INDEX

FAMILARITY WITH INSTRUMENTS USED IN CHAIN SURVEYING

OBJECTIVE: Study of various instruments used in chain surveying and their uses

INSTRUMENTS:

1) Chain or tape
2) Arrows
3) Ranging rods
4) Cross staff
5) Offset rods
6) Pegs
7) Plumb bob

DESCRIPTION OF INSTRUMENTS:

1 **a) CHAIN:**

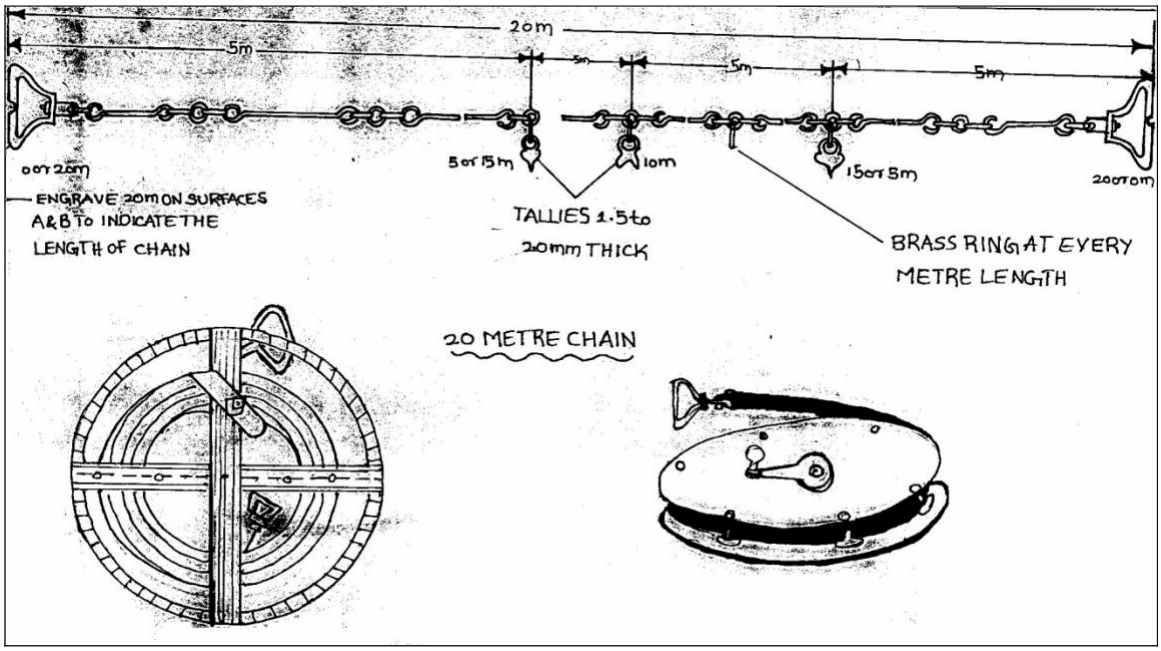
The chain is composed of 100 or 150 pieces of galvanized mild steel wire, 4mm in diameter called links .The ends of each link are bent into a loop and connected together by means of three oval rings. The ends of the chain are provided with handles for dragging the chain on the ground, each wire with a swivel joint so that the chain can be turned without twisting. The length of the chain is measured from the outside of one handle to the outside of another handle.

Following are the various types of chain in common use:

1) Metric chain
2) Gunter` s chain or surveyors chain
3) Engineers chain
4) Revenue chain
5) Steel band or Band chain

METRIC CHAIN:

Metric chains are made in lengths 20m and 30m. Tallies are fixed at every five-meter length and brass rings are provided at every meter length except where tallies are attached



b) TAPES:

The following are the various types of tapes

i) Cloth tape

ii) Metallic tape

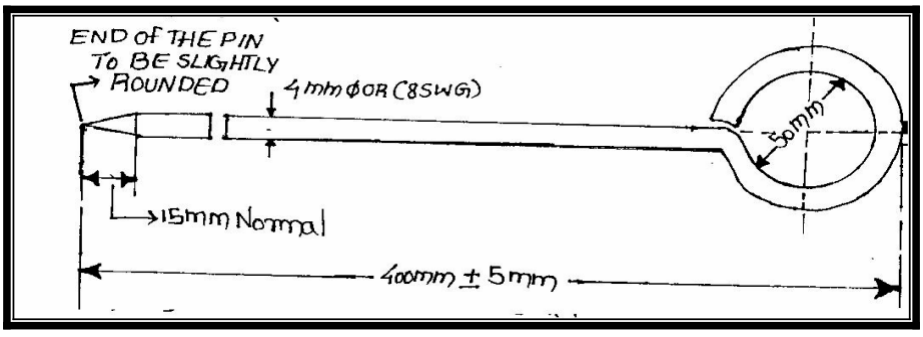
iii) Steel tape

iv) Invar tape

Among the above, metallic tapes are widely used in surveying. A metallic tape is made of varnished strip of waterproof line interwoven with small brass, copper or bronze wires. These are light in weight and flexible and are made 2m, 5m 10m, 20m, 30m, and 50m.

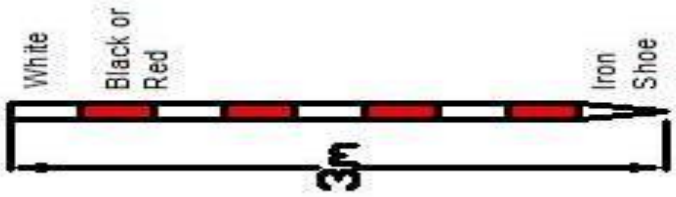
2. ARROWS:

Arrows are made of good quality hardened steel wire of 4 mm diameter. The arrows are made 400 mm in length, are pointed at one and the other end is bent into a loop or circle



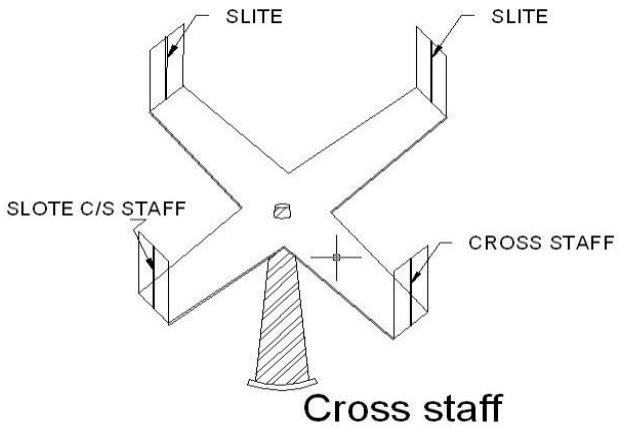
3. RANGING RODS:

Ranging rods are used to range some intermediate points in the survey line The length of the ranging rod is either 2m or 3m. They are shod at bottom with a heavy iron point. Ranging rods are divided into equal parts 0.2m long and they are painted alternately black and white or red and white or red, white and black. When they are at considerable distance, red and white or white and yellow flags about 25 cm square should be fastened at the top.



4. CROSS STAFF:

The simplest instrument used for setting out a right angle. The common forms of cross staff are:



Cross staff

5. OFFSET ROD:

The offset rod is used for measuring the off set of short lengths. It is similar to a ranging rod and is usually of 3m lengths.

6. PEGS:

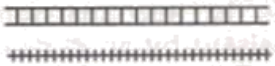
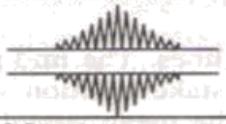
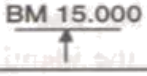
These are rods made from hard timber and tapered at one end, generally 25mm or 30mm square and 150mm long wooden pegs are used to mark the position of the station on.

7. PLUMB BOB:

While chaining along sloping ground, a plumb bob is required to transfer the points to the ground.

CONVERSION SYMBOLS

The signs or symbols for the revealation of the above surface features are presented as follows:

1. Triangulation Station. 	2. Traverse station 	3. Tie station. 	4. Chain line.
5. Wood fencing.	6. Pipe railing.	7. Wire fencing.	8. Demarcated property boundary.
9. Undermarcated property boundary.	10. Compound wall. 	11. Stream. 	12. River. 
13. Cart track. 	14. Canal. 	15. Railway line. 	16. Railway double line. 
17. Unmetalled road. 	18. Metalled road. 	19. Pucca building. 	20. Katcha building 
21. Hedge 	22. Trees. 	23. Woods. 	24. Orchard. 
25. Cultivated land. 	26. Swamps. 	27. Culvert. 	28. Bridge. 
29. Embankment. 	30. Cutting. 	31. Railway bridge. 	32. Temple. 
33. Mosque. 	34. Church. 	35. Pond or lake. 	36. North line. 
37. Gates. 	38. Well. 	39. Bench mark. BM 15.000 	40. Pucca drain.
41. Katcha drain.	42. Electric line.	43. Shed.	44. Gate and wall.
45. Pasture.	46. Cemetry	47. Foot path.	48. Lawn.

FOLDING AND UNFOLDING A CHAIN

OBJECTIVE: To learnt the technique of unfolding and folding of a metric chain.

INSTRUMENTS: Metric chain

PROCEDURE:

UNFOLDING:

1. Remove the strap of the folded chain and take both the handles in the left hand and hold the remaining portion of the chain in the right hand.
2. Holding both the handles in the left hand, throw the remaining portion o f the chain in the forward direction on the ground.
3. Now the follower stands at the starting station by holding one handle and directs the leader to move forward by holding the other handle until the chain is fully stretched.

