LAND SURVEY PRACTICE-I LAB MANUAL

SEMESTER-4TH

DEPARTMEMT OF CIVIL ENGINEERING
GOVERNMENT POLYTECHNIC
NABARANGPUR

SL NO	NAME OF THEEXPERIENT
Linear Measurements, Chaining and Chain Surveying	
1	Testing and adjusting of a metric chain
2	Measurement of distance between two points (more than 2 chain lengths apart) with chain including direct ranging.
3	Setting out different types of triangles, given the lengths of sides with chain and tape.
4	Measurement of distance by chaining across a obstacles on the chain line i) a pond ii)a building iii) a stream/ river (in the event of non-availability of stream / river, a pond or lake may be taken, considering that chaining around the same is not possible.
5	Setting perpendicular offsets to various objects (at least 3) from a chain line using-(1) tape, (2) cross-staff, (3) optical square and comparing the accuracy of the 3 methods
6	Setting oblique offsets to objects (at least 3) from a chain using tape
Angular Measurement and Compass Surveying	
7	Testing and adjustment of Prismatic compass and Surveyor's compass.
8	Measurement of bearings of lines (at least 3 lines) and determination of included angles using Prismatic compass and Surveyor's compass.
9	Setting out triangles (at least 2) with compass, given the length and bearing of one side and included angles
10	Setting out a closed traverse of 5 sides, using prismatic compass, given bearing of one line and included angles and lengths of sides.
11	Conducting chain and compass traverse surveying in a given plot of area (2plots) and recording data in the field book. (5 to 6 students/groups)
Plane Table Surveying	
12	Setting up of Plane Table and Plotting five points by radiation method and five inaccessible points by intersection method
13	Conducting Plane Table surveying in a given plot of area by traversing (Atleast a 5-sided traverse and locating the objects)
14	Plane table surveying by Resection method two point problem method
	Plane table surveying by Resection method three point problem method
Theodolite Traversing	
15	Measurement of horizontal angles (3nos.) by repetition method and compare two methods
16	Measurement of horizontal angles (3nos.) by reiteration method and compare two methods
17	Prolonging a given straight line with the help of a theodolite
Leveling and Contouring	
18	Making temporary adjustments of Levels
19	6.4 Conduct Fly Leveling (Compound) between two distant points with respect to R.L. of a given B.M. and reduction of levels by both

	height of collimation and rise & fall method and applying Arithmetic check. (At least 3 change points must be covered)
20	Conduct profile leveling along the given alignment for a road / canal for 150m length, taking L. S. at every 15m and C. S. at 1m & 3m apart on both sides at every 30m interval and recording the data in level book and applying arithmetical check.

Experiment No-01

Aim of the experiment:-To learn the technique for testing and adjusting of a metric chain.

Instrument required:-

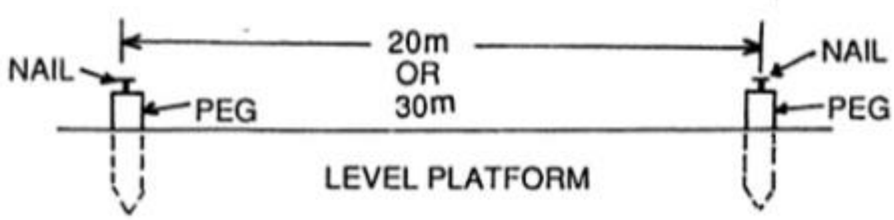
1. Metric chain(20m or 30m)
2. Peg
3. Steel tape

Theory:-

- Due to continuous use, a chain may be elongated or shortened.
- So the chain should be tested and adjusted accordingly.
- If full adjustment is not possible then the amount of shortening (too short) and elongation (too long) should be noted clearly for necessary correction applicable to the chain.

Procedure:-

I. A test gauge is established on a level platform with the help of a standard steel tape.
II. The test gauge consists of two pegs having nails at the top and fixed on a level platform a required distance apart (say 20 or 30 m).
III. The incorrect chain is fully stretched by pulling it under normal tension (say about 8 kg) along the test gauge.
IV. If the length of the chain does not tally with standard length, then an attempt should be made to rectify the error.
V. Finally, the amount of elongation or shortening should be noted.
VI. The allowable error is about 2 mm per 1 m length of the chain.



ADJUSTMENT OF CHAIN

Chains are adjusted in the following ways:

1. When the chain is too long, it is adjusted by
   a. Closing up the joints of the rings,
   b. Hammering the elongated rings,
   c. Replacing some old rings by new rings, and
   d. Removing some of the rings.

2. When the chain is too short, it is adjusted
   a. Straightening the bent links,
   b. Opening the joints of the rings,
   c. Replacing the old rings by some larger rings, and
   d. Inserting new rings where necessary.

Conclusion:-

From the above experiment we know how to test and adjustment a metric chain in the field.

Experiment No-02

Aim of the experiment: - To measure the distance between two points on a level ground with chain by direct ranging.

Instrument required: -

1. Metric chain (20m or 30m)
2. Peg-2 nos.
3. Ranging rod-4nos
4. Arrows-5 no's

Theory: -

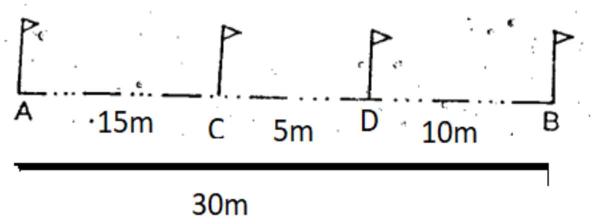
- The process of establishing intermediate points on a straight line is known As ranging.
- Ranging must be done before a survey line is chained.
- It is generally done by naked eye.
- It is of two types.
    - Direct ranging
    - Indirect ranging or reciprocal ranging.
- Direct ranging

  When intermediate ranging rods are fixed on a straight line by direct observation from end station, the process is known as direct ranging.
- Indirect ranging

  When the end stations are not intervisible due to their being high ground between them, intermediate ranging rods are fixed on the line in indirect way. This process is known as indirect ranging or reciprocal ranging.

Procedure: -

VII. Fix the ranging rods at the two given stations, where pegs are already driven on the ground.
VIII. The surveyor stands about 2 m behind the stations A and directs the assistant with ranging rod to come in line with AB by using signal of ranging.
IX. When the ranging rod comes in the line of AB the surveyor directs the assistant to fix the ranging rod in position.
X. Let the intermediate point be C which should be less than 20m or 30m.
XI. Now the assistant taken another ranging rod and stands between A & B about 2/3 distance from A.
XII. The surveyor directs the assistant to come in line of AB by using signal of ranging.
XIII. As when the point is located in the line of AB the surveyor instructs the assistant to fix the ranging rod in position.
XIV. The other intermediate position be D which is less than 20m or 30m from B.
XV. Now A, B, C & D in one line and measured the distance between them.



RESULT

The distance between AB=15m

BC=5m

CD=10m

AD=30m

Conclusion: -

From the above experiment we knew the measurement of distance between the two points with chain by direct ranging.

Experiment No-03

Aim of the experiment: - To set out different types of triangles, given the lengths of sides with chain and tape in order to calculate an area of the field.

Instrument required: -

1. Metric chain (20m or 30m)
2. Tape
3. Protractor

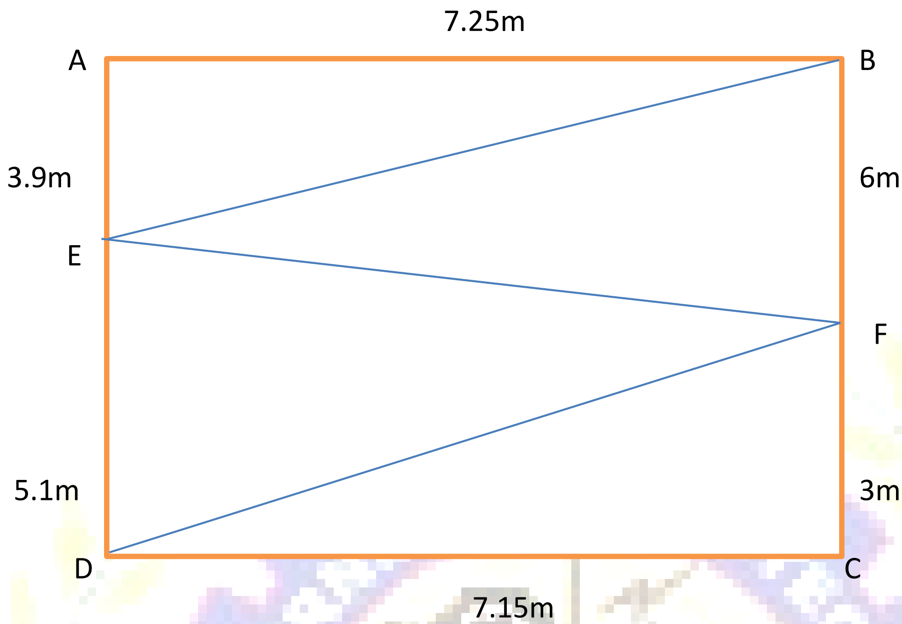
Theory: -

- Different triangles used in the chain surveying are
  - Well-conditioned triangle
  - Ill conditioned triangle

- Well-conditioned triangle: -
  - ✓ A triangle is said to be well conditioned when no angle in it is less than 30^0 or greater than 120^0.
  - ✓ An equilateral triangle is considered to be the best condition or ideal triangle.
  - ✓ Well-conditioned triangles are preferred because their apex points are very sharp and can be located by a single dot.
- Ill conditioned triangle: -
  - ✓ A triangle in which an angle is less than 30^0 or more than 120^0 is said to be ill conditioned triangle.
  - ✓ Ill conditioned triangles are not used in chain surveying.
  - ✓ This is because their apex points are not sharp and well defined.

Procedure: -

XVI. ABCD is the required closed traverse in an open field to be surveyed for calculating the area.
XVII. From the station A the length of all the sides such as AB, BC, CD & AD are measured with chain.
XVIII. The total area is then divided into 04 no's of suitable triangles and sides of all triangles are measured with the chain.
XIX. The measured lengths are plotted for the record.
XX. Further the tape measurements are done for better accuracy of the results.



