Dhanalakshmi College of Engineering is committed to provide highly disciplined, conscientious and enterprising professionals conforming to global standards through value based quality education and training.

**VISION**

**MISSION**

- To provide competent technical manpower capable of meeting requirements of the industry
- To contribute to the promotion of Academic Excellence in pursuit of Technical Education at different levels
- To train the students to sell his brawn and brain to the highest bidder but to never put a price tag on heart and soul

DEPARTMENT OF CIVIL ENGINEERING

To impart professional education integrated with human values to the younger generation, so as to shape them as proficient and dedicated engineers, capable of providing comprehensive solutions to the challenges in deploying technology for the service of humanity

**VISION**

**MISSION**

- To educate the students with the state-of-art technologies to meet the growing challenges of the civil industry
- To carry out research through continuous interaction with research institutes and industry, on advances in structural systems
- To provide the students with strong ground rules to facilitate them for systematic learning, innovation and ethical practice
PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Fundamentals

To provide students with a solid foundation in Mathematics, Science and fundamentals of engineering, enabling them to apply, to find solutions for engineering problems and use this knowledge to acquire higher education.

2. Core Competence

To train the students in Civil Engineering technologies so that they apply their knowledge and training to compare, and to analyze various engineering industrial problems to find solutions.

3. Breadth

To provide relevant training and experience to bridge the gap between theory and practice which enables them to find solutions for the real time problems in industry, and to design products?

4. Professionalism

To inculcate professional and effective communication skills, leadership qualities and team spirit in the students to make them multi-faceted personalities and develop their ability to relate engineering issues to broader social context.

5. Lifelong Learning/Ethics

To demonstrate and practice ethical and professional responsibilities in the industry and society in the large, through commitment and lifelong learning needed for successful professional career.
PROGRAMME OUTCOMES (POs)

a) Underscoring the importance of technical education (markedly civil engineering education) in the infrastructural development of a country as a whole, Institute of Engineering has aimed to provide quality engineering education in civil engineering.

b) This program has been serving through its product in different parts of the country ranging from the gamut of remote and mountainous areas to the southern plains of Nepal.

c) Regarding civil engineering education, survey course comprises the core of this education program.

d) Survey course is required from the very preliminary study stage to construction stages. Developing country like Nepal requires manpower of interdisciplinary expertise to accomplish project independently.

e) Institute of engineering has given significant importance to the field oriented subject like surveying. Regarding surveying, conventional surveying has been replaced by modern computerized high-tech survey equipments.

f) With the viewpoint to enhance survey course, Institute of Engineering provided sufficient number of modern equipments such as total stations with survey software.

g) At present state, although survey course is equipped with modern technologies,

h) Doubt still arises regarding its better use and execution, cost-effectiveness, quality and sustainability.

i) Since the success of surveying course depends upon its quality and better performance, this paper aims at providing suggestions and recommendations regarding the proper formulation of Survey Camp guide.
CE6311 – SURVEY PRACTICAL I
SYLLABUS

COURSE OBJECTIVES

- To acquire practical knowledge on handling basic chain survey equipments
- To possess knowledge about compass surveying
- To have the ability to prepare leveling table
- To possess knowledge about contour map

LIST OF EXPERIMENTS

- Study of chains and its accessories
- Aligning, Ranging and Chaining
- Chain Traversing
- Compass Traversing
- Plane table surveying: Radiation
- Plane table surveying: Intersection
- Plane table surveying: Traversing
- Plane table surveying: Resection – Three point problem
- Plane table surveying: Resection – Two point problem
- Study of levels and leveling staff
- Fly leveling using Dumpy level
- Fly leveling using tilting level
- Check leveling
- LS and CS

COURSE OUTCOMES

- Gain the ability to use modern survey equipment to measure angle and distance
- Understood the basic principle and techniques about survey field
- Gain design knowledge related to various structural system
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<td>Plane table surveying - intersection method</td>
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Contouring

Study of theodolite

Expt. No. 1  STUDY OF CHAIN AND TAPE AND ACCESSORIES USED FOR CHAIN SURVEYING

Aim:  
To study the Chain and tape and accessories used for chain surveying

A) Chain:  
1. The chains are made in lengths of 30 meters/20 meters.
2. The brass tallies are fixed at every 5m length.
3. Small brass rings are provided at every one meter length.
4. It is composed of 100 or 150 pieces of galvanized mild steel wire of 4mm in diameter called links.
5. The ends of each links are bent into a loop and connected together by means of 3 oval rings which give flexibility to the chain.
6. The length of each links is 20cm i.e. the distance between 2 consecutive middle rings.
7. The end of the chains is provided with brass handle for dragging the chain on the ground.
8. The chain length is measured from the outside of one handle to the other.
9. To hold the arrows in the position with the handle of the chain a groove is cut on the outside surface of the handle.

B) Ranging rods:  
1. They are usually of 2m or 3m in length.
2. They are in circular cross section and having alternate black, white and red bands of 20 cm length each to make them visible at a distance.
3. They are used for ranging the lines and for marking the positions of points on the ground.

C) Arrows:  
1. They are made of a steel wire of 4mm diameter for 40cm length.
2. They are pointed at one end for inserting into the ground and bent at the other end for facility of carrying.
3. They are used to mark the end of each chain during chaining.

E) Cross staff:  
1. It consists of a wooden block with two fine saw cuts at right angles to each other on the top.
2. It is used to set a perpendicular at a given point on the chain line.
3. The head is fixed to a top of an iron staff with pointed end to drive into the ground.

F) Optical square:
1. This is also used to set a perpendicular with more accuracy.
2. This has 2 mirrors placed at an angle of 45° to each other.
3. By means of reflection we can see the ranging rods along the chain line and the offset point at right angles to the chain lines simultaneously.

Result:
The Chain and tape and accessories used for chain surveying has been studied fully

Outcome:
At the end of this experiment, student acquires knowledge about the Chain and tape and accessories used for chain surveying

Viva-voce

1. What is surveying?
2. What are the basic principles of surveying?
3. What is Plane Surveying?
4. What is Geodetic Surveying?
5. What are the instruments used for chain surveying?
6. What are the instruments used for setting out right angles to a chain line?
7. What are the different sources of error in chain surveying?
8. What are the different tape corrections?
9. What is meant by hypotenuse allowance?
10. How will you record the observation in a field book?
11. What is meant by well-conditioned triangle?
12. How will you test a chain?
13. What is meant by reconnaissance survey?
14. What is representative fraction?
15. What is meant by scale of plan?

**Applications**

1. It is used for rapid measurements
2. Knowing the concept of analytical lens in tachometer
3. Error rectifying
4. Knowing the values d and s for different points
Expt. No.2 RANGING AND CHAINING OF A LINE

Aim:
To find the distance between the given two points by ranging and chaining a line

Apparatus required:
1. Chain (30m)
2. Ranging rods
3. Arrows

Procedure:
A) For ranging a line:
1. Fix the ranging rods vertically at the ends of the given line.
2. To fix the intermediate ranging rod, instruct the other person to stand with a ranging rod at any intermediate point desired.
3. Stand at about 2m behind the first ranging rod and instruct the other person to adjust the ranging rod in such a way that the intermediate ranging rod comes in a line with the end rods.
4. Erect the rod vertically and firmly at that point.
5. Repeat steps 2 to 4 to erect other intermediate ranging rods.