FOLDING:

1. Bring the two handles together on the ground by pulling the chain at the center.
2. Commencing from the center two pairs of links are taken at a time with the right hand and placed alternatively in both directions in the left hand.
3. When the chain is completely folded the two brass handles will appear at the top.
4. Now tie the chain with leather strap.

EXPERIMENT – 1

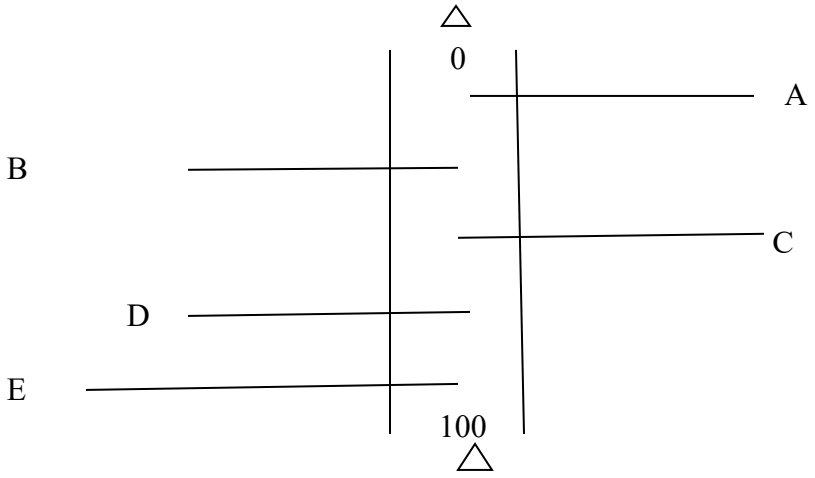
CHAINING OF A LINE USING CHAIN, MEASUREMENTS OF AREA BY CROSS STAFF SURVEYING.

AIM:- To Carry out survey of an area by chain survey and plot the same.

APPARATUS:- chain ,tape ,cross staff ,ranging rods ,arrows.

PROCEDURE:-

1. This survey is carried out to locate the boundaries of a field and to determine its area.
2. A chain line is run through the center of area which divided into a no. of Triangles and trapezoids.
3. The offsets to the boundary are taken in order to their chainages as shown.
4. After the field work is over the survey is plotted to a suitable scale.
5. Then the area of a field is calculated as shown in tabular column



CALCULATIONS:-

S.NO	Name of figure	Chainage (m)	Base (m)	Offsets (m)	Mean (m)	Area (m2)

RESULT:- Total area of field=

EXPERIMENT – 2

MEASUREMENT OF DISTANCE BETWEEN TWO POINTS WHEN THERE IS AN OBSTACLE FOR BOTH CHAINING AND RANGING

AIM:- To measure distance between two points by chaining across different types of Obstacles encountered by indirect method.

APPARATUS:- Chain, tape, cross-staff , ranging rods, arrows.

PROCEDURE:-Obstacles to chaining prevent chainmen to measuring directly between Two points and give rise to a set of problems in which distances are found by indirect Measurements.

1. Obstacles to chaining are of three kinds.
2. Obstacles to ranging but not chaining.E.x (High level ground)
3. Obstacles to chaining but not ranging. E.x(Pond,river)
4. Obstacles to both chaining and ranging. E.x(building)

A) OBSTACLES TO RANGING BUT NOT CHAINING:-

This type of problem comes, when a rising ground or a forest area interrupts the chain line. The end station are not inter visible

There may two cases of this obstacle.

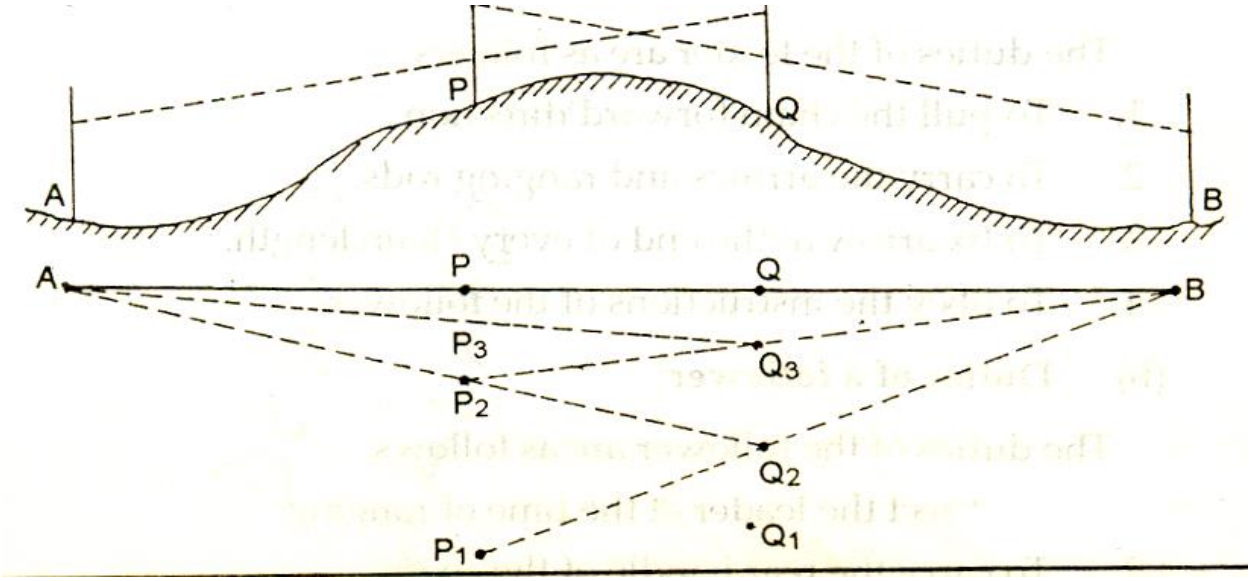
1. Both ends of line may be visible from intermediate points on line.
2. Both ends of line may not be visible from intermediate points on line.

CASE-1

Both the stations are visible from intermediate points on the line

1. In this case reciprocal ranging is adopted and chaining is done by stepping method
2. A and B are two end stations, which are not inter visible due to a hill in between them.
3. Select two intermediate points Pl and Ql, such that from each station point A and B are visible.
4. Two persons take up the positions Pl and Q_1 with ranging rods.
5. First the person standing at Pl directs the person at Q_1 to come in line of P_1 B, and his new position will be Q_2.
6. Now, the person standing at Q_2, directs the person at pi, to come in line of Q_2 A, and his new position will be P_2.

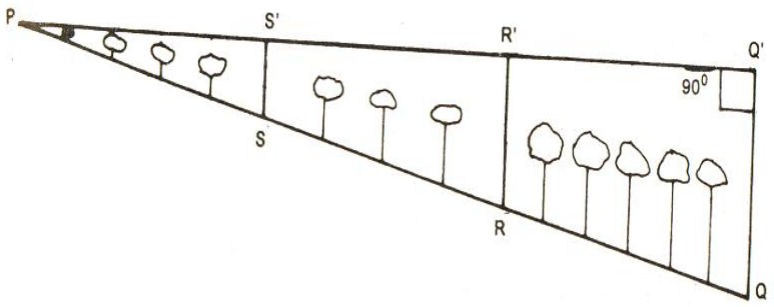
7. Now, the person standing at P_2, directs the person at Q_2, to come in line of P_2 B, and his new position will be Q_3.
8. This process is continued until the intermediate points P and Q are located in such a way that the person standing at P, see Q and B in the line, and the person standing at Q, see P and A in the line.
9. Distance AB = AP+PQ+QB



CASE-2

The end stations are not visible from the intermediate points on the line:

1. In fig let PQ be the line in which P and Q are not visible from intermediatePoint on it.
2. Through P draw a random line PQ in any convenient direction but as nearly to Towards Q as possible.
3. The points Q should be so chosen that, Q1 is visible from Q and Q,Q1 is in random Line.
4. Measure QQ1 select points S1 and R1 on random line and erect perpendicular SS1 and RR1 on it.
5. Make SS1= PS1/PQ1 x QQ1 And RR1= PR1/PQ1 x QQ1
6. Join SR and prolong



B) OBSTACLES TO CHAINING BUT NOT RANGING:-

There may be two cases of this obstacle.

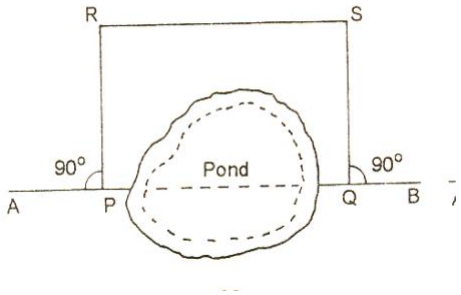
1. When it is possible to chain round the obstacle. i.e. A POND.
2. When it is not possible to chain round the obstacle. i.e. A RIVER.

CASE (1):

Following are the methods.

Method (a):

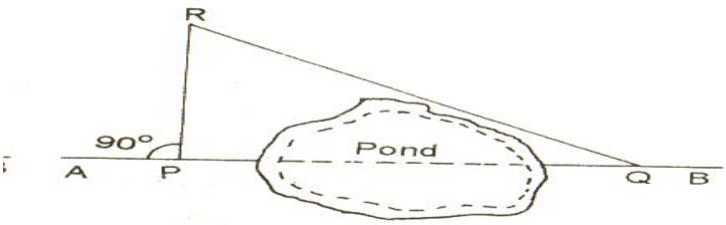
1. Select two points A AND B on either side.
2. Set out equal perpendicular AC and BD as shown in fig (a)
3. Measure CD=AB.



