Techno India NJR Institute of Technology

Lab Manual

Basic Civil Engineering Lab (1FY3-27/ 2FY3-27)

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For Techno India NJR Institute of Technology
पंकज पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

I & II Semester

Common to all branches of UG Engineering & Technology

1FY3-27/ 2FY3-27: Basic Civil Engineering Lab

1. Linear Measurement by Tape:
   a) Ranging and Fixing of Survey Station along straight line and across obstacles.
   b) Laying perpendicular offset along the survey line
2. Compass Survey: Measurement of bearing of linesusing Surveyor's and Prismatic compass
3. Levelling: Using Tilting/ Dumpy/ Automatic Level
   a) To determine the reduced levels in closed circuit.
   b) To carry out profile levelling and plot longitudinal and cross sections for road by Height of Instrument and Rise & Fall Method.
4. To study and take measurements using various electronic surveying instruments like EDM, Total Station etc.
5. To determine pH, hardness and turbidity of the given sample of water.
6. To study various water supply Fittings.
7. To determine the pH and total solids of the given sample of sewage.
8. To study various Sanitary Fittings.

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Course Overview: Students will learn and understand the Basics of Civil Engineering including surveying, transportation, types of buildings, its foundation and environmental pollution control.

CO No.	Cognitive Level	Course Outcome (LAB)
1	Create	To develop a relationship between civil engineering branch to other branches.
2	Evaluate	To plan the execution of a construction work.
3	Analyze	To relate the reflexes needed for being a civil engineering in comparison to other engineering branches.
4	Apply	To solve the problems related site work.
5	Understand	To summarize how levelling works in civil engineering.

Course Outcome Mapping with Program Outcome (LAB):

Basic Civil Engineering Year of study: 2020-21														
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	2	2			2									
CO 2				2		2							1		
CO 3	2		2		2								1		
CO 4	2	2			2									1	
CO 5	2	2	2			2			2		2		1	1	
C11FY309 (AVG)	1.6	1.2	1.2	0.4	0.8	0.8			0.4		0.4		0.6	0.4	
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (high)															

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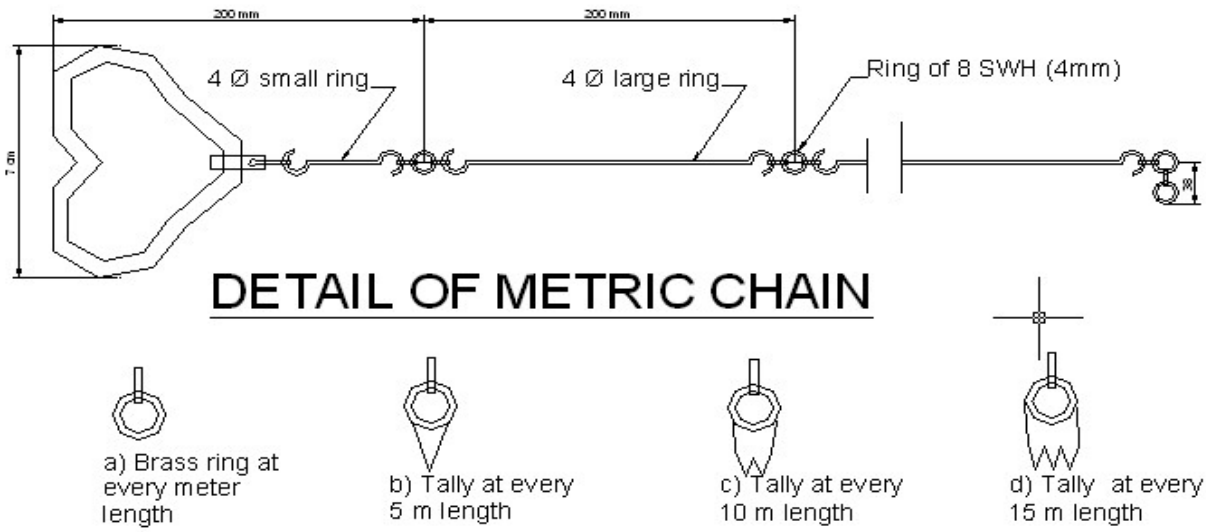
AIM : **Measurement of distance by Ranging and Chaining**

EQUIPMENT- : Chain, Arrows, Tapes, Ranging Rods, Offset Rods, Cross staff or optical square, Plumb bob, wooden mallet, pegs.

