Ministry of Higher Education
Mansoura Higher Institute of Eng. &Tech.
Civil Engineering Department

Survey Laboratory Manual

2020-2021

SURVEYING LABORATORY SYLLABUS

COURSE OBJECTIVES

1. To acquire practical knowledge on handling basic chain survey equipment's.
2. To possess knowledge about compass surveying.
3. To have the ability to prepare leveling table.
4. To possess knowledge about contour map.
5. To possess knowledge about the advanced surveying.

LIST OF EXPERIMENTS

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset.
2. Setting out works – Foundation marking using tapes single Room and Double Room.
3. Compass Traversing – Measuring Bearings & arriving included angles.
4. Fly levelling using Dumpy level &Tilting level.
5. Check levelling.
6. Measurements of horizontal angles by reiteration and repetition and vertical angles.
7. Determination of elevation of an object using single plane method when base is accessible/inaccessible.
8. Determination of Tachometric Constants.
9. Heights and distances by stadia Tachometry.
10. Heights and distances by Tangential Tachometry.
11. Study of Total Station, Measuring Horizontal and vertical angles.
12. Determination of distance and difference in elevation between two inaccessible points using Total station.

COURSE OUTCOMES

1. Gain the ability to use modern survey equipment to measure angle and distance.
2. Understood the basic principle and techniques about survey field.
3. Gain design knowledge related to various structural system.

INDEX

EXPT. NO.1 STUDY OF CHAINS AND ITS ACCESSORIES, ALIGNING, RANGING, CHAINING AND MARKING PERPENDICULAR OFFSET

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 giveflexibility 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 sow 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

EXPT. NO.2 ALIGNING, 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 insuch 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

EXPT. NO.1 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 $A = \frac{1}{2} bh$ sq. units.

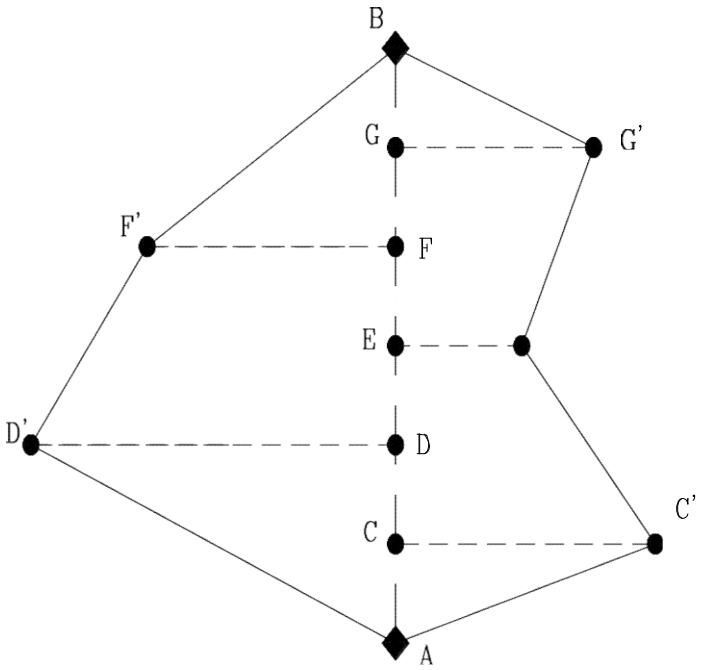
Area of the trapezium $A = \frac{1}{2} h (a+b)$ sq. units.

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

Diagram

At the end of this experiment, student acquires knowledge about the perpendicular offset method



Result

The area of the field = ...

Outcome

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 is plumb bob?
6. What is check line and tie line?
7. What is meant by reciprocal ranging?
8. What is meant by hypotenusal allowance?
9. What are optical square?
10. What is well conditioned triangle?
11. What is the use of cross staff?
12. What are all the sources of error?
13. What are the different types of chain triangulation?
14. What is meant by representative fraction?
15. What is meant by scale of plan?

Application

1. Fixing intermediate points on the chain lines, without going to either end we can fix the intermediate points. Time reducing method
2. Area to be surveyed is comparatively small. It is used for rapid measurements
3. Ranging must be done before a survey line is chained. It may be necessary to establish a number of intermediate points prior to chaining when chain line is much longer.
4. It is necessary that the chain should be laid out on the ground in a straight line between the end stations. Error rectifying