Method (b):

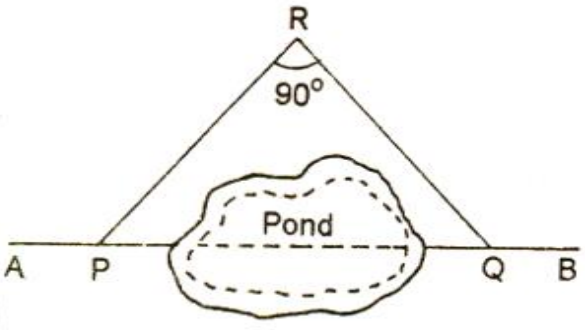
1. Set out AC perpendicular to chain line as shown in fig (b)
2. Measure AC and BC
3. The length AB is calculated from the relation

$AB=\sqrt{BC^2-AC^2}$



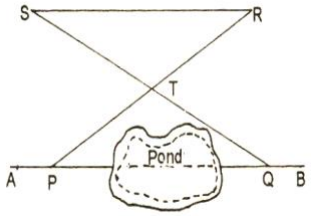
Method (c):

1. By cross staff find a point C .which subtends 90° with A and B as Shown in fig (C). AC and BC.
2. The length AB is calculated from relation $AB= \sqrt{AC^2+BC^2}$.



Method (d):

1. select any point E and range C in line with AE, making AE =EC
2. Range D in line with BE and make BE=ED as shown in fig (d).
3. Measure CD then AB=CD.

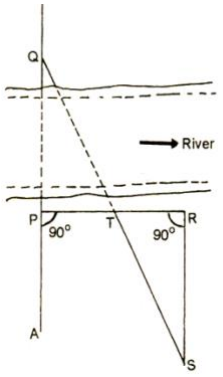


CASE (2):-

Following are the methods.

Method (a):

1. Select point B on one side and A and C on the other side.
2. Erect AD and CE as perpendicular to AB and range B,D and E in One line as shown in fig (e).
3. Measure AC, AD and CE.
4. If a line DF is drawn parallel to AB cutting CE in F perpendicularly The triangle ABD and FDE will be similar.



Method (b):

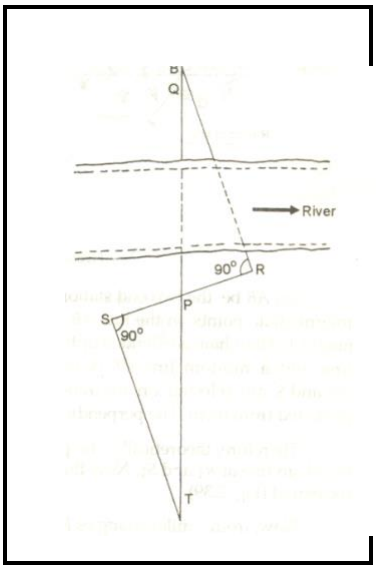
1. Locate a point R in such a way that it makes 90^0 with PQ.
2. Range S in line with PR and make PS = PR.
3. At S erect a perpendicular ST to cut the line AB at T.
4. Then PQ =PT

C) OBSTACLES TO BOTH CHAINING AND RANGING:-

A Building is the typical example of this type of obstacles. The problems lies in prolonging the line beyond the obstacle and determine the distance across it.

Method (a):-

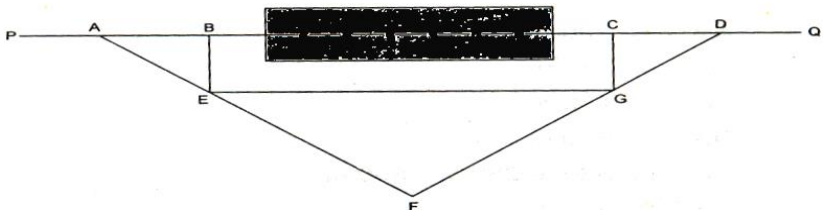
1. Choose two points A and B to one side erect perpendicular AC and BD of equal length.
2. Join CD and prolong It pass the obstacles.
3. Choose two points E and F on CD and erect perpendicular EG and FH equal to AC or BD as shown in fig (g).
4. Join GH and prolong it. Measure DE.
5. BG=DE.



Method (b):-

1. select a point A and erect a perpendicular AC of any convenient Length.
2. Select another point B on chain line such that AB=AC.
3. Join B and C and prolong it. To any convenient point D.
4. At D set a right angle DE such that DE=DB.

5. Choose another point F on DE such that DF=DC with F as centre and AB as radius. Draw an arc with E as center draw another arc of same Radius to cut previous arc in G
6. Join GE which will be in range with chain line. Refer the fig (h)
7. Measure CF then AG=CF.



PRISMATIC COMPASS

DESCRIPTION OF INSTRUMENTS

COMPASS BOX: It is a circular box of diameter 85 to 110 mm having pivot at the center and covered with plain glass at top.

MAGNETIC NEEDLE: It facilitates in taking the bearings of survey lines with reference to the magnetic north.

GRADUATED RING: The bearings are marked inverted on the graduated rings from 0° to 360° in a clockwise starting 0° from south.

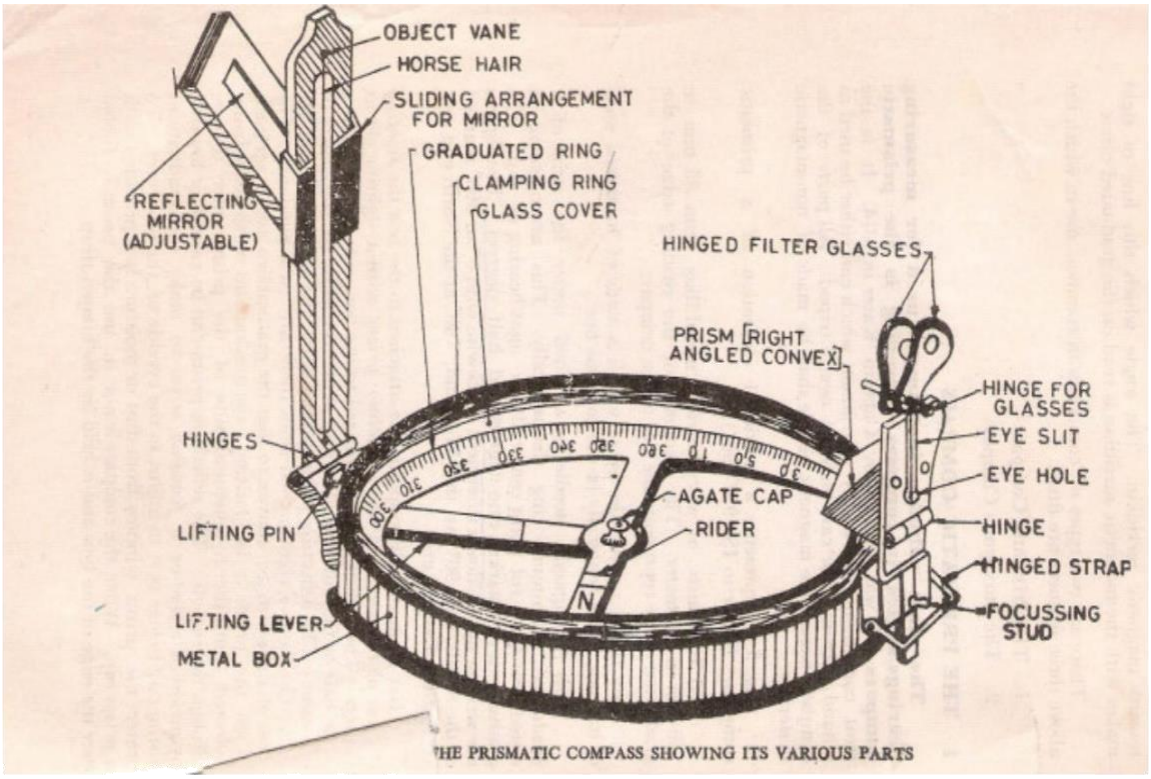
PIVOT: Magnet is freely held with this.

OBJECT VANE: It consists of prism with a sighting slit at the top The prism magnifies and erects the inverted graduations.