B) For chaining a line:
1. Hold one handle of the chain at first ranging rod.
2. Instruct the follower to drag the chain along the given line.
3. Fix the arrows at the end of the chain length.
4. Do the same procedure for the full length of the line.
5. Count any fractions of the chain length at the end of the last ranging rod by using tallies, rings & links

Result:
Length of the given line =

Outcome:
At the end of this experiment, student acquires knowledge about the ranging and chaining of the line
1. What is plumb bob?
2. What is check line and tie line?
3. What is meant by reciprocal ranging?
4. What is meant by hypotenusal allowance?
5. What do you understand by “working from whole to part”?
6. What are the kinds of errors?
7. How will you Classify surveying based on accuracy?
8. What are all the types of chain?
9. What are tie stations?
10. What are all the accessories used in chain surveying?
11. What are the errors in chaining?
12. What are the types of Ranging?
13. What is cross staff?
14. What are the types of optical square?
15. What is well conditioned triangle

Applications

1. Getting accurate values comparing reiteration method
2. Easy to measure the targets
3. Error rectifying
Expt. No.3 DETERMINE THE AREA OF THE BOUNDARY USING CHAIN SURVEY

Aim:
To find out the area of the given boundary points by perpendicular offset method

Instruments required:
1. Chain (30m)
2. Cross staff
3. Ranging rods
4. Arrows

Formulae:
Area of the triangle \[ A = \frac{1}{2} bh \text{ sq. units.} \]
Area of the trapezium \[ A = \frac{1}{2} h (a+b) \text{ sq. units.} \]

Procedure:
1. The survey stations are fixed.
2. To range a line AB, the ranging rods are fixed at the end of the line.
3. The surveyors stand just behind the ranging rod A. The assistant holds a ranging rod at point C, approximately on the line AB.
4. Locate the perpendicular offset by using cross staff.
5. Move the cross staff towards left / right.
6. Now base line (AB) is visible and perpendicular line also visible.
7. Perpendicular line measurements are taken.
8. The operation is repeated until the end station of the line is reached.
9. To check the accuracy of the measurement, the line is measured in the reverse direction.
10. Split the area, by triangle and trapezoidal.
11. Move the cross staff towards left / right.
12. Now base line (AB) is visible and perpendicular line also visible.
13. Perpendicular line measurements are taken.
14. Calculate the area by using triangle and trapezoidal formula
Result:

The area of the field = 

Outcome:

At the end of this experiment, student acquires knowledge about the perpendicular offset method
1. What are optical squares?
2. What is well conditioned triangle?
3. What is the use of cross staff?
4. What are all the sources of error?
5. What are the different types of chain triangulation?
6. What is meant by representative fraction?
7. What is meant by scale of plan?
8. What is meant by well conditioned triangle?
9. What is meant by scale in surveying?
10. What is Plane and Geodetic surveying?
11. What are Arrows?
12. What is Plumb bob?
13. How will you differentiate check line and tie line?
14. What is meant by reciprocal ranging?
15. What is meant by hypotenusal allowance?

Viva-voce

1. Time reducing method
2. Easy to measure the targets
3. Error rectifying

Applications
Expt. No. 4  
RUNNING A CLOSED TRAVERSE BY CHAIN AROUND AN EXISTING BUILDING

Aim:
To plot the plan of an existing building by running a closed chain traverse and to find the area of the plot.

Instruments required:
1. Chain
2. Cross staff
3. Optical square
4. Ranging rods
5. Arrows & tape

Procedure:
1. Range and chain the lines around the given building to form a rectangle in clockwise/anti-clockwise direction.
2. Measure all the offset points (Perpendicular/Oblique) from the chain line.
3. Plot the building in a drawing sheet with suitable scale.
4. Subtract the un-built up area (open space) of the plot from the total area of the plot to find the built up area of the building.

Diagram:

Result:
The plan of the building is plotted as shown in figure.
Area of the plot \((a)\) = \(\ldots\ldots\ldots\ldots\) m\(^2\)
Area of the open space \((b)\) = \(\ldots\ldots\ldots\ldots\) m\(^2\)

Outcome:
Gain knowledge about closed traversing in the wide field.
1. Mention the different types of chain.
2. Define - ranging.
3. What are the types of ranging?
4. When you adopt reciprocal ranging?
5. What is the length of ranging rod?
6. What are optical square?
7. Define - well conditioned triangle
8. What is the use of cross staff?
9. Mention the sources of error?
10. What are the different types of chain triangulation?
11. What is meant by representative fraction?
12. What is meant by scale of plan?
13. What is meant by well conditional triangle?
14. What is meant by scale in surveying?
15. Define - Plane and Geodetic surveying

Applications

1. Getting accurate values comparing reiteration method
2. Easy to measure the targets
3. Error rectifying
Expt. No. 5 STUDY OF COMPASS SURVEYING

Aim:
To study the Compass and its accessories used for chain surveying

Description of the Instruments:

Prismatic Compass:

1. A magnetic needle is attached to the circular ring made up of aluminum.
2. The needle is on the pivot to orient N and S ends.
3. The line of sight is defined by object vane and eye slit both attached to the compass bar.
4. The object vane consists of a vertical hair attached to a suitable frame while the eye slit consist of a vertical slit above the prism unit.
5. When the object is sighted, the sight vanes will rotate with respect to the NS end of the ring through an angle which the line makes with the magnetic meridian.
6. The reading increase in clockwise direction from 0˚ at south and to 90˚ at west end 180˚ at north end and 270˚ at east end.
7. Break- pin is placed at the base of the object vane to clamp the oscillation of the needle while taking reading.
8. Dark glasses are used to sight bright objects.
Adjustments of prismatic compass:

A) Centering:
   1. It is the process of keeping the instrument exactly over the station.
   2. It is done by dropping a pebble from the centre of the bottom of the instrument.

(B) Leveling:
   1. For which the tripod is provided with ball and socket arrangement to fix the compass on level.
   2. Adjust the box in such a way that the graduated disc is swinging freely and appears to be level.

(C) Focusing the Prism:
   The prism attachment is sided up or down till the readings are seen to be sharp and clear.

B. Surveyor Compass:
   1. The object vane is similar to that of prismatic compass.
   2. The eye vane consists of a simple metal vane with the fine slit without the prism.
   3. The graduation ring is directly attached to the box and not with needle.

Result:

Thus the components of prismatic compass are studied.

Outcome:
Students will Gain knowledge about compass and its accessories

**Viva-voce**

1. Mention different types of compasses?
2. What is whole circle bearing?
3. Define quadrant bearing
4. What is different between fore bearing and back bearing?
5. Define dip.
6. What is magnetic meridian?
7. What are the different sources of local attraction?
8. State the three point problem.
9. State the two point problem.
10. List out the errors in a plane table surveying.
11. Differentiate closed traverse from open traverse.
12. What is intersection method? Where it is used?
13. What is meant by strength of fix?
14. Write the disadvantages of plane table surveying?
15. Write the advantages of plane table surveying?

**Applications**

1. Making good alignment in field work
2. Easy to measure the irregular boundary areas
3. Less error method
**Expt. No. 6**

**DETERMINE THE BEARINGS USING PRISMATIC AND SURVEYOR COMPASS**

**Aim:**
To find the bearing of different objects and to convert Whole Circle Bearing (WCB) to Reduced bearing (RB)

**Instruments required:**
1. Prismatic Compass
2. Surveyors Compass with stand
3. Required no. of ranging roads

**Procedure:**
1. Setup the instrument at any convenient point and do the initial adjustments.
2. Turn the compass box until the ranging rod at the object vane is bisected by the hair when looked through the slit above the prism.
3. Note down the reading at which the hair line produced appears to cut the image of the graduated ring.