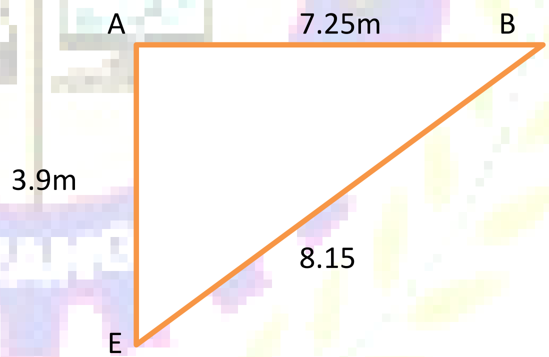
Observation & calculation : -

The area which was observed during the survey work shall be divided into 04 nos of suitable triangles.

1. From the Δ ABE,

$\angle BAE=90^0$
$\angle BEA=65^0$
$\angle ABE=25^0$

∴ Triangle is ill conditioned.



Sides of the triangles are AB=7.25m
BE=8.15m
AE=3.9m

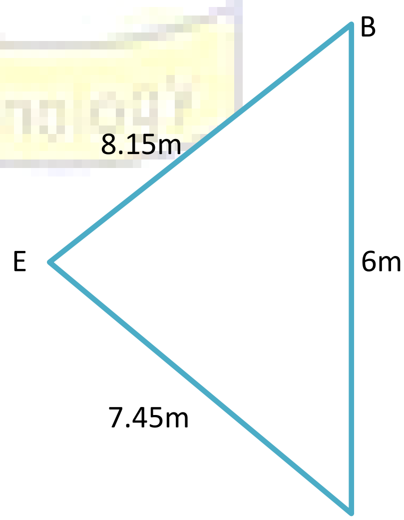
Area of Δ ABE= $\frac{1}{2} \times b \times h$

$\frac{1}{2} \times 3.9 \times 7.25 = 14.14$ sq m

2. From the Δ BEF,

$\angle BEF=40^0$
$\angle BFE=65^0$
$\angle FBE=75^0$

∴ Triangle is well conditioned.



Sides of the triangle BE=8.15m
EF=7.45m
BF=6m

$s = \frac{a+b+c}{2}$

$= \frac{6+7.45+8.15}{2}$ =10.8m F

Area of Δ BEF $= \sqrt{s(s-a)(s-b)(s-c))}$

$= \sqrt{10.8(10.8-6)(10.8-7.45)(10.8-8.15)}$

= 21.45 sq m

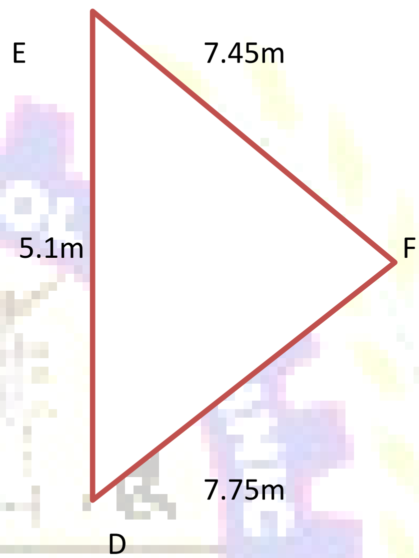
3. From the Δ EFD,

∟EFD=40^0

∟DEF=70^0

∟FDE=70^0

∴ Triangle is well conditioned.



Sides of the triangle ED=5.1m

EF=7.45m

DF=7.75m

$s = \frac{a+b+c}{2}$

$= \frac{5.1+7.45+7.75}{2}$ =10.15m

Area of Δ EFD $= \sqrt{s(s-a)(s-b)(s-c))}$

$= \sqrt{10.15(10.15-5.1)(10.15-7.45)(10.15-7.75)}$

= 18.22 sq m.

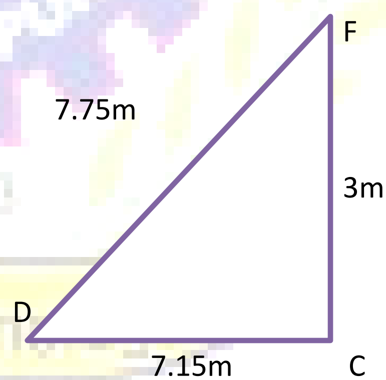
4. From the Δ DFC,

∟DFC=60^0

∟FDC=30^0

∟DCF=90^0

∴ Triangle is well conditioned.



Sides of the triangle DF=7.75m

FC=3.0m

DC=7.15m

Area of Δ DFC $= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 3 \times 7.15 = 10.725$ sq m

Total Area=14.14+21.45+18.22+10.725=64.535 sq m

Conclusion: -

From the above experiment we calculated the total area of the surveyed land is 64.535 sq m.

Experiment No-04

Aim of the experiment: - To determine the distance by chaining across a obstacle on the chain line in case of chaining obstructed but vision free.

Instrument required: -

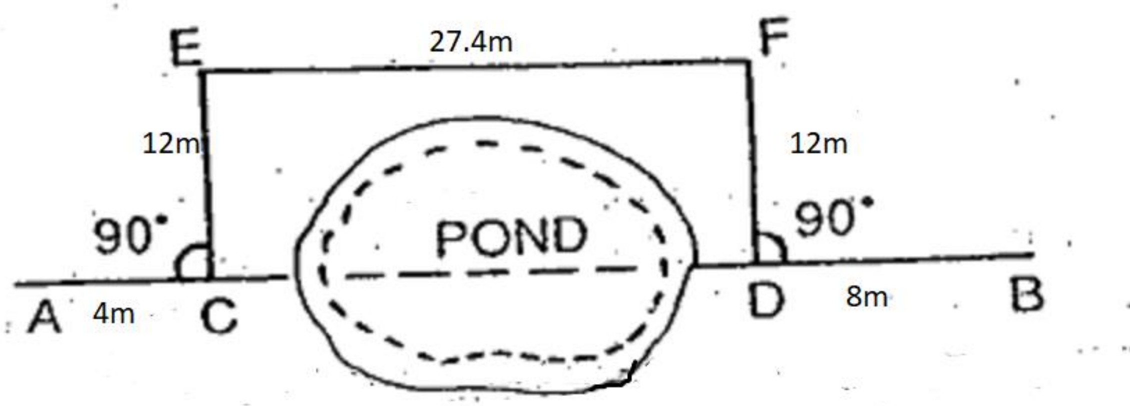
1. Metric chain (20m or 30m)
2. Tape-01 no
3. Ranging rod-4nos

Theory: -

- A chain line may be interrupted in the following three situations.
  - When chaining is free but vision is obstructed
  - When chaining is obstructed but vision is free
  - When chaining and vision both are obstructed
- Obstacles which obstructed chaining but vision is free, such a problem arises when a pond or a river comes across the chain line.
- When a pond interrupted the chain line, it is possible to go around the obstruction.

Procedure: -

- Take AB as the chain line.
- Two points C & D are selected on it an opposite bank of the pond.
- Equal perpendicular CE & DF are erected at C & D.
- The distance EF is measured, here CD=EF.



Calculation: -

CD=EF=27.4 m

Conclusion: -

From the above experiment we are calculated the width of the pond which causes obstruction during the chain surveying is 27.4m.

Experiment No-05

Aim of the experiment: - Setting out perpendicular offset to various object from a chain line using tape, cross staff and optical square.

Instrument required: -

1. Metric chain (20m or 30m)
2. Tape-01 no
3. Ranging rod-4nos
4. Cross staff

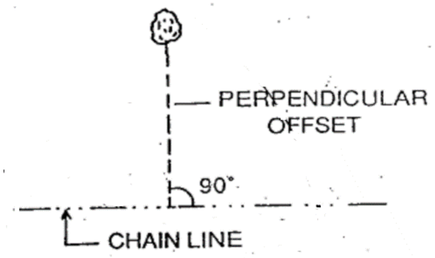
Theory: -

- Cross staff: -
  - Cross staff is a simple instrument for setting out right angles that is taking offsets from a chain line.
  - It is easier & quicker method, but not very accurate.

- Optical square: -
  - An optical square is a hand instrument used for setting out right angles.
  - It comprises of two optical glass prisms in a small circular metal box.

Procedure: -

- To find the foot of the perpendicular from the object, the cross staff is held approximately in position and one pair of slits is directed in the direction of the ranging rod fixed at the forward end of the chain line.
- The observer then looks through the other pair of slits and sees whether the particular object is bisected.
- If not, the cross staff is moved to and from till the necessary bisection is obtained.
- To set a perpendicular to the chain line at a given point one pair of slits is oriented in the direction of chain line by looking at the ranging rod fixed at the forward end by looking through the other pair of slits, ranging rod is fixed in the direction of the line of sight provided by this pair.



Conclusion: -

From the above experiment we setted out perpendicular offset by the cross staff.

Experiment No-06

Aim of the experiment: - Setting out oblique offset to various object from a chain line using tape.

Instrument required: -

1 Metric chain (20m or 30m)
2 Tape-01 no
3 Arrow

Theory: -

Offset: -

- The lateral measurement taken from an object to the chain line is known as 'offset'. Offsets are taken to locate objects with reference to the chain line.
- They may be of two kinds.

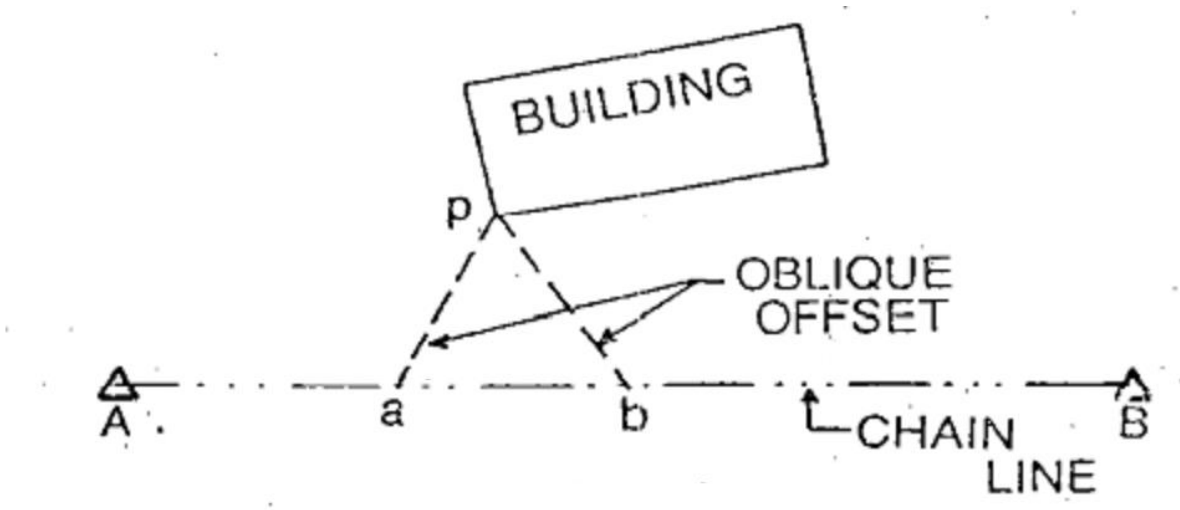
1. Perpendicular offset and
2. Oblique offset.