EXPT. NO.2 SETTING OUT WORKS – FOUNDATION MARKING USING TAPES SINGLE ROOM AND DOUBLE ROOM

Aim

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

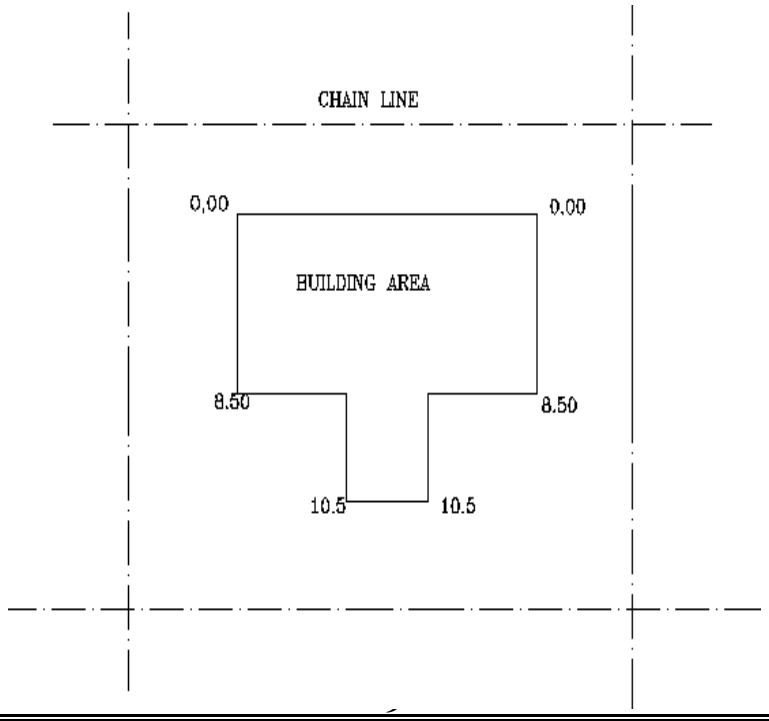
Instruments required

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 clockwisedirection.
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)** =… ..... m^2

Area of the open space **(b)** = ... m^2

Outcome

Gain knowledge about closed traversing in the wide field

Viva-voce

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

Application

1. Ranging must be done before a survey line is chained. It may be necessary to establish a number ofintermediate points prior to chaining when chain line is much longer.
2. Getting accurate values comparing reiteration method. Easy to measure the targets.
3. It is necessary that the chain should be laid out on the ground in a straight line between the end stations.

EXPT. NO.3 COMPASS TRAVERSING – MEASURING BEARINGS &ARRIVING INCLUDED ANGLES

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 up to 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 thetraverse, 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

Line	Distance in m	F.B	B.B	F.B~ B.B	Local Attraction
AB					
BC					
CD					
DE					
EA					

Calculation

Angle of EAB = F.B of AB – B.B of AE

=

Angle of ABC = F.B of BC – B.B of BA

=

Angle of BCD = F.B of CD – B.B of CB

=

Angle of CDE = F.B of DE – B.B of DC

=

Angle of DEA = F.B of EA – B.B of ED

To Check

Sum of included angle of pentagon = (2n-4)90°

Error = x°

Distribution of error = x°/n

Result

The amount of closing error =……..

Outcome

At the end of the experiment, students will gain knowledge about closed compass traversing

Viva-voce

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?

Application

1. The compass calculates the bearings in whole circle bearing system which determines the angle which the survey line makes with the magnetic north in the clockwise direction making good alignment in field work.
2. Compass surveying is recommended when the area is large, undulating and crowded with many details.
3. To find the horizontal angle between the true north and the magnetic north at the time of observation.

EXPT. NO.4 FLY LEVELLING USING DUMPY LEVEL &TILTING LEVEL

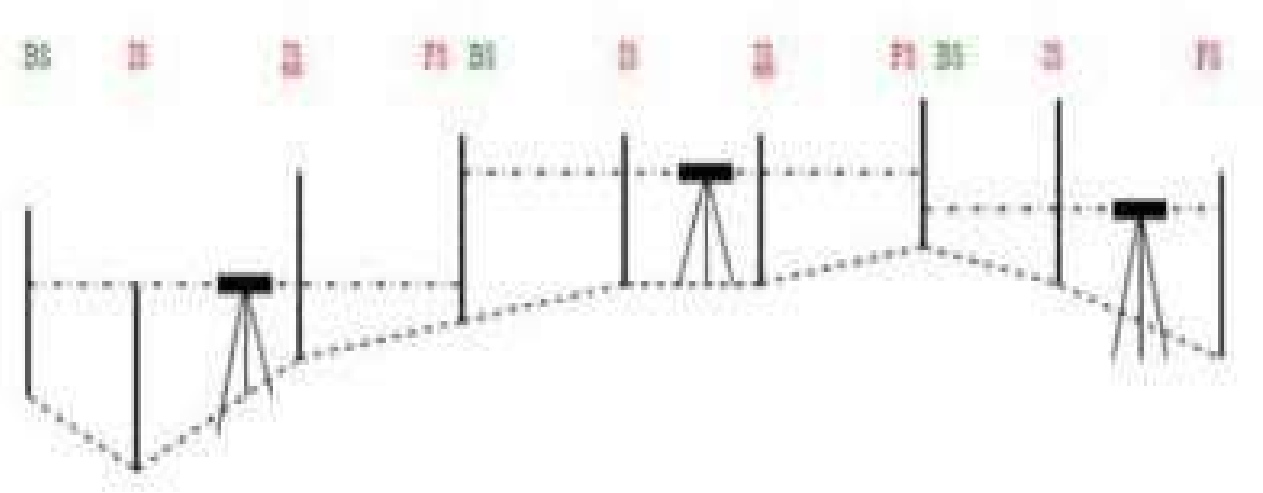
Aim

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



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 lastrequired point.

Observation

Height of collimation

Reduced Level of the first point =…….

Staff station	B.S	I.S	F.S	H.I	R.L	Remarks

Arithmetic Check

∑B.S - ∑ F.S = Last RL – First RL

Observation

Rise & Fall

Reduced Level of the first point =…….