**Rule for the conversion of WCB to RB:**

<table>
<thead>
<tr>
<th>Case</th>
<th>W.C.B Between</th>
<th>Rule for RB</th>
<th>Quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0 and 90</td>
<td>=W.C.B</td>
<td>N.E</td>
</tr>
<tr>
<td>II</td>
<td>90 and 180</td>
<td>=180-W.C.B</td>
<td>S.E</td>
</tr>
<tr>
<td>III</td>
<td>180 and 270</td>
<td>=W.C.B-180</td>
<td>S.W</td>
</tr>
<tr>
<td>IV</td>
<td>270 and 360</td>
<td>=360-W.C.B</td>
<td>N.W</td>
</tr>
</tbody>
</table>

**Diagram:**
Observation:
Using Prismatic Compass:

<table>
<thead>
<tr>
<th>Instrument at</th>
<th>Sight to</th>
<th>W.C.B</th>
<th>R.B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>In Degree</td>
<td>In Minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Result:
1) Whole Circle Bearing = ......................
2) Reduced Bearing = .........................

Outcome:
Gain knowledge about compass bearings in the wide field
1. Define - traverse
2. What is local attraction?
3. What is true magnetic meridian?
4. Define - meridian
5. Define - bearing
6. What is magnetic meridian?
7. What are the different sources of local attraction?
8. State the three point problem.
9. State the two point problem.
10. List out the errors in a plane table surveying.
11. Differentiate closed traverse from open traverse.
12. What is intersection method? Where it is used?
13. What is meant by strength of fix?
14. Write the disadvantages of plane table surveying?
15. Write the advantages of plane table surveying?

Applications

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No. 7  CLOSED TRAVERSE USING COMPASS

Aim:
To run a closed compass traverse along a chosen boundary, adjust the closing error by Bowditch rule and calculate the local attraction

Instruments required:
1. Prismatic Compass
2. Chain or tape
3. Arrows
4. Ranging rods

Procedure:
1. Let A, B, C, D, E be the given points along the closed traverse.
2. Set up the instrument at each point and note down fore bearing and back bearing (i.e) A to B and B to A. Continue the procedure upto EA and AE.
3. Measure the distances between the consecutive points.

Procedure of balancing a traverse Bowditch’s rule (Graphical method):
1. In figure (a), polygon AB’C’D’E’A’ represents an unbalanced traverse having a closing error equal to A’A since the first point A and last point A’ are not coinciding.
2. The total closing error AA’ is distributed linearly, to all the sides in proportional to their length by a graphical construction, shown in figure (b). In figure (b), AB’, B’C’, C’D’, etc. represents the length of the sides of the traverse, either to the same scale as that of figure (a) or to a reduced scale.
3. The ordinate aA’ is made equal to the closing error A’A of figure (a).
4. By constructing similar triangles, the corresponding errors bB’, cC’, dD’, eE’ are found.
5. In figure (a), lines E’E, D’D, C’C, B’B are drawn parallel to the closing error A’A and made equal to eE’, dD’, cC’, bB’ respectively.
6. The polygon ABCDE so obtained represents the adjusted traverse.
7. It should be remembered that the ordinates bB’, cC’, dD’, eE’, aA’ of figure (b) represents the corresponding errors in magnitude only but not in direction.
8. The ordinate aA’ is made equal to the closing error A’A of figure (a).
9. By constructing similar triangles, the corresponding errors bB’, cC’, dD’, eE’ are found.
Observation:

<table>
<thead>
<tr>
<th>Line</th>
<th>Distance in m</th>
<th>F.B</th>
<th>B.B</th>
<th>F.B~ B.B</th>
<th>Local Attraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EA</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Calculation:

\[
\text{Angle of EAB} = F.B \text{ of AB} - B.B \text{ of AE} = \\
\text{Angle of ABC} = F.B \text{ of BC} - B.B \text{ of BA} = \\
\text{Angle of BCD} = F.B \text{ of CD} - B.B \text{ of CB} = \\
\text{Angle of CDE} = F.B \text{ of DE} - B.B \text{ of DC} = \\
\text{Angle of DEA} = F.B \text{ of EA} - B.B \text{ of ED} = \\
\]

To Check:

\[
\begin{align*}
\text{Sum of included angle of pentagon} & = (2n-4) 90° \\
\text{Error} & = x° \\
\text{Distribution of error} & = x°/n \\
\end{align*}
\]

Result:

The amount of closing error = ............

Outcome:

At the end of the experiment, students will gain knowledge about closed compass traversing.
1. What is local attraction?
2. Define dip
3. What is the least count of compass?
4. What is magnetic declination?
5. How local attraction can be detected?
6. State the two point problem.
7. List out the errors in a plane table surveying.
8. Differentiate closed traverse from open traverse.
9. What is intersection method? Where it is used?
10. What is meant by strength of fix?
11. Write the disadvantages of plane table surveying?
12. Write the advantages of plane table surveying?
13. Differentiate Prismatic compass from Surveyor’s compass with reference to reading as well as tripod.
14. List out the errors in a compass instrument.
15. What is true meridian?

**Applications**

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No. 8  STUDY OF PLANE TABLE SURVEYING

Aim:
To study the Plane table and accessories used for chain surveying

Diagram

Description of the Instruments:

a) Alidade:
1. It consists of a metal rule with tow vanes at the ends.
2. One of the vanes is provided with a narrow slit while the other is open and carries a hair or the wire.
3. The alidade can be rotated about the points representing the instrument station on the sheet so that the line of sight passes through the object to be sighted.
4. For accurate centering, a telescope alidade is used.

b) U-Frame:
1. The fork consists of a hairpin shaped frame in which a plump bob is suspended from the end of the lower arm.
2. This is used to transfer the ground point on to the sheet to make the two points in a vertical line.

c) Sprit Level:
The table is leveled by placing this level transversely and longitudinally on the board and bringing the bubble at the center of the tube.
d) Trough compass:
   This is used for orienting the table to magnetic north.

ADJUSTMENTS OF THE INSTRUMENT

a) Leveling:
   The table is leveled by placing the sprit level on the board in two positions at right angles and
   the bubble is central in both directions.

b) Centering:
   This is done in such a way that the point plotted on the sheet should be exactly over the station
   on the ground by adjusting the table with the help of U-frame.

c) Orientation:
   It is the process of putting the plane table into same fixed direction so that the line representing
   a certain direction on the sheet is parallel to that direction on the ground.

METHOD OF ORIENTATION:

4. By using trough compass:
   1. The compass is placed on table with the needle floats centrally and a pencil line is ruled
      against the long side of a bar.
   2. When the table is to be oriented at any other station, the compass is placed against this
      line and the table is rotated until the needles floats centrally, and then clamp the table.

5. By back sighting:
   1. This is done by keeping the alidade in the reverse elevation (ba) on the previously drawn
      line (ab) when the table is at B.
   2. Then turn the table about its vertical axis until the point A is bisected, and clamp it.

Result:

Thus the instruments used for plane table surveying are studied

Outcome:

Students will gain knowledge about plane table and its accessories
Viva-voce

1. What is plane table surveying?
2. List out the various instruments used in plane table surveying?
3. What is the use of plane table surveying?
4. Define plumb bob line.
5. How mapping can be done?
6. What is orientation? Why it is to be performed?
7. What are bearings? Name the types.
8. What is an alidade? State its uses.
9. What is meridian? Name the types.
10. What is magnetic declination?
11. Enlist the disadvantages of plane table surveying.
12. What is orientation? Why is it done?
13. What is magnetic meridian?
14. What is whole circle bearing?
15. Differentiate between magnetic declination and dip.