Oblique offset: -

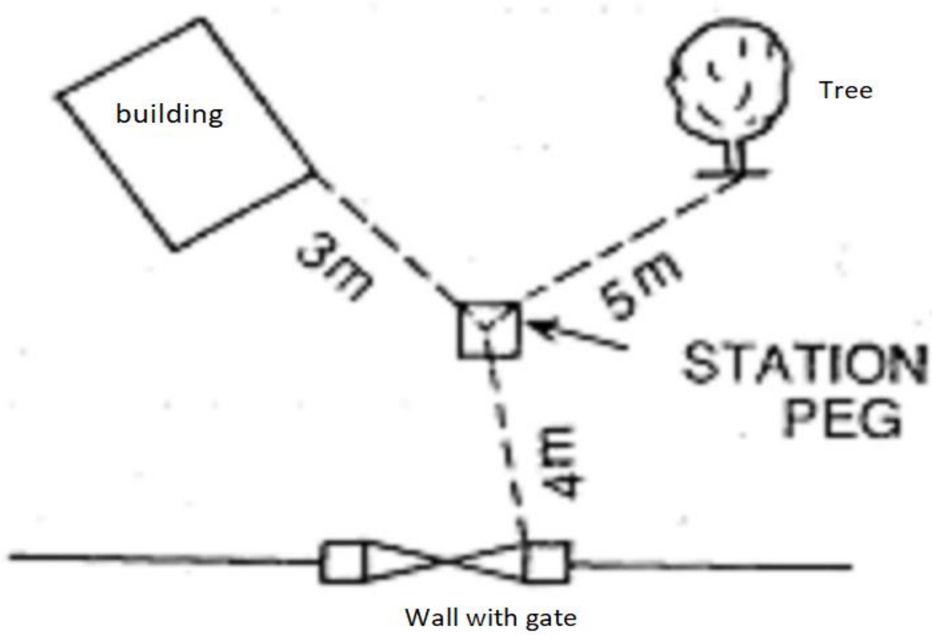
- Any offset not perpendicular to the chain line is said to be oblique offset.
- Oblique offset taken when the objects are at the long distance from the chain line or when it is not possible to set up a right angle.

Procedure: -

- AB is our chain line and p is the corner of a building which may be taken as our offsets from chain line.
- Two points 'a' and 'b' are taken on the chain line.
- The chainages of 'a' and 'b' are noted.
- The distances 'ap' and 'bp' are measured with the help of tape and noted in the field book.
- Then 'ap' and 'bp' our oblique offsets as shown in the below figure.
- When the triangle 'abp' is plotted, the apex point 'p' will represent the position of the corner of the building.



- By following above procedure, we have taken two other oblique offsets.



Conclusion: -

From the above experiment we setted out oblique offsets with tape.

Experiment No-07

Aim of the experiment: - Testing and adjustment of Prismatic compass and Surveyor's compass.

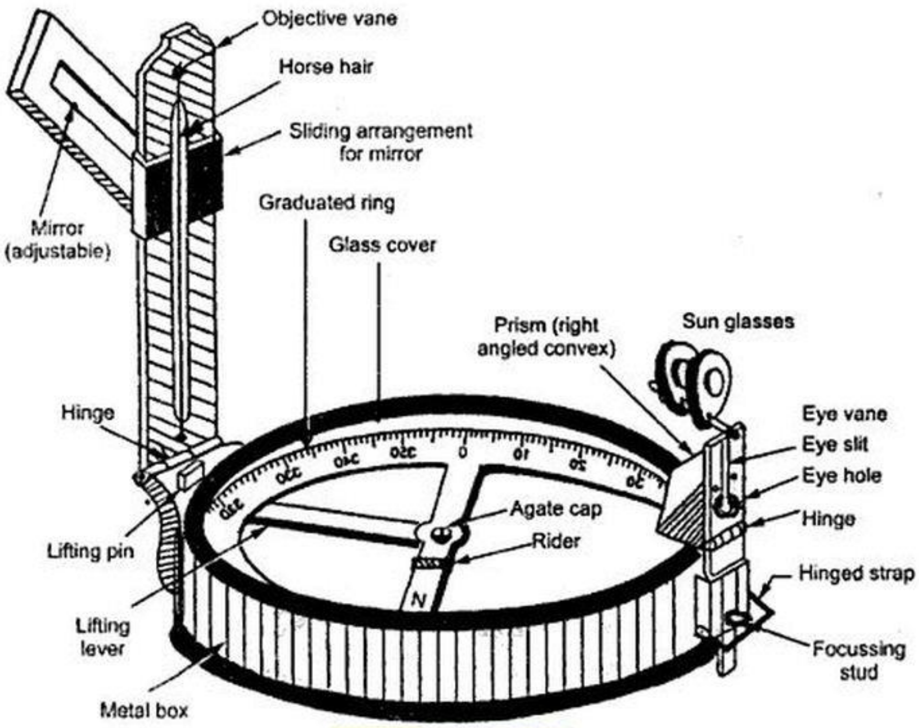
Instrument required: -

1. Prismatic compass
2. surveyors' compass
3. Tripod stand
4. Plumb bob

Theory: -

- Compass is an instrument designed for the measurement of direction with the reference to the magnetic meridian.
- It is of two types
  1. Prismatic Compass.
  2. Surveyor Compass.

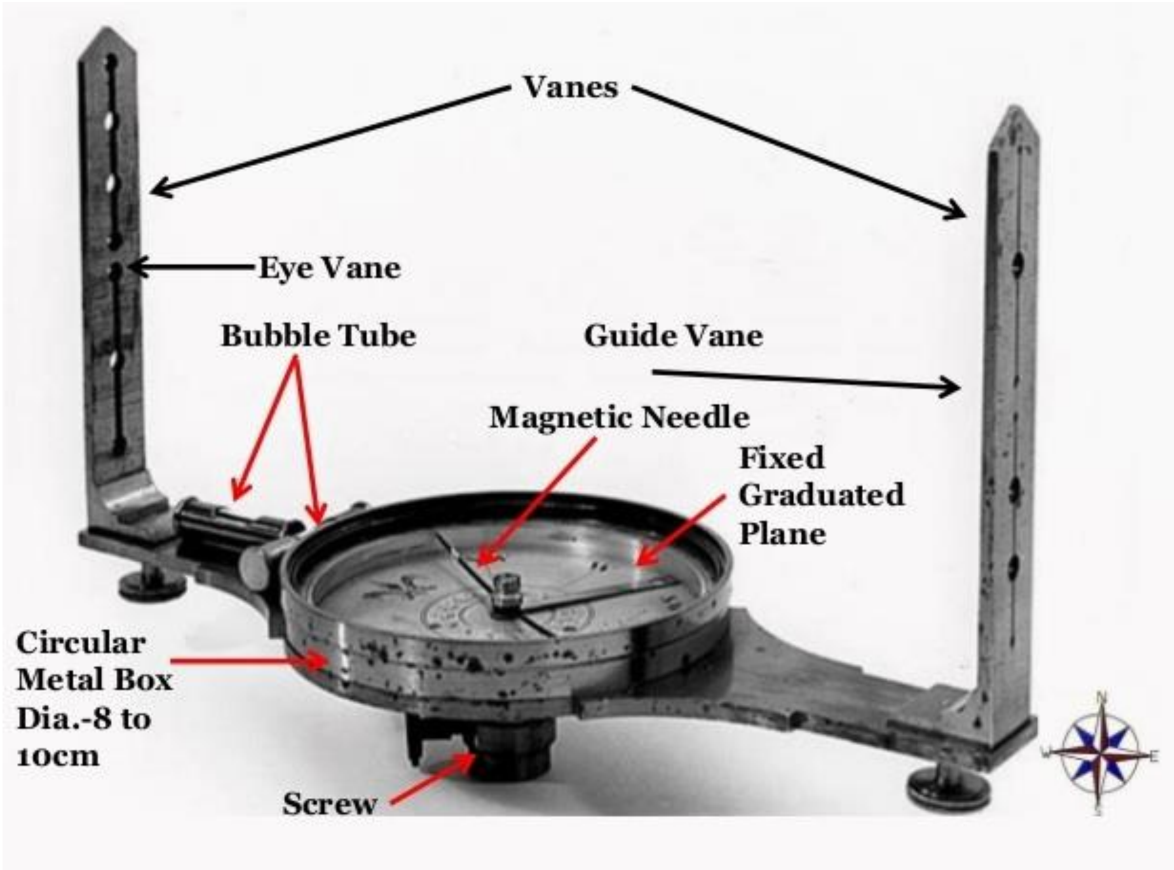
1. **PRISMATIC COMPASS: -**
   - This type of compass is a light and simple instrument and is used for rough surveys where too much accuracy is not necessary.
   - We can use it by keeping on palm as hand instrument or temporary fixing on tripod.
   - Magnetic needle of prismatic compass is attached to a graduated circular aluminium ring.
   - This needle is made of a broad magnetised iron bar. The bar is pointed at both ends.
   - A line which passes through objects vane and eye slit is knows as line of sight.
   - In prismatic compass reading increasing in clockwise direction.
   - The reading of prismatic compass is 0° at south and 180° at north. West direction shows 90° and 270° at the east. Angle measurements in case of prismatic compass vary between 0° to 360°.



Prismatic compass parts

2. SURVEYOR'S COMPASS: -

- The surveyor's compass is mainly used in Mine Surveying. For other types of survey, it is not usually used.
- In surveyor compass readings are taken clockwise or anticlockwise manner with naked eye.
- It consists of an eye vane in place of prism with a fine sight slit.
- The ring of the compass is divided into four parts which are North West, North east, south east and South west.
- Angle measurements are taken with respect to North or South direction.
- In surveyor compass reading written as N 60° W or E and S 45° W or E. Always written first N or S then, written angle, after that W or E written.
- Here letters N, S, W and E represent North, South, West and East direction respectively.
- In Surveyor's compass reading of angle vary between 0° to 90°.


Vanes
Eye Vane
Bubble Tube
Guide Vane
Magnetic Needle
Fixed
Graduated
Plane
Circular
Metal Box
Dia.-8 to
10cm
Screw

Surveyor's compass needle

ADJUSTMENT OF PRISMATIC COMPASS AND SURVEYOR'S COMPASS.