Staff station	B.S	I.S	F.S	Rise	Fall	R.L	Remarks

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

∑B.S - ∑ F.S =∑ Rice - ∑ Fall = Last RL – 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?

Application

1. The measured levels can be represented on paper with suitable scale.
2. The existing soil profile at ground level along a particular line, or as related to the proposed surface of a road or section of a pipeline.
3. Laying a circular arch line for athletics. Reference a circular arch line for taken by this method.

EXPT. NO.5 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 lastrequired point.
7. Do the same procedure in the reverse direction and close with the first point.

Observation

Reduced level of the first point =……..

Staff station	B.S	I.S	F.S	H.I	R.L	Remarks

Arithmetic Check

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

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.
2. Define level book.
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?

Application

1. The measured levels can be represented on paper with suitable scale.
2. The existing soil profile at ground level along a particular line, or as related to the proposed surface of a road or section of a pipeline.
3. Laying a circular arch line for athletics. Reference a circular arch line for taken by this method

EXPT. NO.6 MEASUREMENTS OF HORIZONTAL ANGLES BY REITERATION ANDREPETITION AND VERTICAL ANGLES

REPETITION METHOD

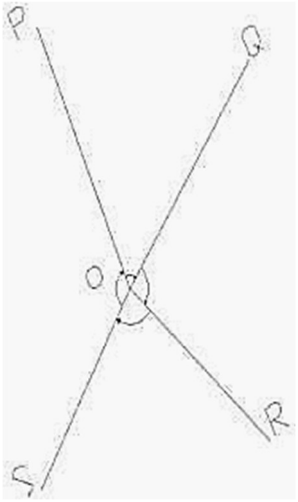
Aim

To find out the horizontal angle between A and B

Instruments required

1. Theodolite
2. Tape
3. Ranging rods
4. Arrows

Diagram



Procedure

1. Theodolite is set over an instrument station (O) exactly and all the temporary adjustments are done. Vertical circle is placed Left to the observer (face Left observation).
2. Vernier A is set to Zero with the help of upper clamp screw and tangent screws. Readings of Vernier A and B are noted.
3. Upper clamp is clamped. Lower clamp is loosened and the telescope is turned towards “P”. Lower clamp is clamped and the point “P” is bisected exactly using tangent screws.

4. Both the Vernier A and B are read and noted (Must be equal to 0° and 180° respectively). Upper clamp is unclamped and the telescope is turned clockwise and "Q" is bisected.
5. Upper clamp is clamped and "Q" is bisected exactly using tangent screws. Both the Vernier are read. Mean of the readings provide an approximate included angle of POQ.
6. The reading of Vernier A gives directly the angle POQ, and 180° is subtracted by the reading of Vernier B. The mean value of two readings gives the angle POQ with one face.

Observation

Face Left:								
Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Face Right :								
Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Result

The horizontal angle between A and B is = ……

Outcome

At the end of this experiment, student acquires knowledge about the perpendicular offset method

REITERATION METHOD

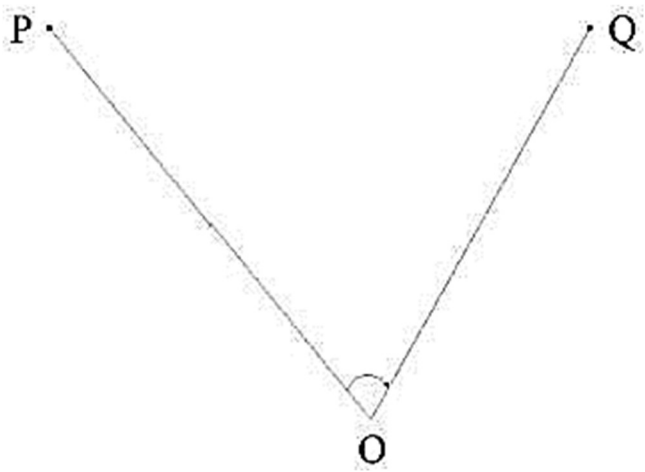
Aim

To find out the horizontal angle between A and B

Instruments required

1. Theodolite
2. Tape
3. Ranging rods
4. Arrows

Diagram



Procedure

1. Theodolite is set over an instrument station (O) exactly and all the temporary adjustments are done. Vertical circle is placed Left to the observer (face Left observation).

2. Vernier A is set to Zero with the help of upper clamp screw and tangent screws. Readings of Vernier A and B are noted.

3. Upper clamp is clamped. Lower clamp is loosened and the telescope is turned towards "P". Lower clamp is clamped and the point "P" is bisected exactly using tangent screws.

4. Both the Vernier A and B are read and noted (Must be equal to 0° and 180° respectively). Upper clamp is unclamped and the telescope is turned clockwise and "Q" is bisected.

5. Upper clamp is clamped and "Q" is bisected exactly using tangent screws. Both the Vernier are

read. Mean of the readings provide an approximate included angle of POQ.

6. The reading of Vernier A gives directly the angle POQ, and 180° is subtracted by the reading of Vernier B. The mean value of two readings gives the angle POQ with one face.

