveling staff at the point where the height is to be measured.
- Adjust the focusing screw of the telescope until the graduations on the staff are clearly visible.
- The telescope must be adjusted so that the line of sight is horizontal.

3. Reading the Staff:

- Place the levelling staff vertically at the point whose elevation is to be determined (point A or B).
- Read the value on the staff through the telescope. This reading is known as the staff reading.
- Record the staff reading in the field book.

4. Repeat the Process:

- Move the leveling staff to the next point and take another staff reading.
- Repeat the procedure for multiple points if necessary.
- The difference between the readings of the staff at the two points gives the height difference between them.

5. Back-Sight and Fore-Sight Method:

- For accurate leveling, take back-sight and fore-sight readings:
 - Back-sight is the first reading taken at the starting point or known point.
 - Fore-sight is the reading taken at the point whose elevation is to be determined.
- Calculate the difference between back-sight and fore-sight to get the elevation change.

Applications of Dumpy Level:

- Establishing Horizontal Lines: The Dumpy Level is primarily used to establish or check horizontal lines in surveying.

- **Determining Elevation:** It is used to determine the difference in elevation between two or more points.
- **Building Foundations:** In construction, it helps in leveling the foundation of buildings.
- **Road Construction:** In road building, it is used to check gradients and elevations.
- **Canal or Ditch Surveying:** To determine the level of water bodies and ditches.

Precautions:

1. Ensure the instrument is set up on a stable tripod and is properly leveled.
2. Ensure that the leveling staff is vertical when taking the readings.
3. The leveling staff should be held steady and at eye level to avoid parallax errors.
4. Always take readings in pairs (back-sight and fore-sight) to minimize errors.
5. Make sure to use proper arithmetic when calculating the height difference.
6. Avoid any obstruction between the Dumpy Level and the leveling staff.

Result: We have studied Dumpy level.

EXPERIMENT No. 11

Aim: Determination of difference in elevation and gradient between two stations using dumpy level.

Apparatus:

- Dumpy Level (instrument for leveling)
- Tripod Stand (to support the Dumpy Level)
- Levelling Staff (used to measure the height difference between two points)
- Measuring Tape or Chain (for measuring the distance between two stations)
- Field Book (for recording observations)
- Spirit Level (for ensuring the instrument is horizontal)
- Plumb Bob (for ensuring vertical alignment of the instrument)
- Calculator (for calculating gradient and height differences)

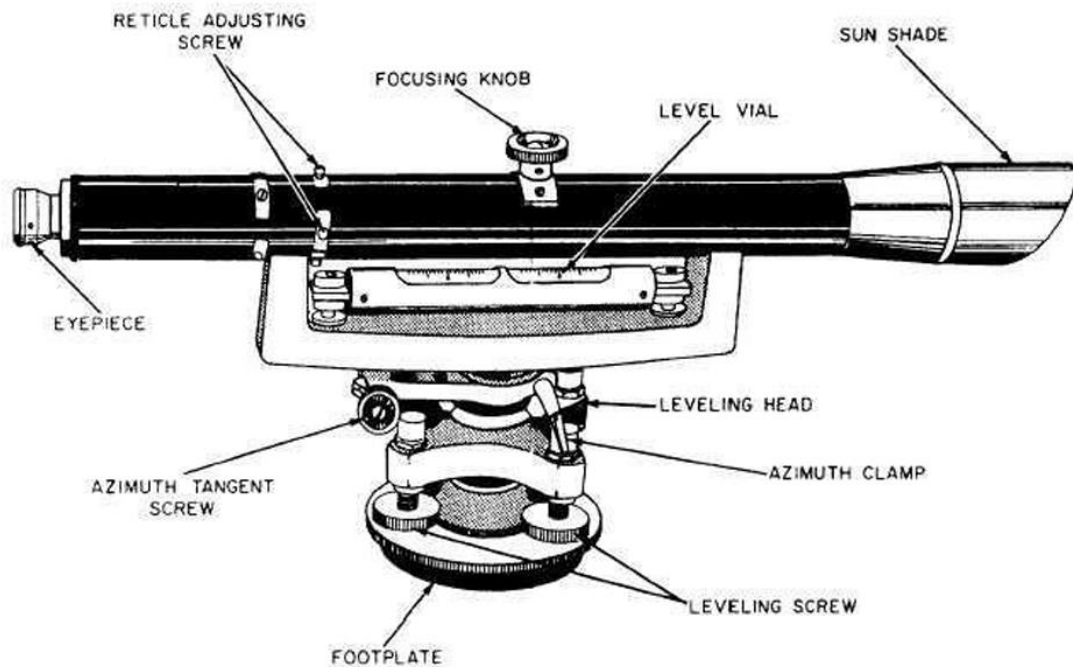


Fig.: Dumpy Level

THEORY:

The Dumpy Level is used in leveling operations to measure the height difference between two points. When the instrument is set up between two stations, the difference in elevation between those points can be determined by measuring the back-sight and fore-sight readings.

The gradient is the slope between two points, calculated by dividing the difference in elevation by the horizontal distance between the two stations.

Procedure:

1. Setting Up the Instrument:

1. Place the Dumpy Level on a stable tripod stand at an intermediate position between the two stations, ensuring that it is approximately at eye level.
2. Use the spirit level to check that the instrument is horizontal. Adjust the leveling screws to bring the instrument into perfect horizontal alignment.
3. Use the plumb bob to ensure that the instrument is vertically aligned over the station point.

2. Taking Measurements:

1. Place the levelling staff at Station 1 (the reference or starting point).
2. Look through the telescope of the Dumpy Level and read the staff reading. This is the back-sight (BS) at Station 1.
3. Record the back-sight reading in the field book.
4. Move the levelling staff to Station 2 (the second station whose elevation is to be determined).
5. Again, read the staff through the telescope and record the staff reading. This is the fore-sight (FS) at Station 2.
6. Record this fore-sight reading in the field book.

3. Calculation of Elevation Difference:

- The difference in elevation (Δh) between the two stations is calculated by the following formula:

$$\Delta h = BS - FS$$

Where:

- BS is the back-sight reading at the reference point (Station 1),
- FS is the fore-sight reading at Station 2.
- If $BS > FS$, the second station is at a higher elevation than the first.
- If $FS > BS$, the second station is at a lower elevation than the first.

4. Calculating the Gradient:

- Measure the horizontal distance d between the two stations (Station 1 and Station 2) using a measuring tape or chain.
- Use the gradient formula to calculate the gradient between the two stations:

$$\text{Gradient} = \Delta h / d$$

Where:

- Δh is the elevation difference (calculated above),
- d is the horizontal distance between the two stations.

Precautions:

1. Ensure that the Dumpy Level is properly set up and perfectly horizontal before taking readings.
2. Use a stable surface and tripod to avoid any vibrations or instability in the instrument.

3. Hold the levelling staff vertically when taking the readings and ensure it is held steady.
4. Record all measurements carefully to avoid errors in calculations.
5. Take readings at both Station 1 (starting point) and Station 2 (ending point) in the same manner.
6. When calculating the gradient, ensure the horizontal distance is measured accurately.

Result: We have determined the difference in elevation and gradient between two stations using dumpy level & was found _____.