Applications

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No.9  

PLANE TABLE SURVEYING  

RADIATION METHOD

Aim:
To locate the object from a single station and to find the area of the given polygon

Instruments required:
1. Plane table with stand  
2. Tape  
3. Trough compass  
4. Alidade,  
5. Spirit level  
6. Plumbing fork with plumb bob  
7. Arrows  
8. Ranging rod

Diagrams:

Procedure:
1. Select the position of the table where it is be set so that all the points to be located are visible from it. Let 'O' be the position of such a point on the ground.
2. Set the plane table over this point and level it. Draw the North line in the top corner of sheet by means of trough compass at the table.
3. Now transfer the position of the point 'O' on the ground to the sheet by means of the plumbing fork. The point 'O' will represent point 'o' will represent point 'O' on the ground.
4. With the alidade touching the point ‘o’ (may be represented by fixing a pin), sight the point A in the field. Draw the ray along the fiducial edge.

5. Similarly sight other points such as B, C, D, E etc. and measure their distances from the instrument station. Plot them to scale to get their position on the sheet such as b, c, d etc. on the sheet.

Calculations:

The outline of the profile is plotted as shown

\[ A = \sqrt{s(s-a)(s-b)(s-c)} \]

\[ S = \frac{(a+b+c)}{2} \]

Result:

The object from a single station where located and the enclosed area of the given polygon is calculated. Area of the polygon ABCDE =

Outcome:

Students will be able to draw the topographical features on the map at the end this experiment
Viva-voce

1. Mention the suitability and unsuitability of plane tabling.
2. When you adopt radiation method?
3. How you fix the north?
4. What is centering?
5. What are the equipments used in plane tabling?
6. What is orientation? Why it is to be performed?
7. What are bearings? Name the types.
8. What is an alidade? State its uses.
9. What is meridian? Name the types.
10. What is magnetic declination?
11. Enlist the disadvantages of plane table surveying.
12. What is orientation? Why is it done?
13. What is magnetic meridian?
14. What is whole circle bearing?
15. Differentiate between magnetic declination and dip.

Applications

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No.10  PLANE TABLE SURVEYING
INTERSECTION METHOD

Aim:

To locate inaccessible point by the intersection of rays drawn from two instrument station

Instrument required:

1. Plane table
2. Trough compass
3. Alidade
4. Sprit level
5. Plumbing bob with plumbing fork
6. Arrows
7. Taps
8. Ranging rods

Diagram:
Procedure:

1. Select two points L and M in such a way so that all the points to be plotted are visible from them. Now set the table at station, point L in such a position so that the sheet should cover all the points. Level the table and clamp it.

2. Draw the north line in the top corner of sheet by means of trough compass

3. Now transfer the position of station point L on the sheet as ‘l’ with the help of plumbing fork so that it is vertically above the instrument station.

4. With the alidade pivoted about ‘l’ sight the ranging rod fixed at station point M and draw the line in the direction of M. Now measure the distance LM by means of the tape and cut off lm to some suitable scale along the ray drawn toward M; thus fixing the position of ‘m’ on the sheet corresponding to station point M on the ground. The line lm is called the base line.

5. With the alidade touching the point ‘l’ sight the objects in the field such as A, B, C, D, E etc. as shown in figure and draw the rays towards them. The direction of each line is marked with an arrow and a letter A, B, C, D, E etc. corresponding to above details.

6. Now shift the table to the station point M and approximately set it in the line with ML. Set it up so that the point ‘m’ is vertically above the station point ‘M’ and level it.

7. Orient the table roughly by compass, then finally by placing the alidade along ml and bisecting the ranging rod fixed at station point ‘L’ i.e. by back sighting ‘L’. Clamp the table in this position.

8. With the alidade centered at m sight the same object in the field such as A, B, C, D, E etc; and draw rays. The intersection of these rays with the respective rays from l locate the object A, B, C, D, E etc; as a, b, c, d, e etc; on the sheet.

Result:

The Distance between two inaccessible point is = .................. m.

Outcome:

Students will be able to found the inaccessible points distance at the end this experiment
1. What are back sights and fore sights?
2. What is the objective of plane table intersection?
3. When we use plane table intersection?
4. What is the use of trough compass?
5. What is orientation? Why it is to be performed?
6. What are bearings? Name the types.
7. What is an alidade? State its uses.
8. What is meridian? Name the types.
9. What is magnetic declination?
10. Enlist the disadvantages of plane table surveying.
11. What is orientation? Why it is done?
12. What is magnetic meridian?
13. What is whole circle bearing?
14. Differentiate between magnetic declination and dip.

Applications

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No. 11  

PLANE TABLE TRAVERSING

Aim:
To run survey lines between various field objects by traversing

Instruments Required:
1. Plane table with accessories
2. Tape & ranging rods

Diagram:

Procedure:
1. Suppose A, B, C and D are the traverse station.
2. The table is set up at station A. A suitable point is selected on the sheet in such a way the whole area may be plotted in the sheet. The table is centered, leveled and clamped. The North line is marked on the right hand top corner of the sheet.
3. With the alidade touching point a, the ranging rod at B is bisected and ray is drawn. The distance AB measured and plotted to any suitable scale.
4. The table is shifted and cantered over B. It is then leveled, orientated by back-sighting and clamped.
5. With the alidade touching point b, the ranging rod at C is bisected and a ray is drawn. The distance BC is measured and plotted to the same scale.
6. The table is shifted and setup at C and the same procedure is repeated for all stations.
7. In this manner, all station of traverse are connected
8. At the end, the finishing point may not coincide with the starting point and there may be some closing error. This error is adjusted graphically by Bowditch’s rule.
Calculation:

\[ \text{Area} = \frac{1}{2} (bh) \]

Result:

The area of the given traverse is = .................

Outcome:

Gain knowledge about to found the station points on the ground

Viva-voce

1. Define height of instrument.
2. What is plane table traversing?
3. What is backsight?
4. How can you calculate area?
5. What is orientation? Why it is to be performed?
6. What are bearings? Name the types.
7. What is an alidade? State its uses.
8. What is meridian? Name the types.
9. What is magnetic declination?
10. Enlist the disadvantages of plane table surveying.
11. What is orientation? Why is it done?
12. What is magnetic meridian?
13. What is whole circle bearing?
14. Differentiate between magnetic declination and dip.
15. What do you understand by the term ‘Traversing’?

Applications

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No.12

PLANE TABLE SURVEYING
TWO POINT PROBLEM

Aim:
To determine the instrument by two point problem

Instruments required:
1. Plane table with accessories
2. Tape and ranging rods

Diagram:

Procedure:
1. Let $O_1, O_2$ be the two stations plotted as $o_1$ and $o_2$ on the drawing sheet. It is required to plot station $O_3$ for plane tabling work.
2. An auxiliary point $A$ on ground is selected such that $AO_3$ is approximately parallel to $O_1 O_2$ and the angle $O_3 O_1 A$ and $O_3 O_2 A$ are balanced angles, i.e. these are neither too acute or too obtuse. The table is set and leveled at $A$, and so oriented that line $O_1 O_2$ on ground is nearly parallel to line $o_1 o_2$ plotted on table map.
3. Alidade, touching $o_2$ and sighting $O_2$ on ground, a ray is drawn through $o_2$. In the same way, draw a ray by touching alidade to $o_1$ and sighting $O_1$ on ground. This ray will intersect the first ray at $a_1$ on the map.
4. With alidade touching $a_1$, sight $O_3$ and draw the ray $a_1 o_3$. Mark the estimated position of $O_3$ on the map as $o'_3$. 
5. The table is removed from $A$ and set at $O_3$ with marked position of $o_3$ over $O_3$, properly levelled and similarly oriented. This is achieved by back sighting $A$ from $O_3$.