Observation

Face Left :								
Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Face Right :								
Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Result

The horizontal angle between A and B is = ……

Outcome

At the end of this experiment, student acquires knowledge about the perpendicular offset method

MEASUREMENT OF VERTICAL ANGLE

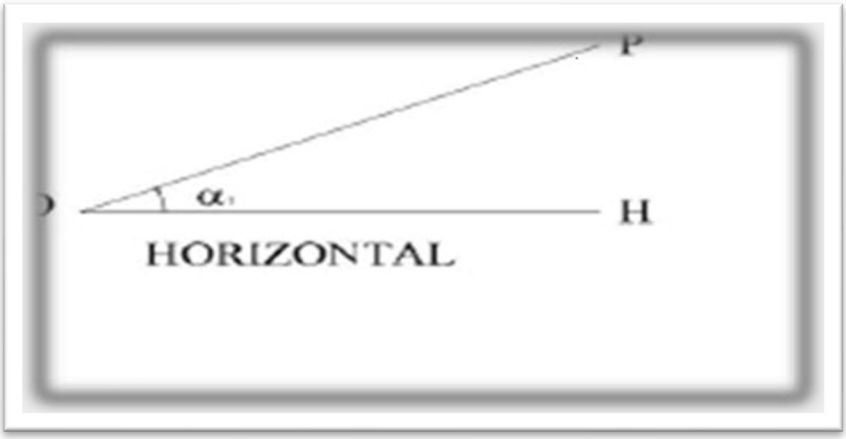
Aim

To Measure the vertical angle between A and B

Instruments required

1. Theodolite
2. Ranging rods
3. Arrows& tape

Diagram



Procedure

1. Theodolite is set up, centered and leveled with reference to the plate bubble.
2. Telescope is placed horizontally by setting the reading of 0°0’0”in the verniers of C and D.
3. Levelling process is carried out with the help of foot screws and the altitude bubble is brought
4. Vertical circle clamp is loosened and the telescope is directed upwards to bisect P.
5. Vertical circle clamp is clamped and the point P is exactly bisected using vertical tangent
6. Both the verniers of C and D are read and noted. Mean of the two verniers provide the vertical
7. Face is changed and all the above steps are repeated to get one more vertical angle HOP.
8. Average of the vertical angles taken to get an accurate vertical angle

Observation

Face Left :

Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Face Right :

Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Result

The Vertical angle between P and H is = ……

Outcome

Gain knowledge about closed traversing in the wide field

Viva-voce

1. What is meant by optical square?
2. What is meant by 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 conditional triangle?
9. What is meant by scale in surveying?
10. What is plane and geodetic surveying?
11. What is the use of arrows?
12. What is the use of plumb bob?
13. How will you differentiate check line and tie line?
14. What is meant by reciprocal ranging?
15. What is meant by hypotenusual allowance?

Application

1. Getting accurate values comparing reiteration method
2. Easy to measure the targets
3. Error rectifying

EXPT. NO.7 DETERMINATION OF ELEVATION OF AN OBJECT USING SINGLE PLANE METHOD WHEN BASE IS ACCESSIBLE/INACCESSIBLE

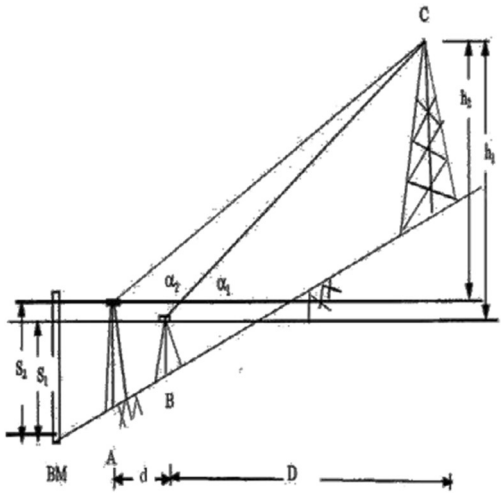
Aim

To determine the height of the building by using theodolite in the field

Instruments required

1. Theodolite
2. Arrows
3. Ranging rods

Diagram



Procedure

1. Set up the theodolite at A, level it carefully and observe the angle of elevation.
2. Set the vertical Vernier to zero, and take a reading on a staff held vertically on a B.M. Let it be S1.
3. Transit the telescope, so that the line of sight is reversed.
4. Mark a point B in the line of sight at a convenient distance d. Measure it accurately.
5. Shift the theodolite to the point B, center it and level it.
6. Observe the angle of elevation.
7. Set the Vertical Vernier to zero and take again a B.M. reading as S2

Observation

S.No	Sight To	Vertical Angle	Top hair	Bottom hair	Staff intercept

Result

The height of the building by using single plane method is =……..

Outcome

At the end of the experiment, students will gain knowledge about closed compass traversing

Viva - voce

1. What is meant by local attraction?
2. Define – Dip
3. What is the least count of compass?
4. What is meant by 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 meant by true meridian?