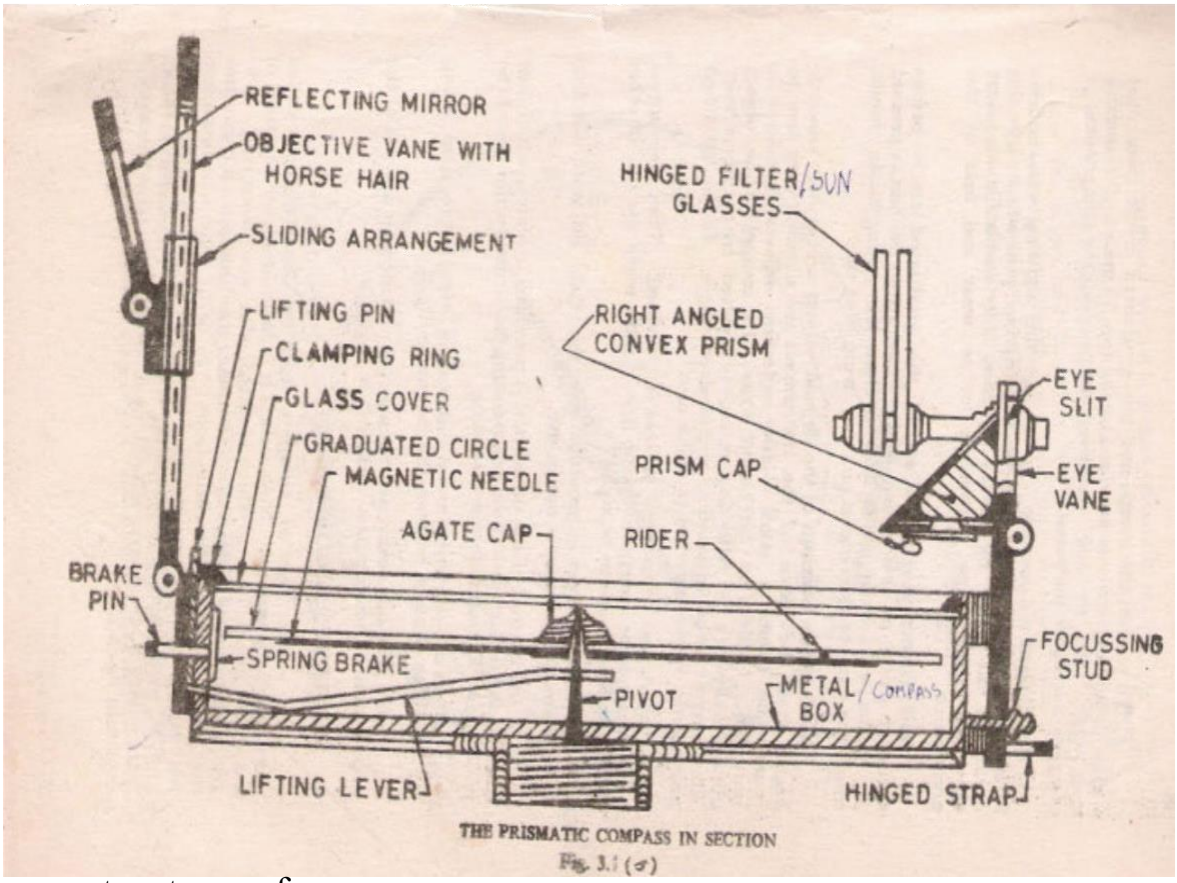
BRAKE PIN: It is pressed to stop the oscillations of the graduated ring.

LIFTING PIN: On pressing it brings the lifting lever into action.

COLOUR GLASSES: Red and blue glasses are provided with the prism to sight luminous objects.



THE PRISMATIC COMPASS SHOWING ITS VARIOUS PARTS



THE PRISMATIC COMPASS IN SECTION
Fig. 3.1 (a)

There are two types of compasses:-

1. **Prismatic compass**

2. Surveyor's compass.

PRISMATIC COMPASS:-

Prismatic compass is very valuable instrument. It is usually used for rough survey for measuring bearing and survey lines. The least count of prismatic compass is 30 min.

It consists of circular box of 10cm-12 cm dia. of non magnetic material. pivot is fixed at the centre of box and is made up of hard steel with a Sharp pivot. graduated aluminum is attached to the needle. It is graduated in clockwise direction from 0^0 to 360^0.the figures are written in inverted. Zero Is written at south end and 180 at north end and 270 at the east. Diametrically opposite are fixed to the box. The sighting vane consists of a hinged metal frame in the centre of which is stretched a vertical Horse hair fine silk thread of which is stretched a vertical hair. it presses against a lifting pin which lift the needle of the pivot and holds it against the glass lid. Thus preventing the wear of the pivot point to damp the oscillations of the needle when about to take reading and to bring to rest quickly, a light spring is brought lifted Inside the box.the face of the prism can be folded out the edge of the box when North end is used Sometime the sighting vanes is provided with a hinge mirror Which can be placed upward or downwards on the frame and can be also Slided along it is required. The mirror can be made inclined at any angle so that Objects which are too high or too low can be sighted directly by reflecting.

BEARING OF LINES:

A bearing of a line is a horizontal angle made by the survey line with some reference direction or meridian. Meridian may be

1. A true meridian
2. A magnetic meridian
3. An arbitrary or assumed meridian

True meridian: The true geographical meridian passing through a point is a line of intersection of earth's surface by a plane containing north south pole and given point. They are not parallel to each other at different places.

14

Magnetic meridian:- The direction indicate by a free suspended and a properly balanced magnetic needle Free from all other attractive forces. The direction of magnetic meridian can be established with the help of Magnetic compass.

Arbitrary meridian: Any direction is assumed to be the Reference meridian to Carry out

small survey.

WHOLE CIRCLE BEARING:

In whole circle bearing system, the bearing of a line is always measured clockwise from the north point of the reference meridian towards the line right round the circle. The angle thus measured between the reference meridian and the line is called Whole circle bearing of the line. Angles measured will have value between 0 to 360 degrees.

Conversion of W.C.B. in R.B

Case	WCB between	R.B.	QUADRANT
1	0^0 TO90^0	WCB	N-E
2	90^0 TO -180^0	180-WCB	S-E
3	180^0 TO -270^0	WCB-180^0	S-W
4	270^0 TO 360^0	360-WCB	N-W

REDUCED BEARING (R.B):

In this system of bearing of a line is measured clockwise or anticlockwise from north or south direction whichever is nearer to the line towards east or west. The concept of reduced bearing facilitates computations in traverse surveying.

Conversion of R.B in W.C.B.

Case	R.B in quadrant	Rule of W.C.B.	W.C.B between	
1	N-E	WCB=R.B	0^0 TO90^0	
2	S-E	WCB =180-R.B	90^0 TO -180^0	
3	S-W	WCB =R.B+180	180^0	TO -270^0
4	N-W	WCB =360-R.B	270^0	TO 360^0

Adjustment of the Prismatic Compass

The compass may be held in hand but for better results it should be fitted at the top of tripod having ball and socket arrangement. The adjustment of a compass is done in the following three steps.

8. **Centering: -**

The compass fitted over the tripod Is lifted bodily and placed approximately on the station peg by spreading the leg of a tripod equally, The centre of the compass is checked by dropping a small piece of stone

from the centre of the bottom of the compass so that it falls on the top of the station peg. A plumb bob may be used to judge the centering either between attaching it with a hook providing at the bottom or otherwise by holding it by hand.

9. **Levelling:-**

After the compass is centered, it is leveled by means of ball and soket arrangement so that the graduated circle may swing freely. It can be checked roughly by placing a round pencil on the top of the compass, when the pencil does not move, that is roughly the horizontal position.

10. **Focusing the prism: -**

The prism attached is moved up and down so that grauation on the graduated circle should become sharp and clear.

LOCAL ATTRACTION:-

Sometimes .the magnetic needle does not point towards magnetic North or South. The reason being that the needle may be under the influence of external attractive forces which are produced due to magnetic substances Thus the deflection of the needle from its original position, due to the presence of some magnetic substances is known as local attraction. To detect local attraction at a particular place, fore and back bearing of each line are taken. Then difference comes out to be 180° there is no local attraction at either station. On the other hand of the difference is other than 180°, the bearing may be rechecked to find out the discrepancy may not be due to the presence of iron substance near to the compass. If the difference still remains the local attraction exists at on or both the stations.

Elimination of Local attraction:-

1st method: -

In this method, the bearing of the other lines are corrected and calculated on the basis of the a line which has the difference between its fore bearing and back bearing equal to 180°.

The magnetic of the error is formed due to local attraction by drawing a sketch of observed and correct bearing of the line at each station. The error will be negative when the observed bearing is less than the corrected one and the correction will be positive and vice versa.

If however, there is no such line in which the difference of fore bearing and back bearing is equal to 180°, the correction should be made from the mean value of the bearing of that line in which the difference between the fore and the back bearing is the least.

If the bearings are observed in quadrantal system, the correction should be applied in proper direction by drawing a neat sketch roughly.

2nd Method: -

This method is more general as the bearing at a station locally affected may be incorrect but include angles calculated from these bearing will be correct since the amount of the error will be the same for all the bearing observed from that station. Thus starting from the unaffected line and using these included angles the correct bearing of all other lines can be calculated.

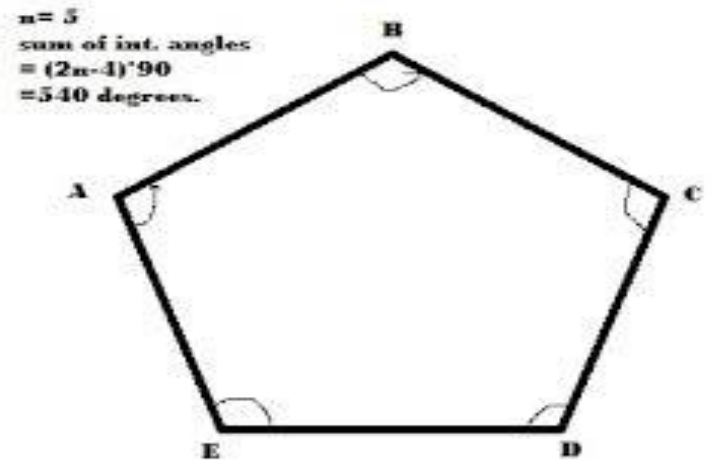
Note: - The sum of the internal included angles must be equal to (2n-4) right angles where n=number of sides of a closed traverse

EXPERIMENT – 3

TRAVERSING BY COMPASS AND ADJUSTMENTS IN INCLUDED ANGLES AND MEASUREMENT OF AREA -GRAPHICA ADJUSTMENTS

OBJECTIVE : To conduct compass survey along the closed traverse.

INSTRUMENTS: Prismatic compass, chain, ranging rods.



PROCEDURE

1. Fix the closed traverse A B C D E .
2. Set up the compass at the station ‘A’.
3. Perform the temporary adjustments.
4. Sight the object at ‘B’ and note down the FB of line AB and measure the distance.
5. Sight the object at E and note down the BB of EA.
6. Sight the instrument to station ‘B’ performs all the temporary adjustments.
7. Sight the object at ‘A’ and take the ‘BB’ of ‘AB’.
8. Take ‘FB’ of ‘BC’ and measure the length of ‘BC’.
9. Check whether the difference of ‘FB’ and ‘BB’ is 180º or not, at all stations.
10. Continue the same process all at other stations.