6. Now with table at $O_3$, keep alidade touching $o_1$ and sight $O_1$ and draw a back ray resecting the line $a_1o_3'$ in $o_3$. Here $o_3$ is the point representing the station $O_3$ with reference to the approximate orientation made at $A$.

7. With alidade touching $o_3$, sight $O_2$ and draw a ray to $O_2$. If the ray passes through the plotted point $o_2'$, the orientation of the table is correct and $o_3$ is the correct position of $O_3$. Whereas, if this ray cuts the previously plotted line $a_1o_2$ at some other point, say $o_2'$, then the position $o_3$ is not the correct position of $O_3$.

8. The orientation error will be equal to $\angle o_2' o_1 o_2$ between the lines $o_1 o_2$ and $o_1 o_2'$. This error can be eliminated by rotating the table through the angle $o_2' o_1 o_2$. This table rotation can be achieved by taking the following steps.

   a. The alidade is placed along line $o_1 o_2'$ and a ranging rod $B$ is fixed in line with $o_1 o_2'$, far away from the plane table.

   b. Alidade is now kept along true line $o_1 o_2$ and table is rotated so that ranging rod $B$ is bisected. The table is clamped in new position.

   c. The true location of $O_3$ on map is now marked by: orienting alidade along $o_1 O_1$ and drawing the

**Result:**

The instrument station “C” is plotted on the sheet of paper as “C” using two point problems.

**Outcome:**

Gain knowledge about to found the station points on the ground
1. Define - two point problem
2. How can you locate the station point?
3. When we using two point method?
4. What is the difference between two point and three point method?
5. How you fix the a and b points?
6. What is orientation? Why it is to be performed?
7. What are bearings? Name the types.
8. What is an alidade? State its uses.
9. What is meridian? Name the types.
10. What is magnetic declination?
11. Enlist the disadvantages of plane table surveying.
12. What is orientation? Why is it done?
13. What is magnetic meridian?
14. What is whole circle bearing?
15. Differentiate between magnetic declination and dip.
16. What do you understand by the term ‘Traversing’?

Applications

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No.13  

PLANE TABLE SURVEYING  

THREE POINT PROBLEM

Aim:
To determine the instrument station by three point problem using trial and error method

Instrument required:
1. Plane table with tripod stand
2. Trough compass
3. Spirit level
4. Alidade
5. Plumping fork with plumb bob
6. Arrow
7. Ranging rod

Lehmann’s Rule:
1. If the position of the plane table is inside the greater triangle, its plotted position should be inside the triangle of error.
2. If the position of the plane table is outside the greater triangle its plotted position should be outside the triangle of error.
3. The plotted positions of the plane table should be so chosen that its distance from the resectors is proportional to the distance of the plane table station from the field position of the considered object.
4. The plotted position of the plane table should be so chosen that its same side of all the three rays.

Procedure:
1. Let A, B and C represent the ground location of a well defined object whose plotted position area, b, c.
2. Let P be the plane table station whose plotted position P is to be determined.
3. Select a plane table position inside the greater triangle A,B,C and set up the table over and orient it by adjustment so that position the apparent line ab is approximately parallel to imaginary side AB
4. Pivot the alidade on a, b, c bisect the single placed at A, B, C in turn and draw a ray. If the orientation of the table is correct, the three rays will meet at one point which is the desired location of p on the sheet. If not the ray will form a triangle of error.
5. Choose a point \( p' \) inside the triangle of error such that its perpendicular distance from each ray is in proportion to respective distance of \( P \) from the three ground objects. For selection of location of \( p' \) Lehman's rule 1 and 3 needed to be applied.

6. Align the alidade along \( p' \) a (assume \( A \) to be farthest station). Rotate the table till plate \( A \) is bisected and clamp the table.

Result:

The new station point was marked and transferred to the ground and established

Outcome:

Gain knowledge about to found the station points on the ground
1. Define - two point problem
2. How can you locate the station point?
3. When we using two point method?
4. What is the difference between two point and three point method?
5. How you fix the a and b points?
6. What is orientation? Why it is to be performed?
7. What are bearings? Name the types.
8. What is an alidade? State its uses.
9. What is meridian? Name the types.
10. What is magnetic declination?
11. Enlist the disadvantages of plane table surveying.
12. What is orientation? Why is it done?
13. What is magnetic meridian?
14. What is whole circle bearing?
15. Differentiate between magnetic declination and dip.

**Applications**

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No.14  
PLANE TABLE SURVEYING - THREE POINT 
PROBLEM (BESSEL’S OR GRAPHICAL METHOD)

Aim:
To determine the instrument station by three point problem using Bessel’s method

Instrument Required:
1. Plane table with tripod stand
2. Trough compass
3. Sprit level
4. Alidade
5. Plumping fork with plumb bob
6. Arrow
7. Ranging rod

Model Figure:
Procedure:

1. After setting & leveling the table, the alidade is placed along the line ca& the board turned until A is sighted being towards A. the table is then clamped. With the alidade centered on C, B is sighted & a ray CB is drawn along the edge of the alidade.
2. When the alidade placed along ac, the board is turned until the line of sight bisects c, c being towards C & then clamped. With the alidade touching a, B is sighted & a ray aB is drawn through a; intersecting the ray previously drawn through in the point d.
3. With the alidade along bd, the table is turned until B is bisected & then clamped. The table is now oriented & t must lie on db& also on Aa& Cc. with the alidade centered on a, A is bisected & a ray is drawn through a, intersecting the ray bd in t, which represent the instrument station T.
4. To check the orientation, the alidade is pivoted on c &C is bisected. The ray Cc should now pass through t, if the work is correct.

Result:

The instrument station “P” is plotted on the sheet “p” using Bessel’s method

Outcome:

Gain knowledge about to found the station points on the ground
1. What is two point problem?
2. How can you locate the station point?
3. When we using two point method?
4. What is the difference between two point and three point method?
5. How you fix the a and b points?
6. What is orientation? Why it is to be performed?
7. What are bearings? Name the types.
8. What is an alidade? State its uses.
9. What is meridian? Name the types.
10. What is magnetic declination?
11. Enlist the disadvantages of plane table surveying.
12. What is orientation? Why is it done?
13. What is magnetic meridian?
14. What is whole circle bearing?
15. Differentiate between magnetic declination and dip.