Application

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Getting the elevation value even obstruction in the field

EXPT. NO.8 DETERMINATION OF TACHEOMETRIC CONSTANTS

Aim

To determine the multiplying and additional constants of a tachometer

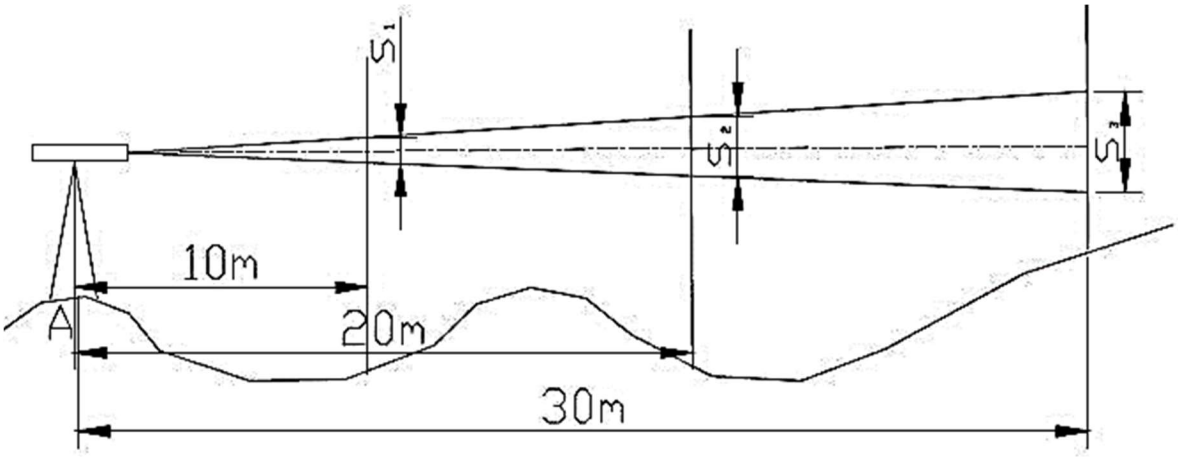
Instruments required

1. Tachometer
2. Leveling staff
3. Tape

Procedure

1. Measure a line, about 200 m long on fairly level ground and drive pegs at some
2. Intervals, say 50 meters.
3. Keep the staff on the pegs and observe the corresponding staff intercepts with
4. Horizontal sight.
5. Knowing the values of d and s for different points, a number of simultaneous
6. Equations can be formed by substituting the values of d and s in equation (1.1).

Diagram



Formulae

Horizontal distance $D = KS + C$

Observation

Face Left :

Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Face Right :

Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Result

The value of tachometer constants are =

Outcome

At the end of this experiment, student acquires knowledge about the analytical lens of tachometer

Viva-voce

1. What is meant by plumb bob?
2. Differentiate between 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 meant by cross staff?
14. What are the types of optical square?
15. What is well conditioned triangle

Application

1. It is used for rapid measurements
2. Knowing the concept of analytical lens in tachometer
3. Error rectifying
4. Knowing the values of d and s for different points

EXPT. NO.9 HEIGHTS AND DISTANCES BY STADIA TACHEOMETRY

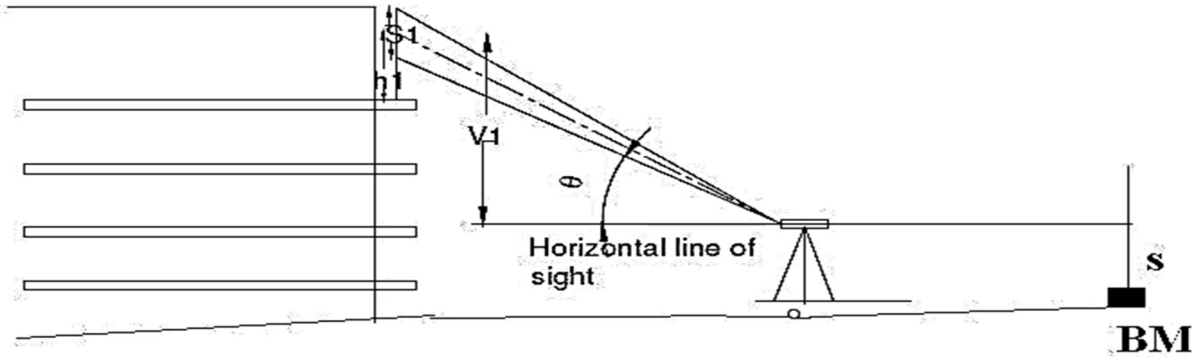
Aim

To determine the distance and elevation of a point using tacheometric stadia system

Instruments required

1. Tacheometer
2. Levelling staff
3. Pegs or Arrow

Diagram



Procedure

1. Tacheometer is set over an instrument station (O) exactly and all the temporary adjustments are done.
2. The verniers C and D are set to read zero by means of vertical circle clamping screw and tangent screw. (Telescope is held at horizontal position).
3. Back sight reading is taken on BM.
4. Telescopic clamping screw is unclamped and the telescope is turned in the vertical plane to sight the leveling staff which is placed over the object "P". Vertical angle α is noted. Staff intercept (S) is also determined.
5. The horizontal distance between O and P is determined as follows: -

$$OP = D = K\ S \cos 2\alpha + A \cos \alpha$$

6. Difference in elevation between O and P is determined as follows: -

$$V = (KS \sin 2\alpha / 2) + A \sin\alpha$$

7. R.L of point "P" is determined as follows:

R.L of point "P" = R.L of Line of collimation + V- h

Observation

S.No	Sight To	Vertical Angle	Top hair	Bottom hair	Staff intercept

Result

i) Horizontal distance between O and P =

ii) Difference in elevation between O and P =

iii) R.L of "P" =

Outcome

At the end of the experiment, students will gain knowledge about tacheometricstadia system