Temporary Adjustment

The adjustments which are required to be made at every set up of the instrument are known as stationary adjustment or temporary adjustment. It includes:

1. **Fixing the Compass with Tripod Stand**
   The tripod stand is placed at the required station with its legs well apart. Then the prismatic compass is held by the left hand and placed over the threaded top of the stand. After this, the compass box is turned clockwise by the right hand. Thus, the threaded base of the compass box is fixed with the threaded top of the stand.

2. **Centring**
   The process of centring the instruments i.e. making the pivot exactly vertically over the ground station mark is called centering. The compass is fixed on the top of a tripod. By adjusting the legs of the tripod, centering is achieved. A plumb bob may be hung from the center of the circular

box, to check the cantering of the compass. If the compass is centered perfectly, the pebble will fall exactly over the ground station mark If the bob is not provides, centering can be done by dropping the stone freely from the center of the bottom of the cylinder box.

3. **Levelling**

The process of holding the compass in such a way that its graduated rings swings freely, is called levelling. The levelling is done by eye judgement. Generally the compass is provided with a ball and socket arrangement attached to the tripod for achieving quick levelling of the instrument.

4. **Focusing the prism**

The process of moving up and down the prism for obtaining the figures and graduations sharp and clear is called focusing the prism.

5. **Observation of Bearing**

After centring and levelling the compass box over the station, the ranging rod at the required station is bisected perfectly by sighting through the slit of the prism and horsehair at the sight vane. At this time, the graduated ring may rotate rapidly. The brake pin is pressed very gently to stop this rotation. When the ring comes to rest, the box is struck very lightly to verify the horizontality of the ring and the frictional effect on the pivot point. Then the reading is taken from the graduated ring through the hole in the prism. This reading will be the magnetic bearing of the line.

Conclusion: -

From the above experiment we learnt about testing and adjustment of Prismatic compass and Surveyor's compass.

Experiment No-08

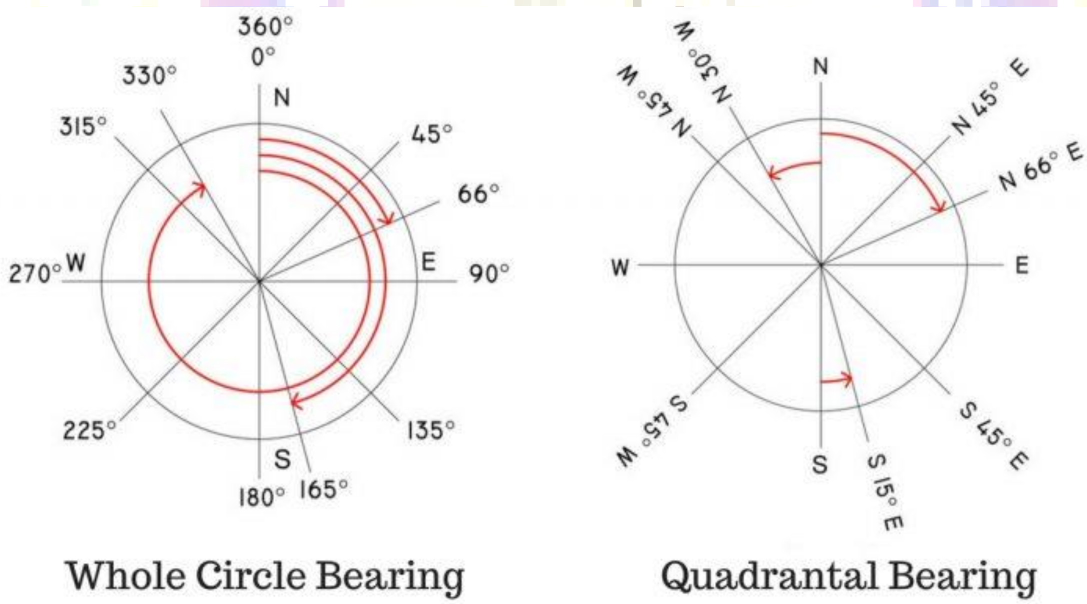
Aim of the experiment: - To measure bearings of lines and determination of included angles using Prismatic compass.

Instrument required: -

1. Prismatic compass
2. tripod stand
3. Plumb bob
4. Ranging rods

Theory: -

- The horizontal angle made by a survey line with reference to magnetic north pole in a clockwise direction is called as bearing of line.
- The common systems of notation for bearings in surveying are whole circle bearing system or Azimuthal bearing system and Quadrantal bearing.



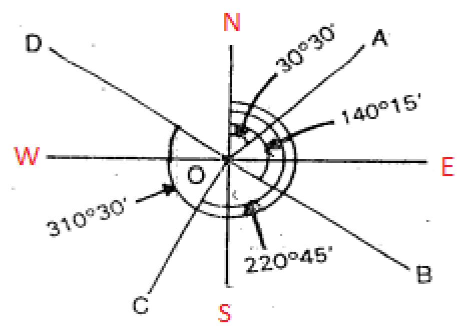
1. Whole circle bearing system

In this system, the bearing of a line is measured with magnetic north in a clockwise direction. The value of the bearing thus varies from 0 degrees to 360 degrees. Prismatic compass is graduated in this system

2. Quadrantal bearing system

In this system, the bearing of a line is measured eastward or westward from north or south, whichever is neared. Thus, both north and south are used as reference meridians and the direction can be either clockwise of anticlockwise depending upon the position of the line. In a quadrantal bearing system, the quadrant in which lines lies will have to be mentioned. These bearings are observed by surveyors compass.

Procedure:-



- → Let 'O' be the instrument station selected from which all other points are visible.
- → Complete all station adjustments like setting, centering and levelling accurately.
- → Sight the object 'A' looking through the prism vane, while the object vane is directed towards the object.
- → Observe the bearing by looking through the prism.
- → Enter the readings in the tabular form.
- → Repeat the process at all objects stations B, C, D etc. and enter the readings.

Observation and calculation:-

SL NO	STATION	SIGHTED TO	WCB
01	A	OA	$30^0 30'$
02	B	OB	$140^0 15'$
03	C	OC	$220^0 45'$
04	D	OD	$310^0 30'$

Calculation:-

∠AOB = Bearing of OB- Bearing of OA

=140°15' – 30°30' = 109°45'

∠BOC = Bearing of OC- Bearing of OB

= 220°45' – 140°15' =80°30'

∠COD = Bearing of OD - Bearing of OC

=310°30' – 220°45' = 89°45'

Conclusion: -

From the above experiment we measure the bearings of lines and determine the included angles using Prismatic compass.

Experiment No: 9

RADIATION METHOD, INTERSECTION METHODS BY PLANE TABLE SURVEY

AIM:

To plot a given area by Radiation and Intersection methods of Plane Table Survey

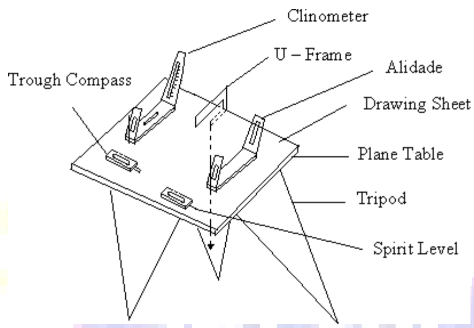
RESOURCES:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Tape	Linen Tape	20m	1
2	Ranging Rods		3m or 2m height	3
3	Arrows			5
4	Plane Table with Tripod and its accessories			1
5	Two Drawing Sheets			1
6	Drawing Clips			
7	Pencil, Eraser and Pins			

PRECAUTIONS:

1. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet
2. Leveling must be done carefully.
3. Readings must be taken with full accuracy
4. Ground points must be transferred to paper with full accuracy.

FIGURE: A plane table and its accessories are shown in the figure below.



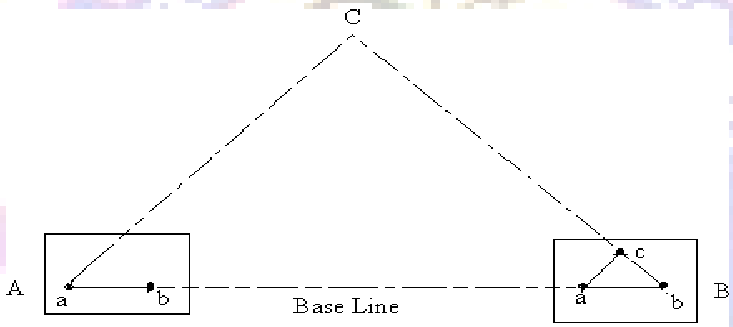


Fig 3

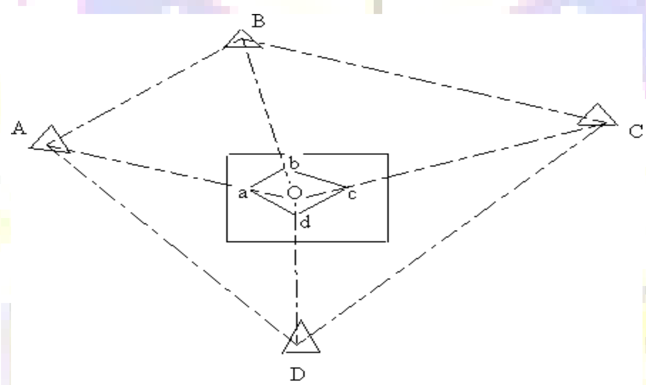


Fig 2

PROCEDURE:

Radiation Method:

In this method the instrument is setup at a station and rays are drawn to various stations which are to be plotted. The distances are cut to a suitable scale after actual measurements.

A station O is selected such that all other stations A, B, C and D are accessible and visible from O (Fig 2). N – S direction is plotted. The plane table is setup at O. The alidade is placed at „o‟ and rays are drawn from „o‟ to the stations A, B, C, D and the distances oa, ob, oc and od are cut to the chosen scale. Joint a, b, c and d.

Intersection Method:

In this method two stations are so selected that all the other stations to be plotted are visible from these. The line joining these two stations is called Base Line. The length of this line is measured very accurately. Rays are drawn from these stations to the stations to be plotted. The intersection of the rays from the two stations gives the position of the station to be plotted on the drawing sheet.