**Applications**

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No.15 THREE POINT PROBLEM – TRACING

PAPER METHOD

Aim:

To determine the instrument station by three point problem using Tracing paper method

Instrument required:

1. Plane table with tripod stand
2. Trough compass
3. Sprit level
4. Alidade
5. Plumping fork with plumb bob
6. Arrow
7. Ranging rod

Procedure:

1. Mark the points a, b, c on the sheet corresponding to the stations A, B, C.
2. Set up the table at “P” the instrument station and orient the table approximately and clamp it.
4. Mark the “P1” on the tracing sheet to locate the instrument station by judgment.
5. Pivot the alidade on “P1” and sight the signals at A, B, C successively and draw rays along each direction.
6. Unfasten the tracing sheet.
7. Move the tracing sheet over the drawing sheet in such a way that the rays drawn are passed through a, b, c on the drawing sheet correspondingly.
8. Transfer the point “P1” on the tracing sheet to drawing sheet as “P” which is the required instrument station.
9. Place the alidade along “PA” and orient the table by sighting “A”

Check:

The points B and C should be sighted with the alidade pivoted on b and c respectively and the rays are drawn. These rays should now pass through “P”. If not, a small triangle of error will result and it may be eliminated by the trial and error method.
Result:

The instrument station “P” is plotted on the sheet of paper as “P1” using tracing paper method.

Outcome:

Gain knowledge about to found the station points on the ground

Viva-voce

1. What is two point problem?
2. How can you locate the station point?
3. When we using two point method?
4. What is the difference between two point and three point method?
5. How you fix the a and b points?
6. What is orientation? Why it is to be performed?
7. What are bearings? Name the types.
8. What is an alidade? State its uses.
9. What is meridian? Name the types.
10. What is magnetic declination?
11. Enlist the disadvantages of plane table surveying.
12. What is orientation? Why is it done?
13. What is magnetic meridian?
14. What is whole circle bearing?
15. Differentiate between magnetic declination and dip.

Applications

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Error rectifying
Expt. No.16 STUDY OF LEVELLING

Aim:
To study the leveling and its accessories used for chain surveying

Description of the instruments:

A) The Level:
1. The instrument, which is used, for measuring related elevation is known as level & consists of the following parts.
2. A telescope to provide a line of sight.
3. A level tube to make the line sight horizontal.
4. A leveling head to bring the bubble of the level tube at the center of its run.
5. A tripod head to support the above 3 parts of the level.

Types of level:
(a) The dumpy level:
1. This consists of a telescope rigidly fixed to its support.
2. It can neither be rotated about it longitudinal axis nor it can be removed from its support.

(b) The wye level:
1. The telescope is supported in Y supports & is not rigidly fixed to the supports.
2. The telescope can be removed from the supports reversed end to end & can be revolved about its longitudinal axis.

(c) The reversible level:
The telescope can be rotated about its longitudinal axis in the sockets & also can be withdrawn from its sockets & replaced end for rod.

(d) The tilting level:
The telescope can be tilted within few degrees in vertical plane by a tilting screw.

B) Telescope leveling staff:
1. It consists of 3 pieces.
2. Top piece is 1.25m long where as central 1.25m & lower piece 1.5m is hollow.
1. When fully extended total length of the staff is 4m.
2. Each metre is subdivided into 200 divisions. The thickness of the graduations being 5 mm.
3. Spaces indicating the decimeter readings are marked in red while all other spaces are marked in black against a white background.
4. The decimeter markings are continuous throughout the staff.
Temporary adjustments of the dumpy level:

a) Setting up the level:
   1. This includes fixing the instrument on the tripod & leveling the instrument approximately by leg adjustment.
   2. To do this, release the clamp and hold the instrument in the right hand & fix it on a tripod by turning round the leveling head with left hand.
   3. The tripod legs are adjusted so that the telescope is at a convenient height & is leveled approximately.

b) Leveling up:
   1. This is done with the help of three-foot screws & by using plate levels.
   2. The object of leveling is to make its vertical axis truly vertical.
   3. First loosen the clamp screw & turn the instrument until the longitudinal axis of the bubble tube is parallel to a line joining any two leveling screws (say A & B).
   4. Holding these two foot screws with the thumb & first finger of each hand turn them uniformly so that the thumbs move either towards each other or away from each other until the bubble comes to the center of the tube.
   5. Rotate the upper plate through 90˚ until the axis of the plate level coincides a line joining the third foot screw C & the midpoint of the first two screws A & B.
   6. Hold the third screw with the thumb & find finger of the right hand & turn it until the plate bubble is central.
   7. Rotate the upper plate through 90˚ to its original position & repeat step 4 till the bubble is central.
   9. Repeat steps 4 & 6 till bubble remains central in both the position.
   10. Rotate the instrument through 180˚ and in this position the bubble should remain central if the instrument is in adjustment.

Elimination of parallax:-
   1. Parallax is a condition arising when the image formed by the objective lens is not in the same plane with the cross hairs.
   2. To get accurate sighting this should be eliminated & this is done.
   3. By focusing the eyepiece for distinct vision of the cross hairs and
4. By focusing the objective to bring the image of the object in the plane of cross hairs.

Focusing the eyepiece:-
1. Direct the telescope either towards the sky or hold a sheet of white paper in front of the objective.
2. Move the eyepiece in or out till the cross hairs appear distinct.

Focusing the objective:-
1. Direct the telescope towards the leveling staff.
2. Turn the focusing screw till the image appears clear & sharp.
3. The image formed must be in the plane of cross hairs.

DEFINITIONS

Important terms:-
The following are the important terms used during leveling.

1. Level Surface:-
   A level surface is any surface parallel to the mean spheroid surface of the earth.

2. A level line:-
   It is a line lying in a level surface & normal to the plumb line at all points.

3. A horizontal plane:-
   A horizontal plane through a point is a plane tangential to the surface at the point.

4. A horizontal line:-
   It is a line lying in the horizontal plane.

5. Vertical line:-
   Vertical line at any point is a line normal to the level surface through the point.

6. Vertical plane:-
   A vertical plane is a plane containing a vertical line.

7. Datum surface:-
   It is any arbitrary assumed level surface from which vertical distances are measured.

8. Elevation:-
   Elevation of a point is its vertical distance above / below the datum also known as reduced level (R.L)
9. Bench mark:-
   It’s fixed reference point of known elevation.

10. Line of collimation:-
    It is the line joining the intersection of the cross hairs to the optical center of the object glass & its continuation also known as line of sight.

11. Axis of telescope:-
    It is line joining optical center of the object glass to the center of the eyepiece.

12. Vertical axis:-
    It is the center line of the axis of rotation.

13. Back sight (B.S):-
    It is a staff reading taken on a point of known elevation (i.e.) on bench mark or change point & is the first reading taken after the level is set up & leveled.

14. Fore sight (F.S):-
    It is a last staff reading on a point whose elevation is to be determined as on a change point.

15. Intermediate sight:-
    It is any other intermediate staff reading taken on a point of unknown elevation from the same set of the level.

16. Change point:-
    It is a point denoting the shifting of the instrument. It is a point on which the back & foresights are taken.

17. Station:-
    It is a point whose elevation is to be determined or a point which is to be established at a given elevation.

18. Height of instrument:-
    It is the elevation of the plane of collimation when the instrument is correctly leveled.

Result:
The terms and definitions also the instruments are used for leveling are studied.

Outcome:
At the end of this experiment, student acquires knowledge about levelling and its accessories used for chain surveying.
Viva-voce

1. Name the different types of Bench marks.
2. What are the different types of leveling staff?
3. Differentiate level line from a horizontal line.
4. Define – Bench Mark
5. Define – GTS Bench Mark and Arbitrary Bench Mark
6. What are the differences between the line of collimation and the axis of the telescope?
7. How is leveling done using foot screws?
8. What are the errors in leveling?
9. What are the various methods of booking a reduced level?
10. What is fore sight?
11. Compare the rise and fall method and height of collimation method.
12. What is back sight?
13. What is leveling?
14. How leveling is done using foot screws?
15. What is fly leveling?