Viva-voce

1. What is the optical square?
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 conditional triangle?
9. What is meant by scale in surveying?
10. What is Plane and Geodetic surveying?
11. State the two-point problem.
12. List out the errors in a plane table surveying.
13. Differentiate closed traverse from open traverse.
14. What is intersection method? Where it is used?
15. What is meant by strength of fix?
16. Write the disadvantages of plane table surveying.
17. Write the advantages of plane table surveying.
18. Differentiate Prismatic compass from Surveyor's compass with reference to reading as well as tripod.
19. List out the errors in a compass instrument.
20. What is meant by true meridian?

Application

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Getting the elevation value by using stadia hairs

EXPT. NO.10 HEIGHTS AND DISTANCES BY TANGENTIAL TACHEOMETRY

Aim

To determine the distance and elevation of a point using tangential tacheometric system

Instruments required

1. Tacheometer
2. Levelling staff
3. Pegs or Arrow

Procedure

1. Tacheometer is set over an instrument station (O) exactly and all the temporaryadjustments are done.
2. The verniers C and D are set to read zero by means of vertical circle clamping screw and tangent screw. (Telescope is held at horizontal position).
3. Back sight reading is taken on BM.
4. Telescopic clamping screw is unclamped and the telescope is turned in the vertical plane to sight the leveling staff which is placed over the object "Q".
5. Upper target reading (R1) is bisected exactly with the help of telescope clamping screw and its tangential screw. Vertical angle α1 is noted.
6. Similarly the lower target reading (R2) is bisected and Vertical angle α2 is noted.
7. From the geometry of the figure, difference in elevation are determined as follows:-

$$MN = D \tan \alpha 1$$

$$M B = D \tan \alpha 2$$

8. Telescopic clamping screw is unclamped and the telescope is turned in the vertical plane to sight the leveling staff which is placed over the object "Q".
9. Upper target reading (R1) is bisected exactly with the help of telescope clamping screw and its tangential screw. Vertical angle α1 is noted.

Observation

Face Left :

Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Face Right :

Instrument station	Sight to	A			B			Horizontal angle
		o			o			

Result

Horizontal distance between O and the Sub tense bar =

Outcome

At the end of the experiment, students will gain knowledge about tacheometric sub tense system.

Viva-voce

1. What is meant by tangential method?
2. What are the three cases of vertical angle?
3. Write the formula for both angles are angles of elevation.
4. Write the formula for both angles are angles of depression.
5. Write the formula for one angle elevation and other angle depression.
6. What is meant by special device fitted to tacheometer?
7. What are the errors in stadia surveying?
8. What are the special instruments available to conduct survey?
9. What is the use pendulum level?
10. What is meant by Brunton universal pocket transit?
11. What are all the types of compass used?
12. What is meant by representative fraction?
13. Write the formula for distance and elevation formula for staff normal.
14. What is meant by anallactic lens?
15. State the principle of stadia method.

Application

1. Using to measure the height of the different elevation of the structure
2. Reference bench mark is easily taken by this method
3. Getting the elevation value by using stadia hairs

EXPT. NO.11 STUDY OF TOTAL STATION, MEASURING HORIZONTAL AND VERTICAL ANGLES

Aim

To study the total station used for surveying.

Total station

1. The Total station is designed for measuring of slant distances, horizontal and vertical angles and elevations in topographic and geodetic works, tachometric surveys, as well as for solution of application geodetic tasks. The measurement results can be recorded into the internal memory and transferred to a personal computer interface.

2. The basic properties are unsurpassed range, speed and accuracy of measurements. Total stations are developed in view of the maximal convenience of work of the user. High-efficiency electronic tachometersare intended for the decision.

3. Angles and distances are measured from the total station to points under survey, and the coordinates (X, Y, and Z or northing, easting and elevation) of surveyed points relative to the total station position are calculated using trigonometry and triangulation.

4. Data can be downloaded from the total station to a computer and application software used to compute results and generate a map of the surveyed area.

5. A total station is an electronic/optical instrument used in modern surveying. It is also used by archaeologists to record excavations as well as by police, crime scene investigators, private accident Reconstructionist and insurance companies to take measurements of scenes. The total station is an electronic theodolite (transit) integrated with an electronic distance meter (EDM), plus internal data storage and/or external data collector.

6. The purpose of any survey is to prepare maps, control points formed a basic requirement for the preparation of these maps.