Let A and B be the two accessible stations (Fig 3), such that A and B can be suitably plotted. C is the station to be plotted by intersection. The plane table is placed at A. N – S direction is plotted. The ground station A is transferred as „a‟ onto the drawing sheet. With the alidade centered at „a‟, station B is sighted. A ray aB is drawn and is cut as „ab‟ to a suitable scale. With the alidade at „a‟, C is also sighted and a ray aC is drawn. The table is now shifted to B and is setup. The alidade is placed at „b‟ and C is sighted. A ray bC is drawn. The intersection of the two rays gives the position of C as „c‟ on the plane table.

CALCULATIONS:

RESULT:

Given area is plotted on paper by Radiation and Intersection methods of Plane Table Survey.

Experiment No: 10

TRAVERSING BY PLANE TABLE SURVEY

OBJECTIVE:

Traversing method for running survey lines of a closed or open traverse

RESOURCES:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Tape	Linen Tape	20m	1
2	Ranging Rods		3m or 2m height	3
3	Arrows			5
4	Plane Table with Tripod and its accessories			1
5	Two Drawing Sheets			1
6	Drawing Clips			
7	Pencil, Eraser and Pins			

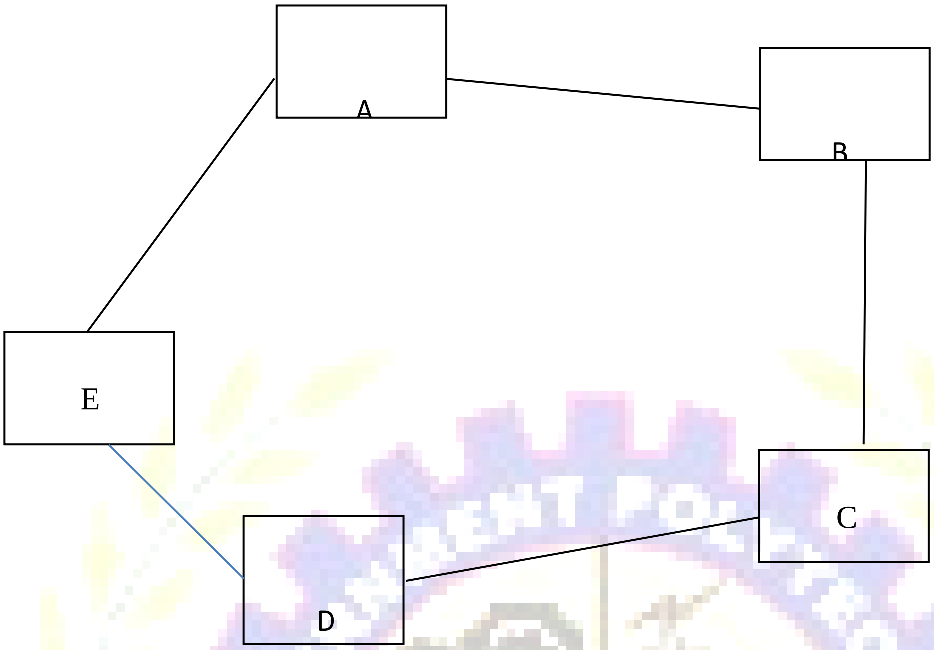
10..3 PRECAUTIONS:

1. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet

2. Leveling must be done carefully.

3. Readings must be taken with full accuracy
Ground points must be transferred to paper with full accuracy

FIGURE: A plane table and its accessories are shown in the figure below.



PROCEDURE:

1) Select the traverse stations A,B,C,D,E etc on the ground.
2) Set the table on starting station „a' and perform temporary adjustments.
3) Mark the magnetic meridian.
4) Locate A on the sheet as „a".
5) Pivot on „a' bisect the next station B and draw a ray
6) Measure the distance AB and locate „b' on the sheet with a suitable scale.
7) Shift the table to next station B, set the table over B, and do temporary adjustments.
8) Place the alidade along „ba' and bisect A for doing orientation of plane table.
9) Pivot on b bisect c draw a ray
10) Measure the distance BC and locate „c' on the sheet with the suitable scale.
11) Report the same procedure at every successive station until the traverse is completed.

10..6 CALCULATIONS:

1) Area of a triangle = ½ * base *height
2) Area of a square = side * side
3) Area of a rectangle = length * breadth
4) Area of a trapezium = ½ * (a + b) * h

A, b are the parallel sides. h is the distance between parallel sides.

RESULT:

Traversing method for running survey lines of a closed or open traverse is done.

Experiment No: 11

TWO POINT PROBLEMS IN PLANE TABLE SURVEY

OBJECTIVE:

To find the required stations by using two point problem.

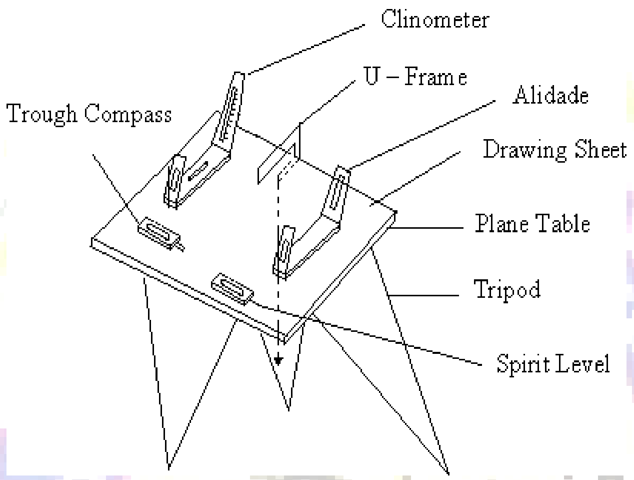
RESOURCES:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Tape	Linen Tape	20m	1
2	Ranging Rods		3m or 2m height	3
3	Arrows			5
4	Plane Table with Tripod and its accessories			1
5	Two Drawing Sheets			1
6	Drawing Clips			
7	Pencil, Eraser and Pins			

PRECAUTIONS:

1. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet
2. Leveling must be done carefully.
3. Readings must be taken with full accuracy
4. Ground points must be transferred to paper with full accuracy.

FIGURE: A plane table and its accessories are shown in the figure below.



PROCEDURE FOR TWO POINT PROBLEM:

A. Let two points A and B be the plotted positions on the plane.
B. C is the station over which the table is to be set up and c is its position on the plane which is required to be located.
C. The solution of the problem requires two instrument stations.
D. The station is obtained as follows.

1) Choose a suitable auxiliary point D, so that the angle CAD and CBD aren‟t too acute for good intersection at A and B.
2) Setup the table at D and level it .Orient the table by compass or by judging ab to be parallel to AB and clamp it.
3) With the alidade touching a, sight A, and draw a ray through a. Similarly, with the alidade against b, sight B and draw a ray through through at d1, which approximately represents the station D and the orientation is approximately.
4) With the alidade centered on d1, sight C and draw a ray d1c1 through d1,estimating the position of c1.

5) Remove the table and set it up at C with c1over c and level it. Orient the

table parallel to its position at D ,by back sighting on D .To do this ,place the alidade along c and d ,rotate the table until D is bisected, clamp the table .

6) With the alidade against a, sight A and draw a ray through a, Intersect the line c1d1in C1 .With the alidade through C1, sight B and draw a ray through C1..This ray will pass through b, provide the initial orientation of the table at D was correct. But since the orientation at D and also at C, also constituent was only approximate, the ray C 1 B will not pass through b. Mark the point of intersection b1 of C 1 B ,and d1b .The point b1 thus represents B. Hence points ad1c1b1 represents ADCB. But since ab is the true representation of AB ,the error in the initial orientation is equal to the angle b1ab between the lines ab and ab1.To eliminate the error ,the table must be rotate through this angle. To do this,

7) Place the alidade along ab1, and fix a ranging rod P at a great distance from the table in the line ab1 produced.

8) Place the alidade along ab and turn the table until the ranging rod P is bisected. Clamp the table ,ab is now parallel to AB and the orientation of the table is correct.

9) To find the true position of C, center the alidade on a and sight A .Draw a ray through a. Similarly with alidade touching b, sight B, and draw a ray through b. The intersection of these two rays gives the true position (c) on the plan of the station (c) occupied.

RESULT:

The required instrument station C is occupied by using two point problems.

Experiment No: 12

THREE POINT PROBLEMS IN PLANE TABLE SURVEY

OBJECTIVE:

To find the required stations by using three point problem.

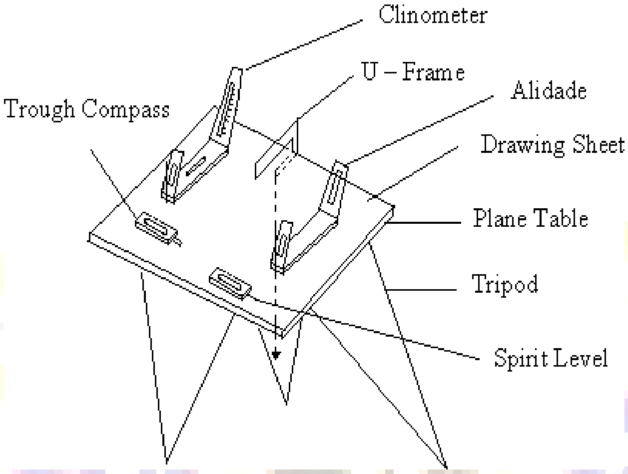
RESOURCES:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Tape	Linen Tape	20m	1
2	Ranging Rods		3m or 2m height	3
3	Arrows			5
4	Plane Table with Tripod and its accessories			1
5	Two Drawing Sheets			1
6	Drawing Clips			
7	Pencil, Eraser and Pins			

PRECAUTIONS:

1. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet
2. Levelling must be done carefully.
3. Readings must be taken with full accuracy
4. Ground points must be transferred to paper with full accuracy.

FIGURE: A plane table and its accessories are shown in the figure below.



PROCEDURE FOR THREE POINT PROBLEM:

1) Plot a, b,c as in the ground.
2) The length of ab, bc and ac are given. It forms a triangle.
3) The alidade place along CA.
4) The board rotates till the point A is sighted and the board is clamped.
5) Pivot the alidade on a and sight to b and draw a ray .These two ray will meet at a point

d. Then joint bd, and rotate the board till the point B is sighted and draw a back ray.

6) This ray will meet at a point on the line bd, this will be the required station.

RESULT:

The required instrument station C is occupied by using three point problem.

EXPERIMENT NO -13

AIM OF THE EXPERIMENT: - Measurement of horizontal angles by repetition method.

APPARATUS: - Theodolite, ranging rod, pegs etc.