Applications

1. Laying a circular arch line for athletics
2. Reference a circular arch line for taken by this method
3. Getting the elevation value by using stadia hairs
Expt. No.17  FLY LEVELLING USING DUMMY LEVEL & TILTING LEVEL – HEIGHT OF COLLIMATION AND RISE & FALL METHODS

Aim:

To determine the R.L. for the given points and to find the level difference between them

Instruments required:

1. Dumpy level & Tilting level
2. Staff

Diagram:

![Diagram](image)

Procedure:

1. Set up the instrument at P to cover the maximum points.
2. Do all the initial adjustments.
3. Direct the telescope towards the first point and enter the reading as B.S.
4. Enter the reading of the last visible point from the instrument station as F.S. and of all other point as I.S.
5. Shift the instrument to Q, set up and level it correctly.
6. Don’t change the position of the staff until the back staff reading is taken on the staff held at the last required point.
Observation:

Height of collimation

Reduced Level of the first point = .................

<table>
<thead>
<tr>
<th>Staff station</th>
<th>B.S</th>
<th>I.S</th>
<th>F.S</th>
<th>H.I</th>
<th>R.L</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Arithmetic Check:

\[ \sum \text{B.S} - \sum \text{F.S} = \text{Last RL} - \text{First RL} \]

Observation:

Rise & Fall

Reduced Level of the first point = .................

<table>
<thead>
<tr>
<th>Staff station</th>
<th>B.S</th>
<th>I.S</th>
<th>F.S</th>
<th>Rise</th>
<th>Fall</th>
<th>R.L</th>
<th>Remarks</th>
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Calculation:

I. Find the level difference between the successive readings & enter this as rise (+ sign), fall (- sign)

II. Then find the R.L by adding the rise and subtracting the fall with the R.L of the previous points.

Arithmetic Check:

\[ \sum \text{B.S} - \sum \text{F.S} = \sum \text{Rise} - \sum \text{Fall} = \text{Last RL} - \text{First RL} \]

Result:

Level difference between the consecutive points = .............

Outcome:

At the end of this experiment, students gain knowledge about leveling points
Viva-voce

1. Name the different types of Bench marks.
2. What are the different types of leveling staff?
3. Differentiate level line from a horizontal line.
4. Define – Bench Mark
5. Define – GTS Bench Mark and Arbitrary Bench Mark
6. What are the differences between the line of collimation and the axis of the telescope?
7. How is leveling done using foot screws?
8. What are the errors in leveling?
9. What are the various methods of booking a reduced level?
10. What is fore sight?
11. Compare the rise and fall method and height of collimation method.
12. What is back sight?
13. What is leveling?
14. How leveling is done using foot screws?
15. What is fly leveling?

Applications

1. Laying a circular arch line for athletics
2. Reference a circular arch line for taken by this method
3. Getting the elevation value by using stadia hairs
Expt. No. 18    CHECK LEVELLING

Aim:
To run the check level to find the level difference of the given points and also to find the amount of closing error

Instruments required:
1. Dumpy level
2. Staff

Procedure:
1. Set up the instrument at P to cover the maximum points
2. Do all the initial adjustments
3. Direct the telescope towards the first point and enter the reading as B.S.
4. Enter the reading of the last visible point from the instrument station as F.S. and of all other point as I.S.
5. Shift the instrument to Q, set up and level it correctly.
6. Don’t change the position of the staff until the back staff reading is taken on the staff held at the last required point.
7. Do the same procedure in the reverse direction and close with the first point.

Observation:
Reduced level of the first point = ……………………

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<th>Staff station</th>
<th>B.S</th>
<th>I.S</th>
<th>F.S</th>
<th>H.I</th>
<th>R.L</th>
<th>Remarks</th>
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Arithmetic Check:
\[ \sum \text{B.S} - \sum \text{F.S} = \text{Last RL} - \text{First RL} \]
Result:

Closing error = ................................
R.L. for the given points = ................................

Outcome:

At the end of this experiment, students gain knowledge about closing error points

**Viva-voce**

1. Mention the temporary adjustments of leveling.
3. What is mean sea level?
4. How can you calculate object height?
5. What is height of instrument method?
6. Name the different types of Bench marks.
7. What are the different types of leveling staff?
8. Differentiate level line from a horizontal line.
9. Define – Bench Mark
10. Define – GTS Bench Mark and Arbitrary Bench Mark
11. What are the differences between the line of collimation and the axis of the telescope?
12. How is leveling done using foot screws?
13. What are the errors in leveling?
14. What are the various methods of booking a reduced level?
15. What is fore sight?

**Applications**

1. Laying a circular arch line for athletics
2. Reference a circular arch line for taken by this method
3. Getting the elevation value by using stadia hairs
Expt. No.19

LONGITUDINAL SECTIONING AND CROSS SECTIONING

Aim:

To plot the profile of the longitudinal and cross section for an existing road, embankment, etc.

Instrument required:

1. Level with tripod
2. Ranging rods
3. Leveling staff
4. Chain,
5. Cross staff
6. Arrows
7. Pegs

Procedure (Longitudinal sectioning):

Field work:

1. Fix the centre line by ranging and chaining
2. Set up the instrument at suitable position and do all the initial adjustments.
3. Place the staff at frequent intervals over the central line (say 5m) and enter the readings correctly.
4. Check the bubble for its centre of run at each and every point.
5. If necessary, shift the instrument to some other place and take B.S as well as F.S. at change points.
6. Do the calibration to find the R.L. for different points.

Procedure (Cross sectioning):

Filed work:

1. Align the centre of the bund using ranging and chaining.
2. Fix the longitudinal intervals along the central line depending upon the nature of ground (say 5 or 10m) and let it be C1,C2,C3..........Cn
3. At each longitudinal intervals fix cross section intervals perpendicular to the centre line using cross staff or optical square to a suitable distance depending upon the nature of slope of the bund (say 1 to 5m) on each side.
4. Set up the instrument at a suitable position the most lowest point and most highest point can be focused.
5. Do all the initial adjustments.
6. Turn the telescope and note down the readings as follows
7. The readings along the centre of the bund is recorded as C1,C2,C3…….Cn.
8. The readings taken on right side of the centre line is recorded as R1,R2,R3…….Rn and the left side as L1,L2,L3….Ln.
9. Shift the instrument if necessary to some other place. Put change the point and repeat the above procedure.
10. Find the R.L for each and every point by any one of the method.

Diagram:

Observation:
Longitudinal sectioning:
Reduced level of the first point = ……………………

<table>
<thead>
<tr>
<th>Staff station</th>
<th>Distance</th>
<th>B.S</th>
<th>I.S</th>
<th>F.S</th>
<th>H.I</th>
<th>R.L</th>
<th>Remarks</th>
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Observation:

Cross sectioning:

Reduced level of the first point = …………………..

Result:

a) The longitudinal and cross section of the given road is thus plotted

Outcome:

At the end of this experiment, students gain knowledge about longitudinal and cross section points
Viva-voce

1. Define - parallax. How is it eliminated in a level?
2. What are the permanent adjustments of leveling?
3. Define - centering
4. How can you make bubble as centre?
5. Mention the temporary adjustments of leveling.
6. What is height of instrument method?
7. Name the different types of Bench marks.
8. What are the different types of leveling staff?
9. Differentiate level line from a horizontal line.
10. Define – Bench Mark
11. Define – GTS Bench Mark and Arbitrary Bench Mark
12. What are the differences between the line of collimation and the axis of the telescope?
13. How is leveling done using foot screws?
14. What are the errors in leveling?