7. There are several numbers of methods like traverse, triangulation etc., to provide these control points.

8. Whatever the method the provision of control points, includes the measurement of two entities (Distance and Angle).

MEASURING HORIZONTAL AND VERTICAL ANGLES

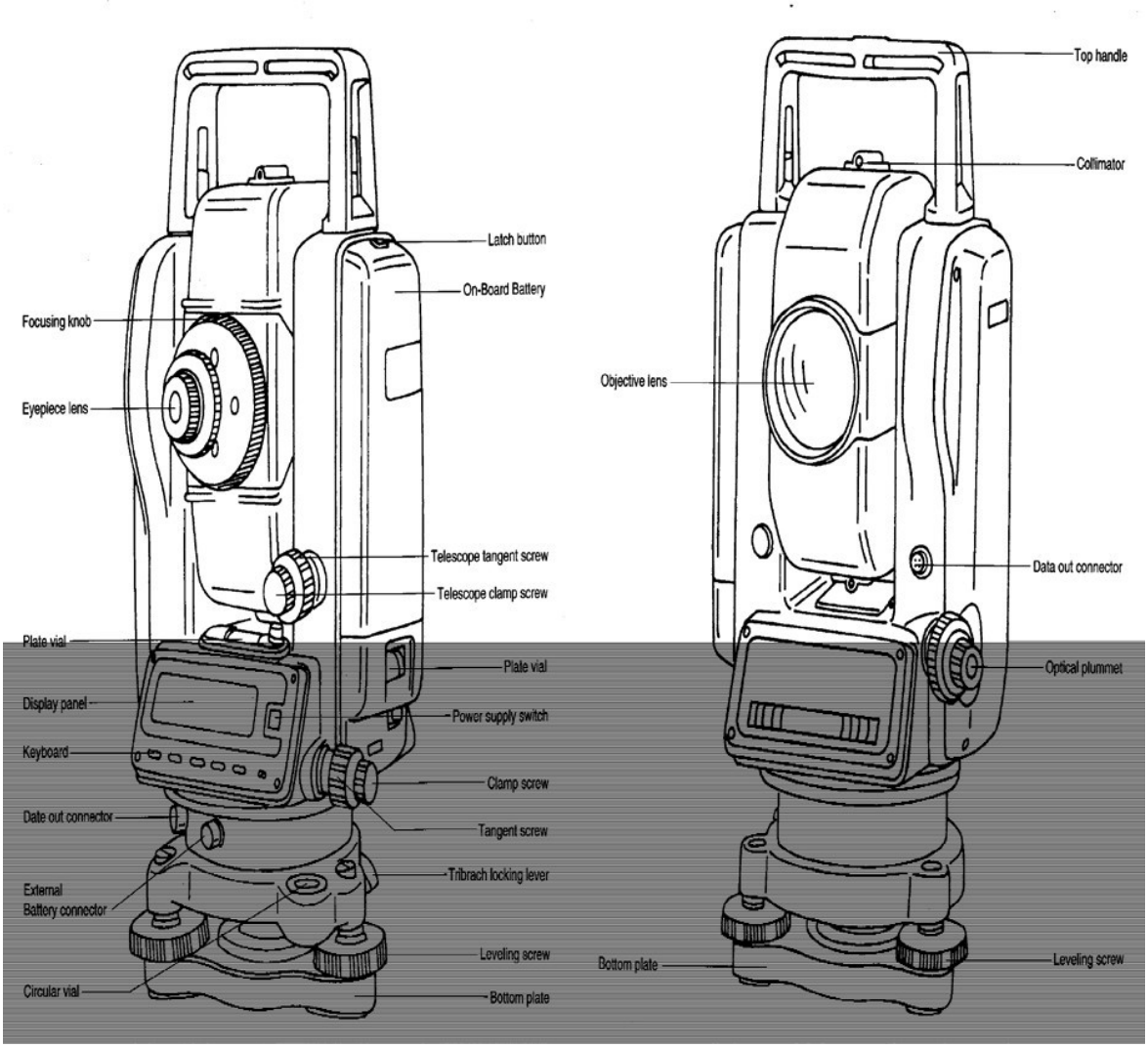
Aim

Measure the area of given boundary points by using Total Station.

Apparatus Required

1. Total Station and tripod
2. Prism and prism rod
3. Arrows

Diagram



Procedure

1. Set the instrument at the station point which the point covers all boundary points.
2. Do the temporary adjustments in the instrument and level it properly.
3. Set the prism height and enter the prism height value in Total Station.
4. Consider all boundary points in closed traverse.
5. Select the area measurement option and bisect the boundary points with the help of prism.
6. Take readings from all boundary points and directly found the area from Total Station.

Result

The area of the given field =---------- measured by Total Station.

Outcome

Gain the ability to use modern survey equipment to measure angle and distance.

Viva-voce

1. What is meant by contour gradient?
2. What are the classifications of total station?
3. What are the different methods of contouring?
4. What are the LS and CS?
5. What are the parts of total station?
6. What is meant by vertical axis?
7. What is meant by Horizontal axis?
8. What is meant by line of sight / line of collimation?
9. What is meant by axis of level tube?
10. What is meant by centering?
11. What is meant by transiting?
12. What is meant by swinging the telescope?
13. What is meant by telescope normal?
14. What is meant by telescope inverted?
15. What is meant by changing face?