TABULAR FORM FOR CLOSED TRAVERSE

Sl.No.	Line	Length	F.B.	B.B	Remarks
1	AB				
2	BC				
3	CD				

4	**DE**				
5	**EA**				

FORMULA:

Included angle = B.B of previous line – F.B of next line.

CHECK:

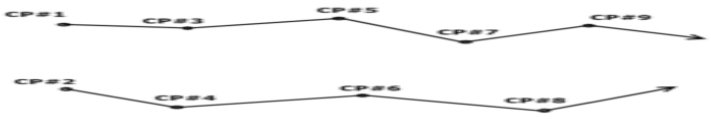
The sum of the included angles should be equals to (2n-4) x 90º Where ‘n’ is number of sides of the tra

EXPERIMENT – 4

DETERMINATION OF DISTANCE BETWEEN TWO INACCESSIBLE POINTS WITH COMPASS.

OBJECTIVE : To perform station adjustments and to observe magnetic bearings using a prismatic compass.

INSTRUMENTS : Prismatic compass, tripod and ranging rods.



PROCEDURE:

The following station adjustments are to be done at each station where the compass is set up.

1. CENTERING:

a. Centering is the process of keeping the prismatic compass over the station point.

b. By moving the legs of the tripod suitably, centering will be done.

c. Centering is checked by dropping a stone so that it falls on the top of the peg.

2. LEVELLING:

a. Leveling is the process of making the compass exactly horizontal.

b. Level the compass by means of ball and socket arrangements.

c. When the compass is leveled, the aluminum ring swings freely.

3. FOCUSSING:

To adjust the height of the prism so that the observations can be read clearly.

4. OBSERVING BEARINGS:

a. Set up the prismatic compass over station ‘O’ and perform station adjustments.

b. Rotate the compass till the line of sight bisects the object at ‘A’.

c. Read the graduated ring through prism. The reading directly gives the magnetic bearing of ‘OA’ in whole circle bearing system.

d. Follow the same procedure to observe the magnetic bearings ‘OB’ ‘OC’ also.

5. TABULAR FORM:

Sl.No.	Station	Sighted to	W.C.B.

EXPERIMENT – 5

RADIATION METHOD AND INTERSECTION METHOD BY PLANE TABLE SURVEY.

AIM:- To locate the details by radiation method and intersection method.

APPARATUS: - plain table, tripod, chain, tape, alidade, sprit level, plumbing fork Ranging rods, pegs, trough compass.

(A) RADIATION METHOD:-

* In this method objects can be located from a single station.

*In this method rays are drawn from the single station to objects.

*The distance from the station to object are measured and plotted to any suitable scale along the respective rays.

*This method is suitable for small areas of survey.

PROCEDURE:-

The following is the procedure of radiation method for plane table survey.

1) Select 'P' as a station on the ground.

2) From the station 'P' the objects A, B, C and D are visible.

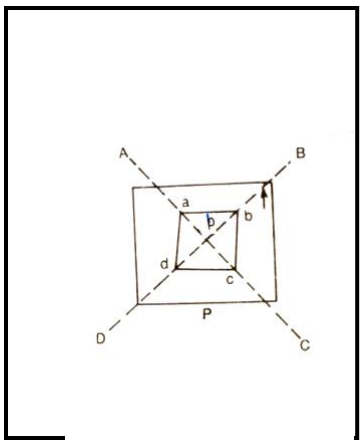
3) Set up table over station 'P' and level and center.

4) Clamp the table.

5) A point 'p' is selected on the sheet to represent the Station 'P'.

6) With the Trough compass the North line is marked on the right hand top Corner of the sheet.

7) With the alidade touching 'p',the ranging rods A,B,C,and D are bisected and the ray's drawn.



8) The distances PA, PB, PC and PD are measured by means of a tape or chain.

9) The distances are plotted to suitable scale to obtain the points a, b, c and d. Representing the objects A, B, C, and D on the sheet.

10) Suitable scale is chosen based on the length of longest line

11) The method is suitable to locate small defaults

12) The method is suitable to calculate the area of a land.

EXPERIMENT – 6

INTERSECTION METHOD AND INTERSECTION METHOD BY PLANE TABLE SURVEY.

AIM:- To locate the details by radiation method and intersection method.

APPARATUS: - plain table, tripod, chain, tape, alidade, sprit level, plumbing fork Ranging rods, pegs, trough compass.

(B) INTERSECTION METHOD:-

Suitability:-

* In this method Object can be located by Intersections of the Rays drawn from two Instrument stations.

* This method is suitable for locating inaccessible object points.

* The line joining two stations is the base line.

* This method is suitable when it is difficult or impossible to measure distances as in mountainous area.

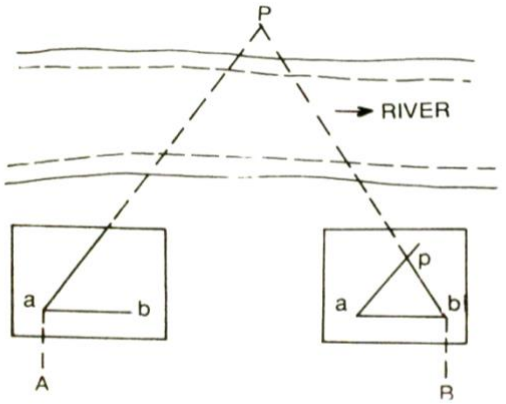
* This method is also used for checking distant objects.

PROCEDURE:-

1) A and B are two stations and P is inaccessible object on the far bank of a River.
2) Now it is required to locate position of P on the sheet by intersection of rays, drawn from A and B.
3) Select two stations A and B, so that the P point to be plotted is visible from both A and B stations.
4) The table is setup at A and levelled.
5) The table is levelled with the help of spirit level and centered by U fork so that a point 'a' on the sheet is just over the station A.
6) The North line is marked on the right side top corner by trough Compass, then table is clamped
7) With the Alidade touching 'a' the ranging rod at B and the object at P are bisected and rays are drawn through the fiducial edge of Alidade
8) The distance AB is measured and plotted to any suitable scale to obtain the point 'b'
9) The table is shifted centered over B and leveled properly
10) The Alidade touching 'b' is placed along the line 'ba'
11) Orientation is done by back sighting. At this time it should be remembered that the centering, leveling and Orientation must be done again if necessary.
12) The Alidade touching 'b' the object 'P' is bisected and ray is drawn .Let this

ray intersects the previous ray at a point ‘p’ on drawing sheet.

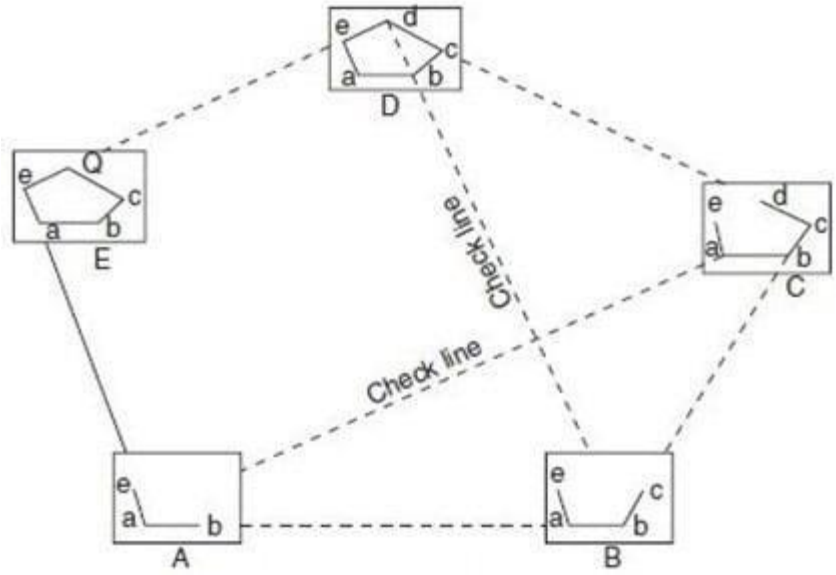
13) This point ‘p’ is the required inaccessible plotted position of ‘P’.



RESULT; - The result of above methods are presented in drawing sheet.

EXPERIMENT - 7
TRAVERSING BY PLANE TABLE SURVEY

AIM OF THE EXPERIMENT:
Traversing method for running survey lines of a closed or open traverse
APPARATUS REQUIRED: Plane table alidade, plumbing fork, plumb bob, Ranging rod, drawing sheet etc.
THEORY
Traversing is the connection of series of straight lines. In case of **traversing**, **plane table** is located at one point for suppose A as shown below. From that point sight towards B and measure the distance AB. Then shift the **plane table** to point B and sight towards A and measure BA



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.
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.