Applications

1. Laying a circular arch line for athletics
2. Reference a circular arch line for taken by this method
3. Getting the elevation value by using stadia hairs
Expt. No. 20  

CONTOURING

Aim:
To determine the RL of the given points and plotting contouring lines.

Instruments required:
Dumpy level, Tripod, Leveling Staff, Prismatic compass, Chain or Tape, Ranging rods, Arrows, pegs etc.

General:
Contour is an imaginary line on the ground joining the points of equal elevation. A contour line is the line on the map representing a contour. Contour interval is the vertical distance between any two consecutive contours.

Procedure:-

Contouring by squares
1. Divide the area into a series of squares by using chain and the corners of the squares marked with arrows.
2. Keep the size of the square varies from 3m to 5m.
3. Set up the instrument at a convenient place.
4. Determine the elevations of the ground at the corner of the squares.
5. Give the notations to the corners as A for row 1 and similarly for others.

Observation & tabulations:
Reduced level of the first point = ……………………

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<th>B.S</th>
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Result:

The contour is thus plotted.

Outcome:

At the end of this experiment, students gain knowledge about longitudinal and cross section points

Viva-voce

1. Define – Contour.
2. Mention the different types of contour.
3. What is horizontal interval?
4. How can you make bubble as centre?
5. Mention the temporary adjustments of leveling.
6. What is height of instrument method?
7. Name the different types of Bench marks.
8. What are the different types of leveling staff?
9. Differentiate level line from a horizontal line.
10. Define – Bench Mark
11. Define – GTS Bench Mark and Arbitrary Bench Mark
12. What are the differences between the line of collimation and the axis of the telescope?
13. How is leveling done using foot screws?
14. What are the errors in leveling?

Applications

1. Laying a circular arch line for athletics
2. Reference a circular arch line for taken by this method
3. Getting the elevation value by using stadia hairs
Expt. No.21 STUDY OF THEODOLITE

Aim:
To study the theodolite and its accessories used for chain surveying

Parts:

A) Leveling Head:
1. A leveling head consists of two parallel triangular plates known as tribrach plates.
2. The upper tribrach has three arms each carrying a leveling screw.
3. The main functions of the leveling head is
   i. To support the main part of the instrument.
   ii. To attach the theodolite to the tripod.
   iii. To provide a mean for leveling the theodolite.

B) Telescope:
It is mounted on a spindle known as horizontal axis or trunnion axis.

C) Vertical Circle:
1. It is a circular arc attached to the trunnion axis.
2. By means of vertical clamp screw and tangent screw the telescope can be accurately set at any desired position in vertical plane.
3. The graduation in each quadrant is numbered from 0° to 90° in opposite directions.

D) Index Frame:
1. At the two extremities, two verniers are fitted to read the vertical axis.
2. When the telescope is moved in a vertical plane, the vertical circle moves relative to the verniers with the help of which reading can be taken.
3. A long sensitive bubble tube is placed on the top of the index frame.

E) Standards (or) A - Frame:
This stands upon the vernier plate to support the horizontal axis.
Diagram:

F) Two Spindles:

The two axes have a common axis which forms the vertical axis of the instrument.

G) Lower Plate:

1. It carries a horizontal circle graduated from 0° to 360° in a clockwise direction as a silvered, beveled edge.
2. By means of clamp screw and tangent screw, this can be fixed at any desired position.

H) Upper Plate:

1. It also carries clamp and tangent screw to accurately with the lower plate.
2. On clamping the upper clamp and unclamping the lower clamp, the instrument can rotates on its outer axis without any relative motion between the two plates.
3. If the lower clamp is clamped and upper clamp unclamped, the upper plate and the instrument can rotate on the inner axis with a relative motion between the vernier and the scale.

4. For using any tangent screw, its corresponding clamp screw must be tightened.

I) Level Tubes:

The upper plate carries two level tubes placed at right angles to each other in which one is kept parallel to the trunnion axis.

These can be centered with the help of foot screws.

J) Plumb Bob:

This is suspended from the hook fitted to the bottom of the inner axis to centre the instrument exactly over the station mark.

Temporary adjustments:

1) Setting over the Station:

Centre the instrument over the station mark by a plumb bob.

2) Levelling Up:

Do this by using three foot screws similar to that of levelling instrument.

3) Elimination of Parallax:

By focusing the eye-piece for distinct vision of the cross-hairs.

IMPORTANT TERMS:

1. Vertical Axis:

   The axis about which the theodolite may be rotated in a horizontal plane.

2. Horizontal Axis:

   The axis about which the telescope along with the vertical circle of a theodolite may be rotated in a vertical plane.

3. Axis of telescope:

   The axis about which the telescope may be rotated is called axis of telescope.

4. Axis of the level tube:

   The straight line which is tangential to longitudinal curve of the level at its centre is called axis of the level tube.
5. Centering:
The process of setting up theodolite exactly over the ground work station is known as centering.

6. Transiting:
The process of turning the telescope in vertical plane through 180° about its horizontal axis is known as transiting.

7. Swing:
A continuous motion of the telescope about the vertical axis in horizontal plane is called swing. The swing may be either in face left or right.

8. Face left Observation:
The observations of angles when the vertical circle is on the left side of telescope.

9. Face right observation:
The observation of angles when the vertical circle is on the right of telescope.

10. Changing the face:
The operation of changing the face of telescope from right to left and vice-versa.

11. A Set of Observation
A set of horizontal observations of any angle consists of two horizontal measures one on the left face and other on the right face.

12. Telescope Normal:
A telescope is said to be normal when its vertical circles is to its left and bubble of the telescope is up.

13. Telescope inverted:
A telescope is said to be inverted or reversed when its vertical circle is to its right and the bubble of the telescope is down.
Result:

Thus the components, terms and definitions of transit theodolite are studied.

Outcome:

At the end of this experiment, student acquires knowledge about theodolite and its accessories used for chain surveying

Viva-voce

1. List out the major parts of theodolite.
2. Define – Transiting of Telescope
3. What is face right observations?
4. What is meant by transit?
5. What are the uses of tangential screw provided for the adjustments in a transit theodolite?
6. Write short notes on face left and face right of the theodolite.
7. List out the essential qualities of a theodolite telescope.
8. What is meant by parallax?
9. What is centering of a theodolite?
10. Mention the method to be used in measuring horizontal angles using theodolite?
11. Write a short note on repetition method?
12. What is Bowditch rule?
13. What is meant by latitude and departure in a theodolite traversing?
14. Define – Closing Error
15. What is Gale’s table? State its uses.

Applications

1. Laying a circular arch line for athletics
2. Reference a circular arch line for taken by this method
3. Getting the elevation value by using stadia hairs
PROJECT TITLES

1. Surveying with GPS, total station and terrestrial laser scanner with a comparative study
2. Total station and its applications in surveying
3. Fully equipped with various surveying concepts and methods using advanced ground survey equipment
4. The effect of technology in the field of quantity surveying
5. An investigation into risk management practices amongst quantity surveyors in the construction industry
6. An assessment of the effect of organizational culture on the performance of quantity surveying
7. Study and detailed estimate of different component of modern residential and commercial building
8. Preparation of detailed estimate for low cost two room set residential and commercial building
9. Preparation of a standard measurement book of a given building
10. Construction of a small concrete road consisting of survey and preparation of site plan