Application

1. Determining accurate coordinates for survey points by simultaneously recording by total station observations over a known and unknown survey point for at least 20 minutes
2. Surveyors' GPS receivers can then collect field data and combine it with the CORS data to calculate positions
3. Getting the elevation value by using stadia hairs

EXPT. NO.12 PLANE TABLE SURVEYING – RADIATION METHOD

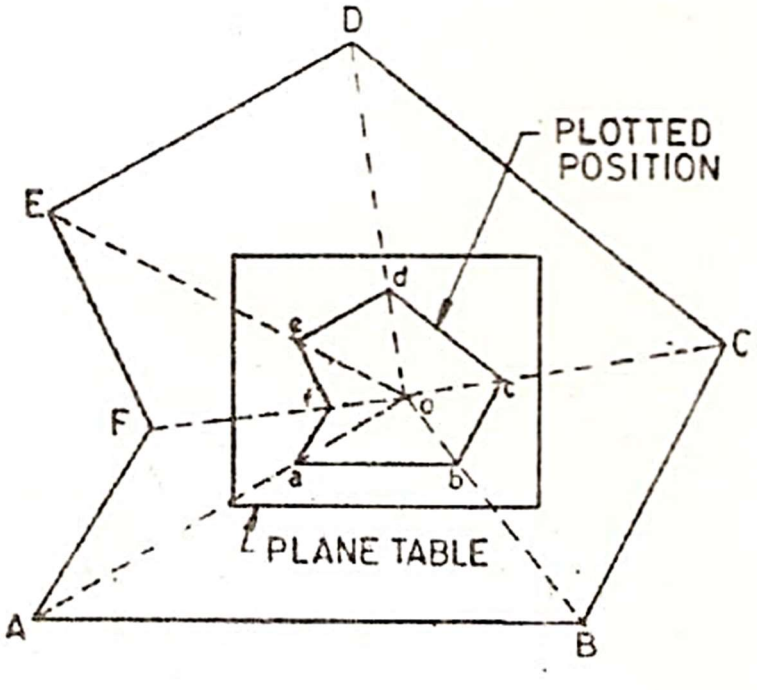
Aim

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



RADIATION METHOD

Procedure

1. Select the position of the table where it is be set so that all the points to be located are visiblefrom 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 = $\frac{(a \square b \square c)}{2}$

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.

Application

1. The field observations and plotting are done simultaneously.
2. A plane table is set over a point and brought to precise horizontal level.
3. The alidade as a surveying level, information on the topography of the site can be directly recorded on the drawing as elevations.

EXPT. NO.13 PLANE TABLE SURVEYING – INTERSECTION METHOD

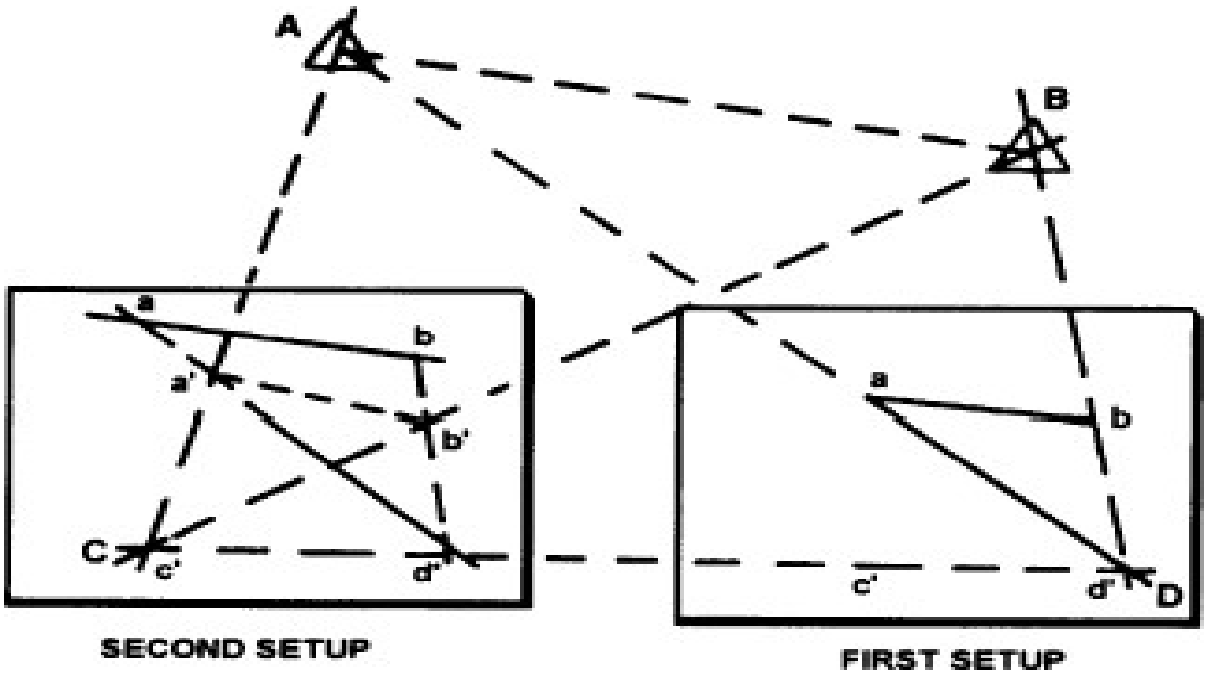
Aim

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

Viva-voce

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 is it done?
12. What is magnetic meridian?
13. What is whole circle bearing?
14. Differentiate between magnetic declination and dip.

Application

1. The field observations and plotting are done simultaneously.
2. A plane table is set over a point and brought to precise horizontal level.
3. The alidade as a surveying level, information on the topography of the site can be directly recorded on the drawing as elevations.