Figure:



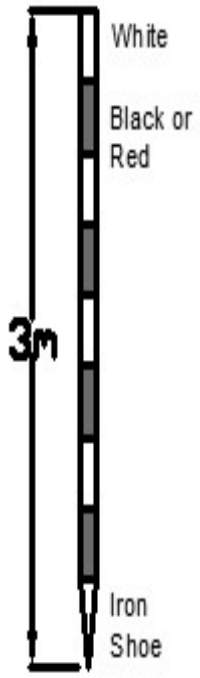
THEORY : By the various methods of determining distance the most accurate and common method is the method of measuring distance with a chain or tape is called Chaining. For work of ordinary precision a chain is used. But where great accuracy is Required a steel tape is invariably used.

The term chaining was originally applied to measure Distance with a chain. The term chaining is used to denote measuring distance with either chain or tape, In the process of chaining, The survey party consists of a leader (the surveyor at the forward end of the chain) a follower (the surveyor at the rare end of the chain and an assistant to establish intermediate points) .

The accuracy to which measurement can be made with chain and tape varies with the methods used and precautions exercised. The precision of chaining. For ordinary work, ranges from 1/1000 to 1/30,000 and precise measurement such as Baseline may be of the order of 1000000.

in diameter called links. The end of each link is bent into a loop and connected together by means of three oval rings which afford flexibility To the chain and make it less liable to become kinked. The ends of chain are provided with brass handles for dragging the chain on the ground, each with a swivel Joints so that the chain can be turned round without twisting. The length of the A link is the distance between the centres of the two consecutive middle rings.The end links include the handles metallic rings indicators of distinctive points of the Chain to facilitate quick reading of fractions of chain in surveying measurements.

RANGING RODS:



The ranging rods are used for marking the positions of Stations conspicuously and for ranging the lines. Io order to make these visible at a distance, they are painted alternately black and white, or red and white or red White and black successively.The adjustment of the chain should as far as possible be affected symmetrically on either side of the middle so as that the position of central tag remains unaltered. In measuring the length of survey line also called as chain line. It is necessary that the chain should be laid out on the ground in a straight line between the end stations.

Two men are required for chaining operation; the chain man at the forward end of chain is called the leader while the other man at the rear end is known as the follower.

Duties of leader &follower

Leader:- 1) To put the chain forward

2) To fix arrows at the end of chain

3) To follow the instruction of the followers.

Follower:- 1) To direct the leader to the line with the ranging rod.

2) To carry the rear end of the chain.

3) To pick up the arrows inserted by the leader.

Chaining 1) The follower holds the zero handle of the chain against the peg &directs the leader to be in line of the ranging rod.

2) The leader usually with to arrows drags the chain alone the line.

3) Using code of signals the follower directs the leader as required to the exactly in the line.

4) The leader then fixes the arrows at the end of chain the process is repeated.

Ranging 1) Place ranging rods or poles vertically behind each point

2) Stand about 2m behind the ranging rod at the beginning of the line.

3) Direct the person to move the rod to right or left until the three ranging rods appear exactly in the straight line.

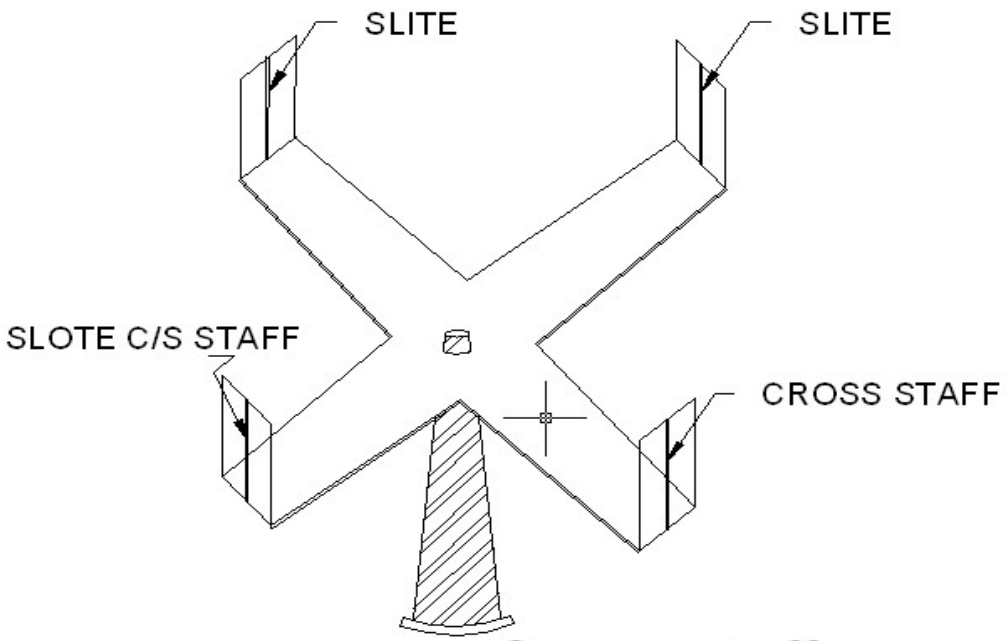
4) Sight only the lower portion of rod in order to avoid error in non-vertically.