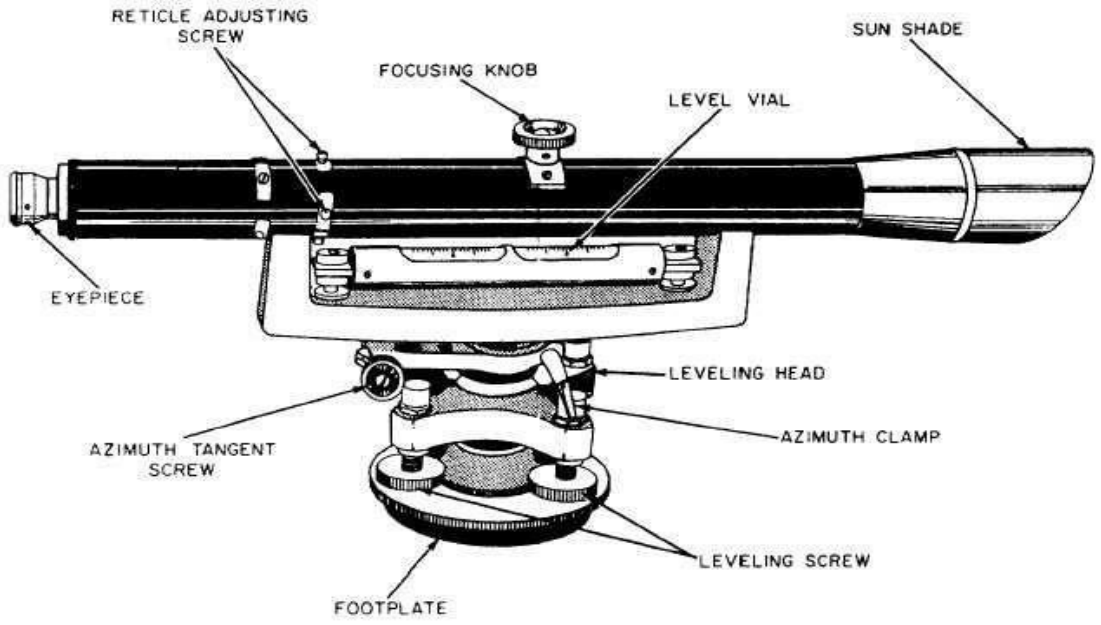
RESULT:
Traversing method for running survey lines of a closed or open traverse is done

EXPERIMENT - 8

MEASUREMENT OF ELEVATION OF VARIOUS GIVEN POINTS

AIM: Determination of elevation of various points with dumpy level by collimation plane method and rise & fall method.

APPARATUS: Dumpy level, leveling staff



Dumpy Level

THEORY:

Levelling: The art of determining and representing the relative height or elevation of different object/points on the surface of earth is called leveling. It deals with measurement in vertical plane.

By leveling operation, the relative position of two points is known whether the points are near or far off. Similarly, the point at different elevation with respect to a given datum can be established by leveling.

LEVELLING INSTRUMENTS:- The instrument which are directly used for leveling operation are Level, Levelling staff

Level: - An instrument which is used for observing staff reading on leveling staff kept over different points after creating a line of sight is called a level.

The difference in elevation between the point then can worked out. A level essentially consists of the following points:

1) Levelling Heads
2) Limb plate
3) Telescope

Telescope:-

Telescope consists of two tubes, one slide into the other and fitted with lens and diaphragm having cross hairs. it creates a line of sight by which the reading on the staff is taken.

The essential parts of a telescope are

1) body 2) object glass 3)Eye-piece 4) Diaphragm 5) Ray shade 6) The rack and pinion arrangement 7) Focusing screw 8) Diaphragm screw.

4) Bubble tube
5) Tripod stand

Dumpy level:

The dumpy level is simple, compact and stable instrument. The telescope is rigidly fixed to its supports. Hence it cannot be rotated about its Longitudinal axis or cannot be removed from its support. The name dumpy is because of its compact and stable construction. The axis of telescope is perpendicular to the vertical axis of the level. The level tube is permanently placed so that its axis lies in the same vertical plane of the telescope but it is adjustable by means of captain head not at one end.

The ray shade is provided to protect the object glass. A clamp and slow motion screw are provided in modern level to control the movement of spindle,about the vertical axis. The telescope has magnifying power of about thirty diameters. The level tube is graduated to 2mm divisions and it has normally a sensitiveness of 20seconds of are per graduation. The telescope may be internally focusing or external Focusing type.

Adjustment of the level:-

The level needs two type of adjustment

1) Temporary adjustment and
2) Permanent adjustment

Temporary adjustments of dumpy level:-

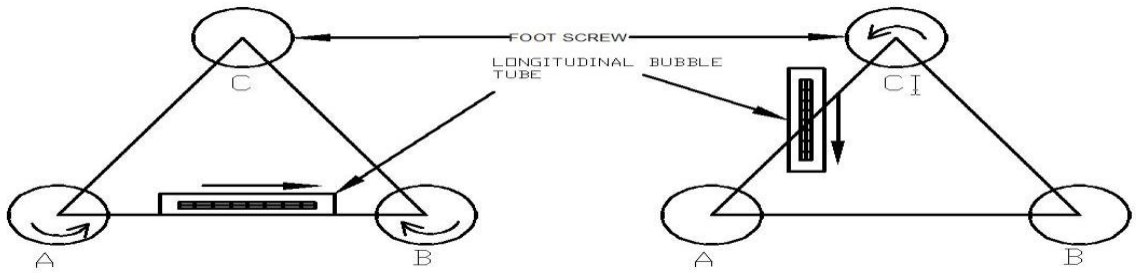
These adjustments are performed at each set-up the level before taking any observation.

A) Setting up the level:- this includes

1) Fixing the instrument in the tripod:- the tripod legs are well spread on the ground with tripod head nearly level and at convenient height. Fix up the level on the tripod.
2) Leg adjustment:- Bring all the foot screws of the level in the centre of their run .Fix any two legs firmly into the ground by pressing them with hand and move the third leg to leg to right or left until the main bubble is roughly in the centre. Finally the legs is fixed after

centering approximately both bubbles. This operation will save the time required for leveling.

B) Levelling: - Levelling is done with the help of foot screws and bubbles. The purpose of levelling is to make the vertical axis truly vertical. The method of leveling the instrument depends upon whether there are three foot screws or four foot screws. In all modern instruments three foot screws are provided and this method only is described.



PROCEDURE:

1) Place the telescope parallel to pair of foot screws.
2) Hold these two foot screw between the thumb and first finger of each hand and turn them uniformly so that the thumbs move either toward each other until the bubble is in centre.
3) Turn the telescope through 90°so that it lies over the third foot screw.
4) Turn this foot screw only until the bubble is centred.
5) Bring the tescope back to its original position without reversing the eye piece and object glass ends.
6) Again bring the bubble to the centre of its run and repeat these operation until the bubble remains in the centre of its run in both position which are at right angle to each other.
7) Now rotate the instrument through 180°,the bubble should remain in centre provided the instrument is in adjustment: if not ,it needs permanent adjustment.Focusing the eye piece:- To focus the eye piece, hold a white paper in front of the object glass ,and move the eye piece in or out till the cross hairs are distinctly seen. Care should be taken that the eye piece is not wholly taken out ,some times graduation are provided at the eye piece and that one can always remember the particular graduation position to suit his eyes,This will save much time of focssing the eye piece.

Focusing the object glass: - Direct the telescope to the leveling staff and on looking through the telescope, turn the focusing screw until the image appears clears and sharp. The image is thus formed inside the plane of cross hairs, Parallax,if any is removed by exact focusing. It may be noted that parallax is completely eliminated when there is no change in staff reading after moving the eye up and down.

Reduced Levels

The system of working out the reduced level of the points from staff reading taken in the field is called as reduced level (R.L) of a points is the elevation of the point with reference to the same datum.

There are two systems of reduced levels

1) The plane of collimation system (H.I. method)
2) The Rise and fall system

1) The plane of collimation system (H.I. method)

In this system, the R.L. of plane of collimation (H.I) is found out for every set-up of the level and then the reduced levels of the points are worked out with the respective plane of collimation as described below.

PROCEDURE :

1) Determine the R.L. of plane of collimation for the first set up of the level by adding B.S. to the R.L. of B.M. i.e(R.L of plane of collimation= R.L. of B.M.+B.S.)
2) Obtained the R.L. of the intermediate points and first change point by subtracting the staff readings (I.S. and F.S. from the R.L. of plane of collimation (H.I). (R.L. of a point=R.L of plane of collimation H.I.-I.S or F.S)
3) When the instrument is shifted and set up at new position a new plane of collimation is determined by addition of B.S. to the R.L of change point. Thus the levels from two set-ups of the instruments can be correlated by means of B.S. and F.S. taken on C.P.
4) Find out the R.L.s of the successive points and the second C.P. by subtracting their staff readings from this plane of collimation R.L.
5) Repeat the procedure until all the R.Ls are worked out.

Observation table:-

Station	Reading			R.L. of plane collimation (H.I)	Reduced Level	Remarks
	B.S	I.S	F.S			

Arithmetical check:

The difference between the sum of the back sights and the sum of the fore sights should be equal to the difference between the last and first reduced levels.

i.e ∑B.S - ∑ F.S.= LAST R.L –FIRST R.L

2) The Rise and fall system

In this system, there is no need to determine R.L. of plane of collimation .The difference of level between consecutive points are obtained as described below.

Determine the difference in staff readings between the consecutive point comparing each point after the first with that immediately preceding it.

Obtained the rise or fall from the difference of their staff reading accordingly to the staff reading at the point is smaller or greater than that of proceeding point.

Find out the reduced level of each point by adding the rise to or subtracting fall from the R.L. of a proceeding point.

Observation table:-

Station	**Reading**			**Rise**	**Fall**	**Reduced Level**	**Remarks**
	B.S	**I.S**	**F.S**				

Arithmetic check:- The difference between the sum of back sight and the sum of fore sight= difference between the sum of rise and the sum of fall = the difference between the last R.L. and the first R.L.