THEORY: -

Theodolite: The theodolite is the most intricate and accurate instrument used for measurement of Horizontal and vertical angles. It consists of telescope by means of which distant objects can be sighted. The telescope has two distinct motions on in the horizontal plane and the other in the vertical plane.

Theodolite are primarily classified as Transit theodolite and non-transit theodolite.

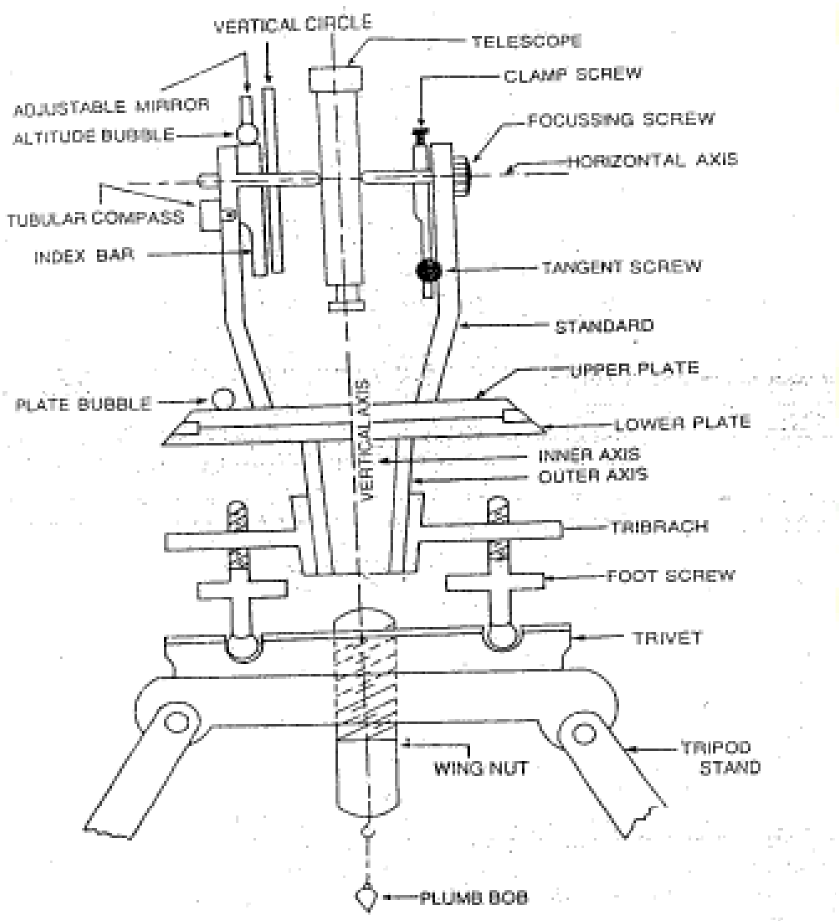


Figure of theodolite

Transit theodolite: -A theodolite is called transit theodolite when its telescope can be resolved through a complete revolution about its horizontal axis in a vertical plane. The transit type is largely used.

Non-Transit theodolite: -in this type of theodolite the telescope cannot be revolved through a complete revolution in a vertical plane.

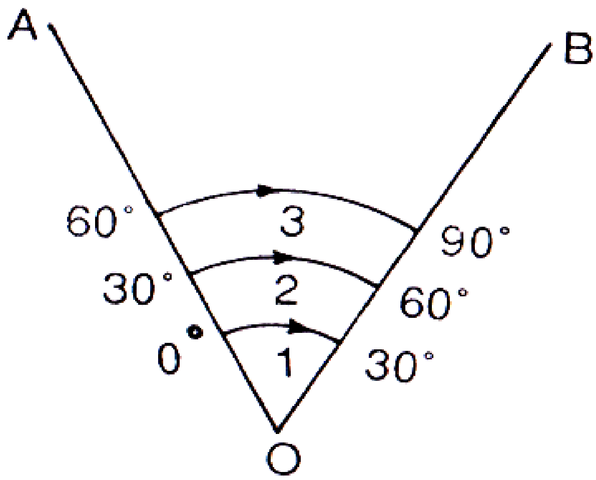
REPETITION METHOD OF MEASURING HORIZONTAL ANGLES

When it is required to measure horizontal angles with great accuracy as in the case of traverse, the method of repetition may be adopted. In this method the same angle is added several times by keeping the vernier to remain clamped each time at the end of each measurement instead of setting it back to zero when sighting at the previous station. The corrected horizontal angle is then obtained by dividing the final reading by the number of repetitions. Usually six reading, three with face left and three with face right, are taken. The average horizontal angle is then calculated.

PROCEDURE: -

1. The angle AOB has to be measured by the repetition process. First set Theodolite at Zero . Then the instrument is to be centered and levelled properly. Thereafter set Vernier A at 0 degree and Vernier B to 180 degree.
2. The upper clamp is to be fixed and the lower clamp has to be loosened. By turning the telescope, the ranging rod at A is perfectly bisected with the help of the lower clamp screw and the lower tangent screw. Here the initial reading of the vernier A is zero Degree.
3. The upper clamp is loosened and the telescope is then turned clockwise to perfectly bisect the ranging rod at B. The upper clamp is clamped. Suppose the reading on vernier A is 30 degrees.
4. The lower clamp is loosened and the telescope turned anticlockwise to exactly bisect the ranging rod at A. Here the initial reading is 30 degree for the second observation.
5. The lower clamp is tightened. The upper one is loosened and the telescope is turned clockwise to exactly bisect the ranging rod at B. Let the reading on vernier A be 60 degree.
6. The initial reading for the third observation is set to be 60 degree and angle AOB is again measured. Let the final reading on the vernier A be 90 degree which is accumulated angle.

Hence Angle AOB = (Accumulated angle) / (No. of Reading) = 90/3= 30 degree
The face of the instrument is changed and the previous procedure is followed.
The mean of the two observations gives the actual angle AOB. The result is shown in observation Table.



OBSERVATION TABLE: - Repetition method of measuring horizontal angle.

station	object	angle	observation	Reading on vernier		Angle on vernier		Mean angle of vernier	Mean angle of observation	remark
				A	B	A	B			
1	2	3	4	5	6	7	8	9	10	11
O	A B	AOB	Face left							
O	A B	AOB	Face right							

Average horizontal angle is found to be ----------

CONCLUSION: -

In this experiment we were to do measurement of horizontal angles by repetition method.

EXPERIMENT NO -14

AIM OF THE EXPERIMENT: Measurement of horizontal angles by reiteration method

APPARATUS: - Theodolite, ranging rod, pegs etc.

THEORY: -

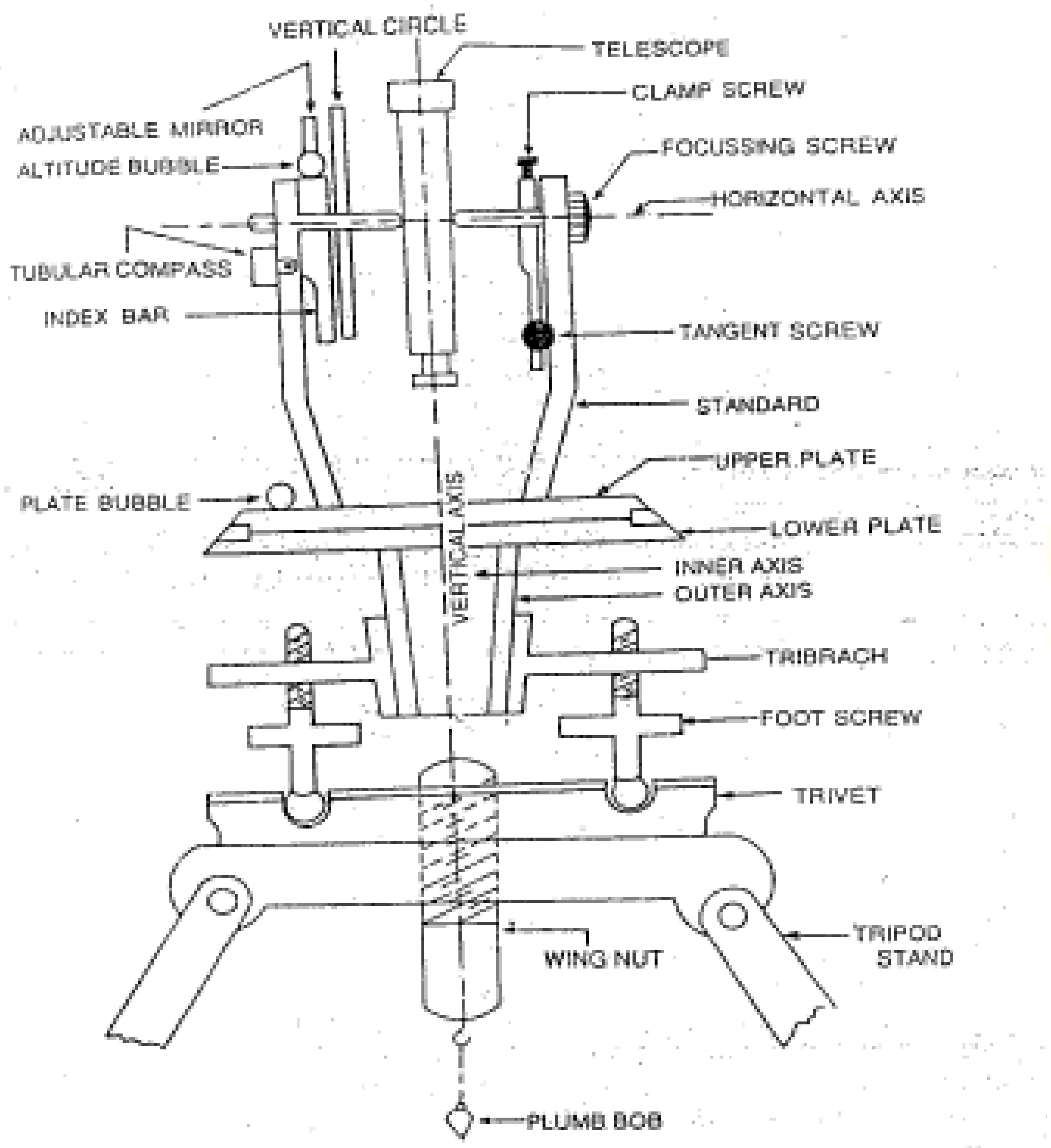


Figure of Theodolite

Transit theodolite: -A theodolite is called transit theodolite when its telescope can be resolved through a complete revolution about its horizontal axis in a vertical plane. The transit type is largely used.