∑B.S-∑F.S =∑RISE -∑FALL =LAST RL- FIRST RL

Inverted staff reading

When the B.M of staff station is above the line of collimation (or line of sight) the staff is held inverted on the point and reading is taken .This reading being negative is entered

in the level field book with minus sign, or to avoid confusion, 'Staff inverted' should be written in the remarks column against the entry of the reading.

Obtained the rise or fall from the difference of their staff reading accordingly to the staff reading at the point is smaller or greater than that of proceeding point.

Find out the reduced level of each point by adding the rise to or subtracting fall from the R.L. of a proceeding point.

Observation table:-

Station	Reading			Rise	Fall	Reduced Level	Remarks
	B.S	I.S	F.S				

Arithmetic check:- The difference between the sum of back sight and the sum of fore sight= difference between the sum of rise and the sum of fall = the difference between the last R.L. and the first R.L.

$$\sum B.S-\sum F.S = \sum RISE - \sum FALL = LAST\ RL - FIRST\ RL$$

Inverted staff reading

When the B.M of staff station is above the line of collimation (or line of sight) the staff is held inverted on the point and reading is taken .This reading being negative is entered in the level field book with minus sign, or to avoid confusion, 'Staff inverted' should be written in the remarks column against the entry of the reading.

Obtained the rise or fall from the difference of their staff reading accordingly to the staff reading at the point is smaller or greater than that of proceeding point.

Find out the reduced level of each point by adding the rise to or subtracting fall from the R.L. of a proceeding point.

Observation table:-

Station	Reading			Rise	Fall	Reduced Level	Remarks
	B.S	I.S	F.S				

Arithmetic check:- The difference between the sum of back sight and the sum of fore sight= difference between the sum of rise and the sum of fall = the difference between the last R.L. and the first R.L.

$$\sum B.S-\sum F.S = \sum RISE - \sum FALL = LAST\ RL - FIRST\ RL$$

Inverted staff reading

When the B.M of staff station is above the line of collimation (or line of sight) the staff is held inverted on the point and reading is taken .This reading being negative is entered in the level field book with minus sign, or to avoid confusion, 'Staff inverted' should be written in the remarks column against the entry of the reading.

Obtained the rise or fall from the difference of their staff reading accordingly to the staff reading at the point is smaller or greater than that of proceeding point.

Find out the reduced level of each point by adding the rise to or subtracting fall from the R.L. of a proceeding point.

Observation table:-

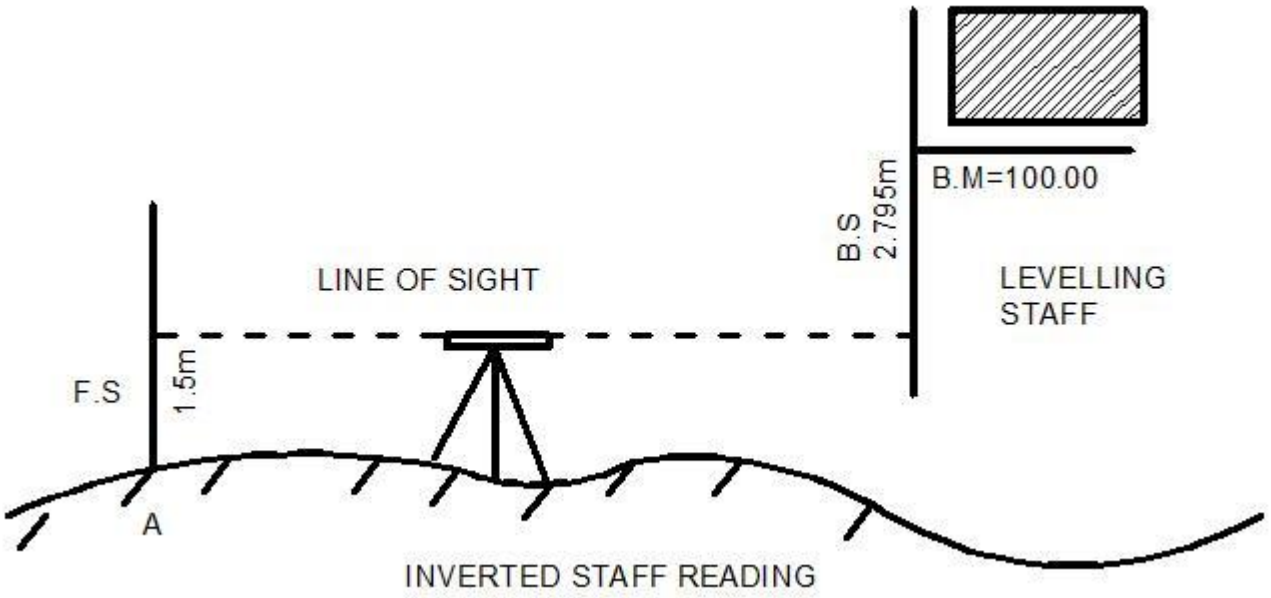
Station	Reading			Rise	Fall	Reduced Level	Remarks
	B.S	I.S	F.S				

Arithmetic check:- The difference between the sum of back sight and the sum of fore sight= difference between the sum of rise and the sum of fall = the difference between the last R.L. and the first R.L.

$$\sum B.S-\sum F.S = \sum RISE - \sum FALL = LAST\ RL - FIRST\ RL$$

Inverted staff reading

When the B.M of staff station is above the line of collimation (or line of sight) the staff is held inverted on the point and reading is taken .This reading being negative is entered in the level field book with minus sign, or to avoid confusion, 'Staff inverted' should be written in the remarks column against the entry of the reading.



The results are tabulated as below:

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

When the reading on the inverted staff is a foresight or intermediate sight .it should also be recorded in field book with minus sign

FORMULA:

R.L.of the point (where the inverted staff is held) =R.L. of H.I +F.S. or I.S.reading

RESULT:

The various reduced levels are calculated by rise and fall method and by using height of plane of collimation method and are shown in observation table.

EXPERIMENT- 10 &11

LONGITUDINAL SECTION LEVELING
CROSS SECTION LEVELING

AIM: L-Section and cross section of the road (one full size drawing sheet each for L- section and cross section)

APPARATUS: Dumpy level, leveling staff, ranging rod, tape etc.

THEORY:

Profile leveling: The process of determining elevations at points at short measured intervals along a fixed line is called Longitudinal or profile leveling.

Cross sectioning: It is a method of leveling to know the nature of Ground on either side of the centerline of the proposed route. Levels are taken at right angles to the proposed Direction of the road end at suitable distances and leveling is carried out along this cross Section.

During location and construction of highways, Rail tracks sewers and canals strakes or other marks are placed at various aligned points and the undulation of the ground surface along a predetermined line is adjoined. The line of section may be a single straight lines changing directions.

Levels are taken at right angles to the proposed Direction of the road end at suitable distances and leveling is carried out along this cross section. Cross section are the sections run at right Angles to the centerline and on the either side of it for the purpose They are taken at each 10,m station on the centerline. The length of Cross section depends upon the nature of the work if cross sections are Short they are set square out by edge. If long they are set out by the Optical square, box sextant or theodolite.

They are serially numbered from the beginning of the Centerline and are taken simultaneously with the longitudinal section they may be taken at the hand level, level, abney level or theodolite

PROCEDURE:

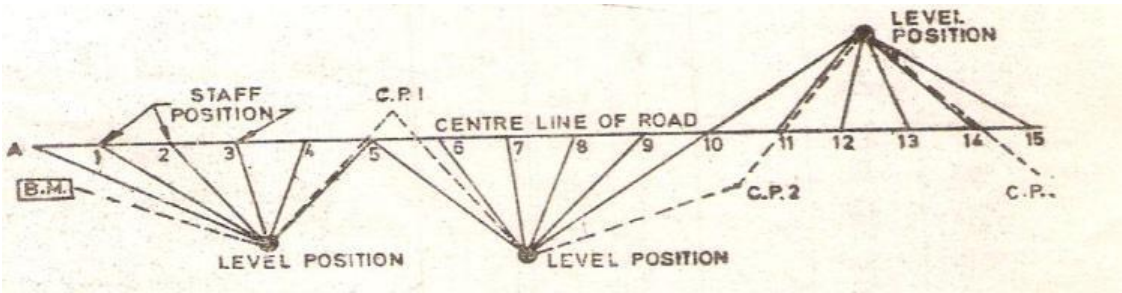
Let ABC be the line of section set out on the ground and marked with pegs driven at equal interval (say 20m to 30m) as in the figure. The level is set up generally on one side of the profile to avoid too short sight on the points near the instrument and care is taken to set up the level approximately midway between two change points. The leveling is strated from the bench mark of known value. From each set up staff reading are taken on pegs already fixed at the desired interval and also at significant points where abrout changes of slope etc. occur. All these readings are recorded as intermediate slight against the respective chainages along the line in the level book. Other data of the level book is also filled up before starting the work. When the length of sight is beyond the power of the telescope (usually it is 100m) ,the foresight on the change point is taken. The level is then is then shifted and setup in an advanced position and a back sight is taken on the change point. The change point

may or may not lie in the line of section. Chaining and reading are then continued as before,till the whole line of section is completed.

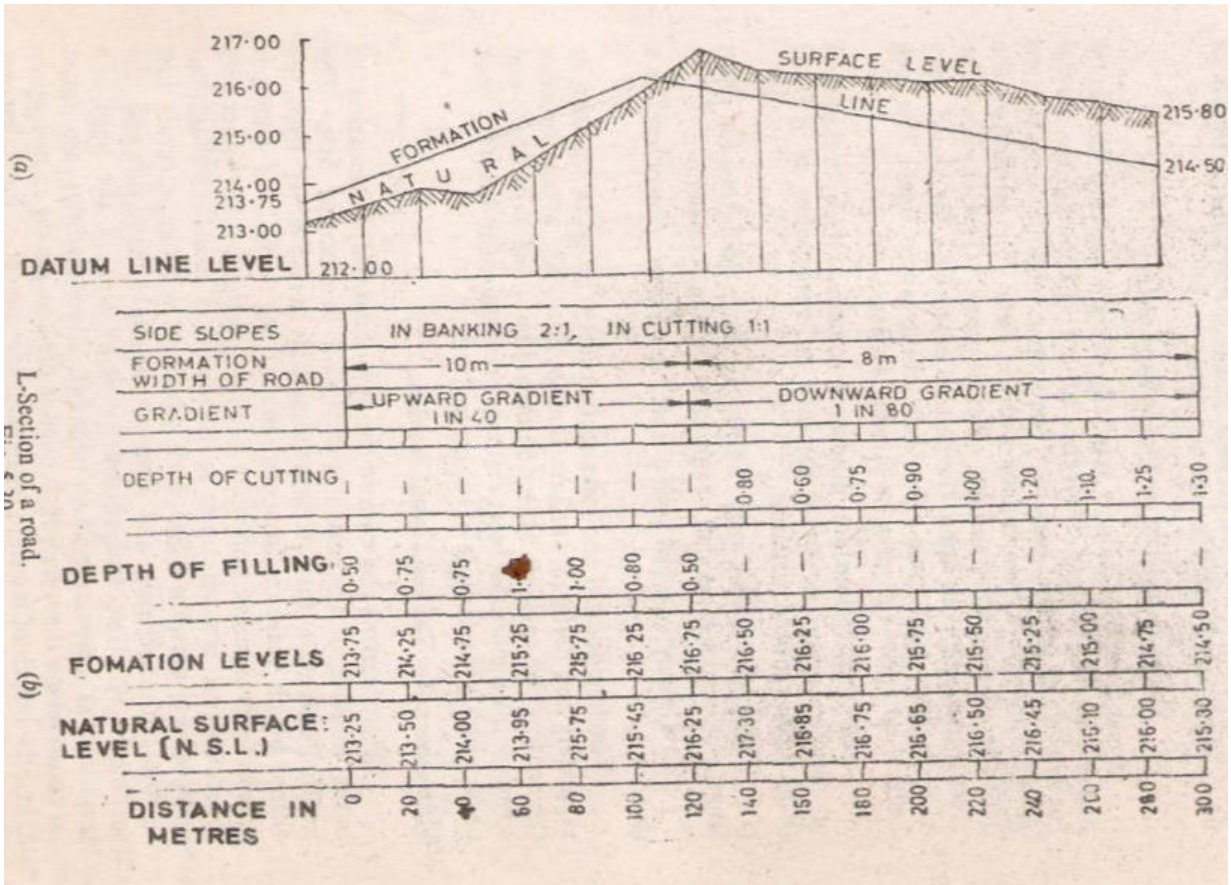
The work is to be checked in the progress of leveling by taking reading on other bench marks, on the way or on bench marks fixed by differential leveling.

The fore and back bearing of the section line should betaken and recorded. Next sketches of the bench mark, change points, and other feature such as nallah, a road, canal, etc. crossing the section line be drawn and fully described in the remarks column of the level-book.

The procedure and corresponding reading and values are represented on the page of a level-book for a part of road project.



Plotting the Longitudinal section



LEVEL BOOK

Whenever leveling operation is carried out the staff reading taken in the field are entered in the note book called a Level-Book. Each page of it has the following columns which help in booking of reading and reduction of levels.

Page of Level-Book

Page of Level-Book										
Name of work survey for:-									Page No:-	
Levelling from --------------------------------				To-- ----- ----- ----- ----- ----						
Instrument No---						Conducted by:-				
Station	Distance In meters	Bearings		Staff Reading			Height of Instrument or		Reduced Level	Remarks
		FORE	BACK	Back (B.S)	Inter (I.S)	Fore (F.S)	Rise	Fall		

EXPERIMENT- 12

PLOTTING OF CONTOURS BY INDIRECT METHOD

AIM OF THE EXPERIMENT : Counter plan of given area (On full size drawing sheet)

APPARATUS REQUIRED: Dumpy level, prismatic compass, chain 20m, 30m, metallic Tape, ranging road Leveling staff, pegs line.

THEORY:

CONTOURING: The elevation and depression the undulations of the surface of the ground are shown as map by interaction of level surface with by means of contour line. a contour may be defined as the line of intersection of a level surface with the surface of the ground.

Characteristics of Counter Lines

The following are the Characteristics of the contours/ contour lines.

1) All points on the same contour line will have the same elevation.

2) Contour lines close together represent steep ground, while uniform slope is indicated when they are uniformly spaced. A series of straight, parallel and equally spaced contours show a plane or flat surface.

3) Contour lines of different elevation cannot merge or cross one another on the map, expect in the case of an overhanging cliff. A vertical cliff is indicated when several contours coincide

4) A contour line must close upon itself either within or without the limits of the map.

5) Series of closed contour lines on the map either represent a hill or a depression according as the higher or lower values are inside them

6) A contour will not stop in the middle of the plan. It will either close or go out of the plan.

7) Ridge or water shad and valley lines are the lines joining the top most or the bottom most points of hill and valley respectively, cross the contours at right 68 angles. A ridge line is shown when the higher values are inside the loop, while in the case of a valley line, the lower values are inside the loop

8) Contour lines are not drawn across the water in the stream or river because the water level in the it is not constant; but contours are drawn along the bed of a river or a stream.

Uses of contour map

1) For preparing contour map in order to select the most economical or a suitable site.

2) For getting the importance about ground whether it is undulating or Mountainous

3) To locate the alignment of canal so that it should follow a ridge line, thus canal construction will be economical and will command maximum irrigated area.
4) To make the alignment for the road, railway so that the quantity of earthwork both in cutting and filling should be minimum.
5) To find out the capacity of the reservoir or a volume of earthwork especially in the Mountainous region.
6) For preparing contour map in order to select the most economical or suitable site.
7) As its definition itself indicates the line joining the points of same elevation that Means it naturally prefers the condition of nature of ground itself.
8) It is also used for irrigation purpose as from it capacity of reservoir is shown.

LOCATING CONTOURS:

BY CROSS-SECTION METHOD:

This method is commonly used in rough survey, cross sections are run traverse to the contour line of road, and railway as canal and the point of change of slope (representations) are located. The cross-section line may be inclined at any angle to the centerline if necessary. The spacing of the cross sections depends upon the characteristics of the ground.

By interpolation of contour is meant the process of spacing the contour69 proportioning between the plotted ground points. Contour may be interpolated by

1) Estimation
2) Arithmetical calculations
3) Graphical method .in all these methods

It is assumed that the slope of the ground between any two random points is uniform.

RESULT: The contour of given land is drawn in the sheet.

AIM OF THE EXPERIMENT : Counter plan of given area (On full size drawing sheet)

APPARATUS REQUIRED: Dumpy level, prismatic compass, chain 20m, 30m, metallic Tape, ranging road Leveling staff, pegs line.

THEORY:

CONTOURING: The elevation and depression the undulations of the surface of the ground are shown as map by interaction of level surface with by means of contour line. a contour may be defined as the line of intersection of a level surface with the surface of the ground.

Characteristics of Counter Lines

The following are the Characteristics of the contours/ contour lines.

1) All points on the same contour line will have the same elevation.
2) Contour lines close together represent steep ground, while uniform slope is indicated when they are uniformly spaced. A series of straight, parallel and equally spaced contours show a plane or flat surface.
3) Contour lines of different elevation cannot merge or cross one another on the map, expect in the case of an overhanging cliff. A vertical cliff is indicated when several contours coincide
4) A contour line must close upon itself either within or without the limits of the map.
5) Series of closed contour lines on the map either represent a hill or a depression according as the higher or lower values are inside them
6) A contour will not stop in the middle of the plan. It will either close or go out of the plan.
7) Ridge or water shad and valley lines are the lines joining the top most or the bottom most points of hill and valley respectively, cross the contours at right 68 angles. A ridge line is shown when the higher values are inside the loop, while in the case of a valley line, the lower values are inside the loop
8) Contour lines are not drawn across the water in the stream or river because the water level in the it is not constant; but contours are drawn along the bed of a river or a stream.

Uses of contour map

1) For preparing contour map in order to select the most economical or a suitable site.
2) For getting the importance about ground whether it is undulating or Mountainous
3) To locate the alignment of canal so that it should follow a ridge line, thus canal construction will be economical and will command maximum irrigated area.
4) To make the alignment for the road, railway so that the quantity of earthwork both in cutting and filling should be minimum.
5) To find out the capacity of the reservoir or a volume of earthwork especially in the Mountainous region.
6) For preparing contour map in order to select the most economical or suitable site.
7) As its definition itself indicates the line joining the points of same elevation that Means it naturally prefers the condition of nature of ground itself.
8) It is also used for irrigation purpose as from it capacity of reservoir is shown.

LOCATING CONTOURS:

BY CROSS-SECTION METHOD:

This method is commonly used in rough survey, cross sections are run traverse to the contour line of road, and railway as canal and the point of change of slope (representations) are located. The cross-section line may be inclined at any angle to the centerline if necessary. The spacing of the cross sections depends upon the characteristics of the ground.

By interpolation of contour is meant the process of spacing the contour69 proportioning between the plotted ground points. Contour may be interpolated by

1) Estimation
2) Arithmetical calculations
3) Graphical method .in all these methods

It is assumed that the slope of the ground between any two random points is uniform.

RESULT: The contour of given land is drawn in the sheet.