Non-Transit theodolite: -in this type of theodolite the telescope cannot be revolved through a complete revolution in a vertical plane.

REITERATION METHOD OF MEASURING HORIZONTAL ANGLES

This method is suitable when several angles are measured from a single station in this method all the angles are measured successively and finally the horizon is closed so the final reading of the leading vernier should be the same as it is initial reading. If the discrepancy is small the error is equally distributed amongst all the observed angles. If it is large the reading should be cancelled and new sets taken.

PROCEDURE: -

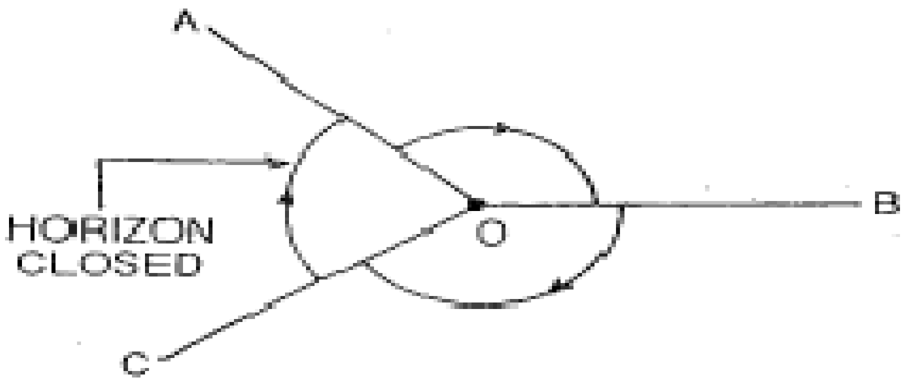
Suppose it is required to measure a angle AOB and BOC from station O, The procedure is as follows.

First Setup.

1. The theodolite is perfectly centered over O and levelled properly. The observation is taken in the face left position and the telescope is turn clockwise.
2. Vernier A is set to zero degree and vernier B is set to 180 Degree.
3. The upper clamp is fixed and the lower one is loosened. The ranging rod at A is perfectly bisected. Now the lower clamp is tightened.
4. The upper clamp is loosened and the ranging rod or object at B is bisected properly by turning the telescope clockwise. The reading on both the vernier are taken and AOB is noted.
5. Similarly, the object C is bisected properly and readings on the vernier are noted and BOC is recorded.
6. Now the horizon is closed i.e the last angle COE is measured and the position of the leading vernier is noted. The leading vernier should show the initial reading on which it was set.

Second Setup

1. The face of the instrument is changed. Again, the vernier are set their initial positions. This time the angles are measured anticlockwise.
2. The upper clamp is fixed and the lower one is loosened. The ranging rod at A is perfectly bisected. Now the lower clamp is tightened.
3. The telescope is turned anticlockwise and the object C is bisected by loosening the upper clamp screen the reading on both the verniers are taken. Angle COA is noted.
4. Then the object B is bisected by turning the telescope anticlockwise and the readings on the verniers are taken. Angle BOC is recorded.
5. Finally, the horizon is closed. Leading vernier A should show a reading of zero degree. The last angle AOB is noted



OBSERVATION TABLE: - Reiteration method of measuring horizontal angle.

Station	Object	Face	Angle	No. of readings	Initial angle on vernier		Final reading on vernier		Angle on vernier		Mean angle of vernier	Mean angle of observation	Remark
					A	B	A	B	A	B			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	A B	Left	∠AOB	1 2 3									
0	A B	Right	∠AOB	1 2 3									

Average horizontal angle is found to be –

CONCLUSION: Measurement of horizontal angles by reiteration method was done in this experiment.

EXPERIMENT NO-15

AIM OF THE EXPERIMENT: Prolonging of the given straight line using Theodolite

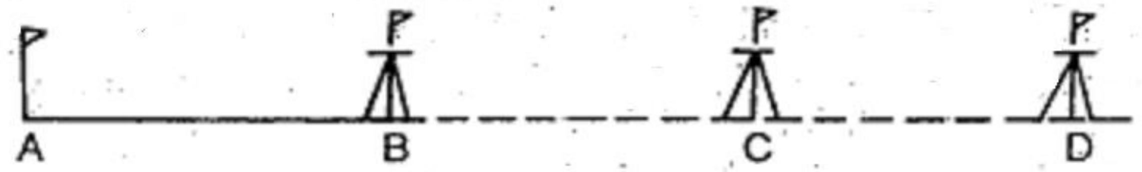
APPARATUS REQUIRED:

- Theodolite
- Ranging rod
- Arrows and
- Pegs

THEORY:

The Theodolite is the most accurate instrument used mainly for measuring horizontal and vertical angles. It can also be used for locating points on a line, prolonging survey lines, finding difference in elevations, setting out grades, raging curves etc.

PROCEDURE:



1. The Theodolite is set up at B and centred and levelled perfectly.

2. The telescope is directed towards A and the ranging rod at A is perfectly bisected. The upper and lower clamps are fixed.

3. The telescope is transited. Looking through it, a ranging rod is fixed at C beyond the point B, along the

line AB.

4. Now the theodolite is shifted and set up at C after removing the ranging rod. It is centred and levelled.

Then a back sight reading is taken at B. The upper and lower clamps are fixed.

5. The telescope is transited and the next point D is fixed on the line by a ranging rod.

6. Similarly other points are fixed.

CONCLUSION:

In the above experiment we prolonged the given straight line using Theodolite.

EXPERIMENT NO-16

Aim of the Experiment: Temporary Adjustment of a Level

Instrument required: -

At each set up of a level instrument, temporary adjustment is required to be carried out prior to any staff observation. It involves some well-defined operations which are required to be carried out in proper sequence.

The temporary adjustment of a dumpy level consists of
(1)Setting,
(2)Leveling and
(3) Focusing.

During **Setting**, the tripod stand is set up at a convenient height having its head horizontal (through eye estimation). The instrument is then fixed on the head by rotating the lower part of the instrument with right hand and holding firmly the upper part with left hand. Before fixing, the leveling screws are required to be brought in between the tribrach and trivet. The bull's eye bubble (circular bubble), if present, is then brought to the centre by adjusting the tripod legs.
Next, **Leveling** of the instrument is done to make the vertical axis of the instrument truly vertical. It is achieved by carrying out the following steps:

Step 1: The level tube is brought parallel to any two of the foot screws, by rotating the upper part of the instrument.

Step 2: The bubble is brought to the centre of the level tube by rotating both the foot screws either inward or outward. (The bubble moves in the same direction as the left thumb.)

Step 3: The level tube is then brought over the third foot screw again by rotating the upper part of the instrument.

Step 4: The bubble is then again brought to the centre of the level tube by rotating the third foot screw either inward or outward.

Step 5: Repeat Step 1 by rotating the upper part of the instrument in the same quadrant of the circle and then Step 2.

Step 6: Repeat Step 3 by rotating the upper part of the instrument in the same quadrant of the circle and then Step 4.

Step 7: Repeat Steps 5 and 6, till the bubble remains central in both the positions.
Step 8: By rotating the upper part of the instrument through 180 o , the level tube
is brought parallel to first two foot screws in reverse order. The bubble will remain in the centre if the instrument is in permanent adjustment.

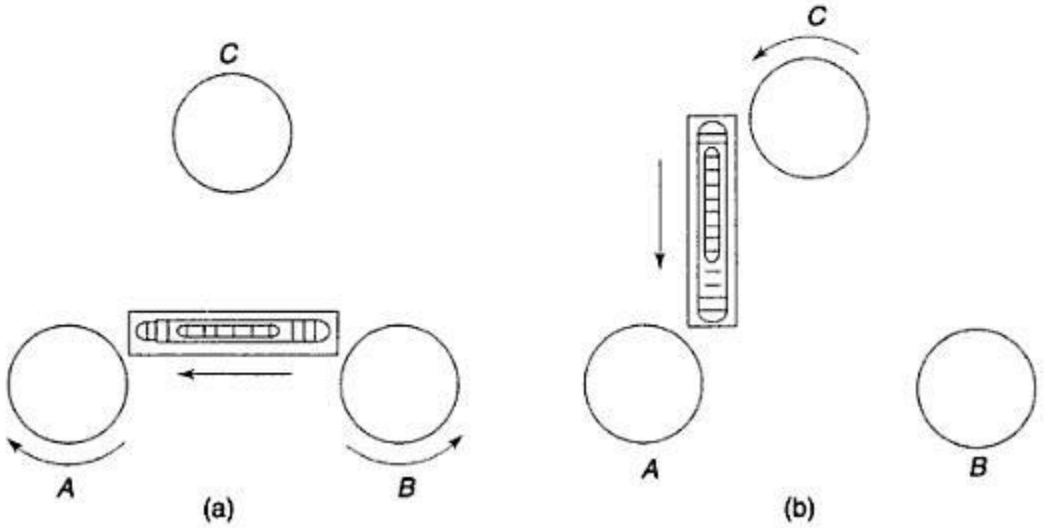


Fig. 6.22 *Levelling with three foot screws*

In the case of four foot screws the levelling is to be carried out as follows

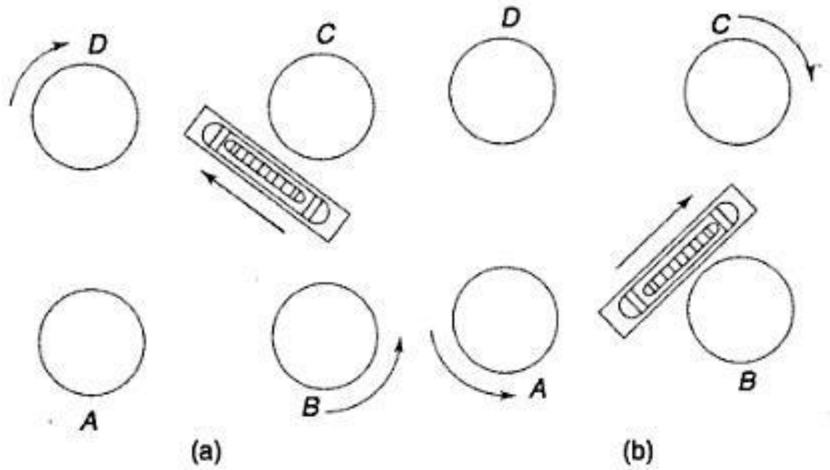


Fig. 6.23 *Levelling with four foot screws*

Focusing is required to be done in order to form image through objective lens at the plane of the diaphragm and to view the clear image of the object through eye-piece. This is being carried out by removing parallax by proper focusing of objective and eye-piece. **For focusing the eye-piece**, the telescope is first pointed towards the sky. Then the ring of eye-piece is turned either in or out until the cross-hairs are seen sharp and distinct. Focusing of eye-piece depends on the vision of observer and thus required whenever there is a change in observer.

For focusing the objective, the telescope is first pointed towards the object. Then, the focusing screw is turned until the image of the object appears clear and sharp and there is no relative movement between the image and the cross-hairs. This is required to be done before taking any observation.

EXPERIMENT NO-17

FLY LEVELLING

Aim: To Determine the level difference between given station

Apparatus Required:

- i. Dumpy Level
- ii. Tripod Stand
- iii. Levelling staff

Principle:

Reduced level = Bench mark + Rise and fall

Staff reading indicates rise or fall according to the reading is smaller or greater the Preceding level.

Procedure:

1. The levelling instrument was placed on the tripod and levelled accurately, the station points A,B and C .
2. The levelling instrument was placed at a convient distance from the station point C and B,A back sight was taken on C and fore sight was taken on B .
3. The points A and B were not intervisible in a single set up. The intervisible point A’ was taken at a convienient distance from A and B.
4. The instruments placed between B and A’, A back sight was taken to B and for sight was taken to B and for sight was taken to A’ then instruments shifted to a convienient distance from A’ and A, A back sight to A was taken.

Result:

Level difference between A and B=

Level difference between B and C=

Level difference between C and A=

EXPERIMENT NO-18

SIMPLE LEVELLING RISE AND FALL METHOD

Aim: To Determine the required level of given points A,B,C, and D, Rise and fall method.

Apparatus Required:

i. Dumpy Level
ii. Tripod Stand
iii. Levelling staff

Principle:

Reduced level = Bench mark + Rise and fall

Staff reading indicates rise or fall according to the reading is smaller or greater the Preceding level.

Procedure:

1. The levelling instrument was placed on the tripod of a convient distance from the station points A,B,C,D and E .
2. Then the approximate levelling was done by adjusting the foot screws.
3. A(BS) was taken on bench mark A reduced level 1000.000 then the intermediate sight were taken at all station B,C,D,E.
4. A(BS) was taken on bench mark A reduced level 50.000 then the intermediate sight were taken at all station b,c,d and then a fore sight was taken on E then the reduced level at each station were found out by rise and fall method then check.

Result:

Reduced level of given points were found by using rise and fall method.

EXPERIMENT NO-19

PROFILE LEVELING (LONGITUDINAL SECTIONING & CROSS SECTIONING)

Objective:

To determine the configuration of ground survey by conducting – Longitudinal & Cross Sectional leveling.

Equipments:

Dumpy Level, Levelling Staff, Tripod, Staff bubble, Chain or Tape.

Procedure

A) Profile Leveling

Profile leveling is one of the most common applications of running levels and vertical distance measurement for the surveyor. The results are plotted in the form of a profile, which is a drawing that shows a vertical cross section. Profiles are required for the design and construction of roads, curbs, sidewalks, pipelines etc. In short, profile leveling refers tothe process of determining the elevation of points on the ground at mostly uniform intervalsalong continuous line.

Field Procedure:

Profile leveling is essentially the same as benchmark leveling, with one basic difference. At each instrument position, where an HI is determined by a back sight rod reading on a benchmark or turning point, several additional foresight readings may be taken on as manypoints as desired. These additional readings are called rod shots, and the elevation of all those points is determined by subtracting the rod shot from the HI at that instrument location. (See figure 1)

Plotting the Profile:

The profile drawing is basically a graph of elevations, plotted on the vertical axis, as a function of stations, plotted on horizontal axis. A gridded sheet called profile paper is usedto plot the profile data from the field book. All profile drawings must have a proper title block, and both axes must be fully labeled with stations and elevations. The elevation or elevation scale is typically exaggerated; that is, it is 'stretched' in comparison to the horizontal scale. For example the vertical scale might be 10 times larger. The horizontal line at the bottom of the profile does not necessary have to start at zero elevation

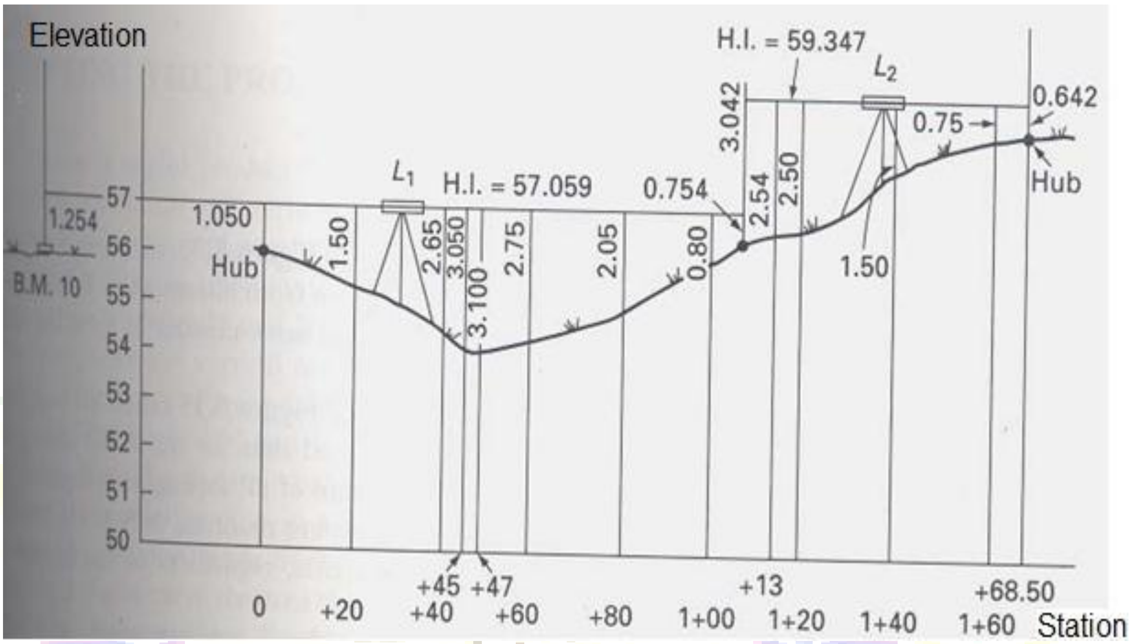


Figure 1: Profile leveling

B) Cross-Section Leveling

The term cross-section generally refers to a relatively short profile view of the ground, which is drawn perpendicular to the route centerline of a highway or other types of linear projects. Cross-sectional drawings are particularly important for estimating the earthwork volumes needed to construct a roadway; they show the existing ground elevations, the proposed cutor fill side slopes, and the grade elevation for the road base.

There is really no difference in procedure between profile and cross-section leveling exceptfor the form of the field notes. Cross-section rod shots are usually taken during the route profile survey from the same instrument positions used to take rod shots along the centerline. Cross-section data are obtained at the same locations along the route that are used for the profile rod-shot stations. (See figure 2 a and b).

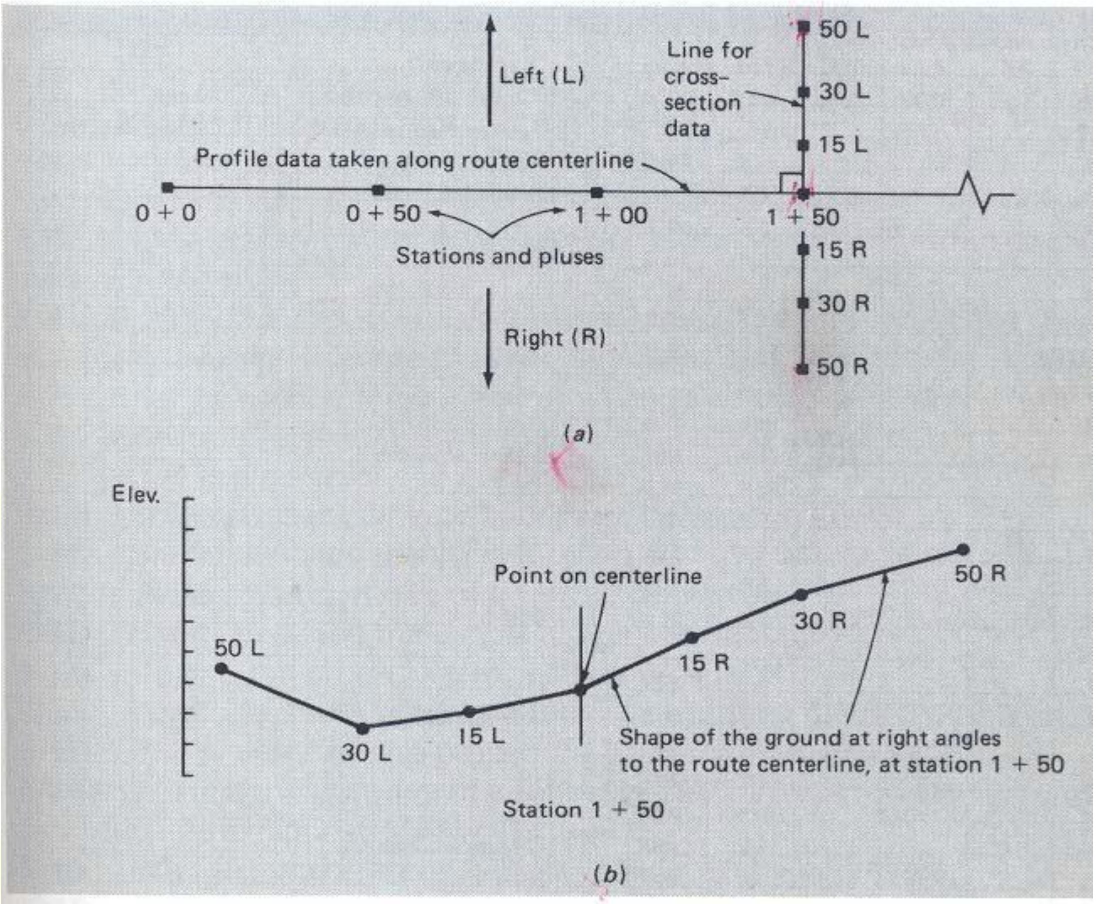


Figure 2:

(a) Top view showing the route center line and the line for cross-section leveling at station 1+ 50.

(b) The cross-section showing ground elevations at points left and right of the center line.

- **Result:** The longitudinal sectioning & cross sectioning is carried out and the profile and crosssections are plotted on Graph sheet.