5) After ascertaining that three rods are in a straight line, ask the person to fix up the rod.

RESULT : By Chaining and ranging the total distance is found to be_____

AIM : **Locating various object by chain & cross staff survey**

APPARATUS: Chain, Ranging rod, Arrows, Cross-staff, Metallic Survey (Tape)



Cross staff

THEORY: Cross-Staff is the simplest instrument used for setting out perpendicular i.e taking offsets from a chain line. it is easier and quicker method ,but not very accurate .if great accuracy is desired ,the work should be carried out by the theodolite.

Open cross staff:- The simplest Type consists two parts 1) the head 2) the leg .the head is made of wooden block octagonal or round in shape about 15cm side or diameter an 4cm deep . on it are scribed two lines at right angles to another .At the end of these two lines are fixed two points of metallic strip having slits made in them .These slits two lines of sight which are at right angles to one another .The head is fixed on a wooden staff or pole about 3cm in diameter and 1.2 to 1.5m length .The pole is provided conical metal shoe so that it can be driven into the ground.

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.

1) 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 and the chain line . The observer then looks through the other pair of slits and sees whether the particular object is bisected or not. if not the cross staff is moved to and from till the necessary bisection is obtained. Before noting down the chainage of the foot of the perpendicular care must be taken to see that one pair of slit is the direction of chain or not. While shifting the position of the cross-staff it may get twisted and hence precaution is necessary.

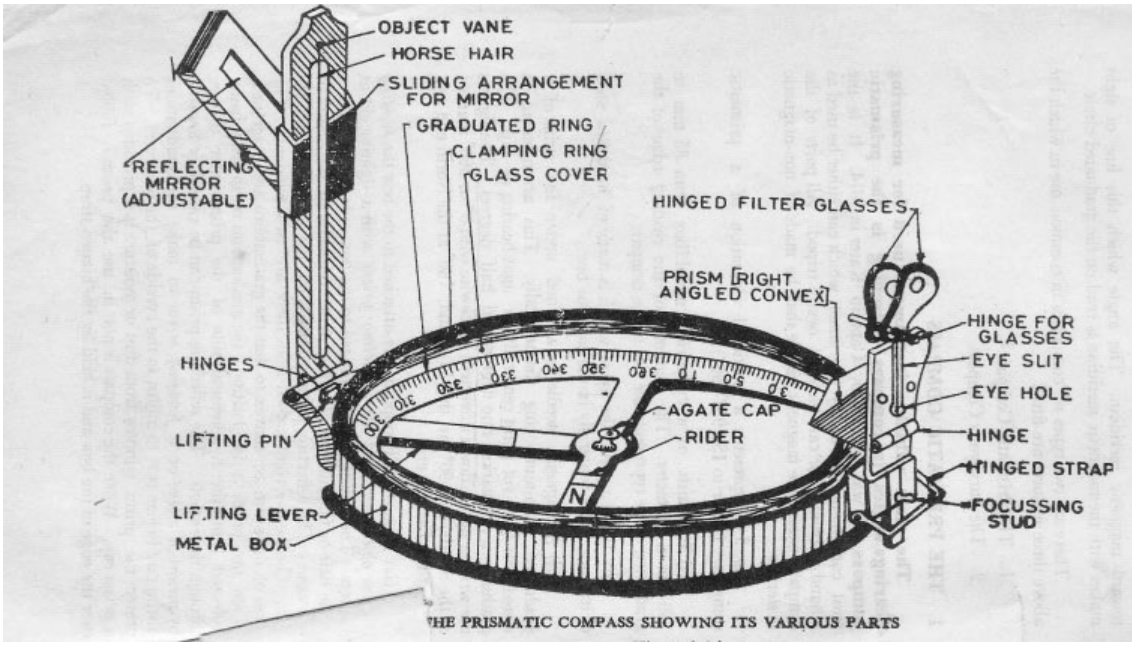
2) To set a perpendicular to the chain line at a given point one pair of slits is oriented in the direction of chain line by looking at the ranging rod fixed at the forward and by looking through the other pair of slits ranging rod is fixed in the direction of the line of sight provided by this pair.

RESULT: Various perpendicular to the chain line object are created using cross-staff survey.

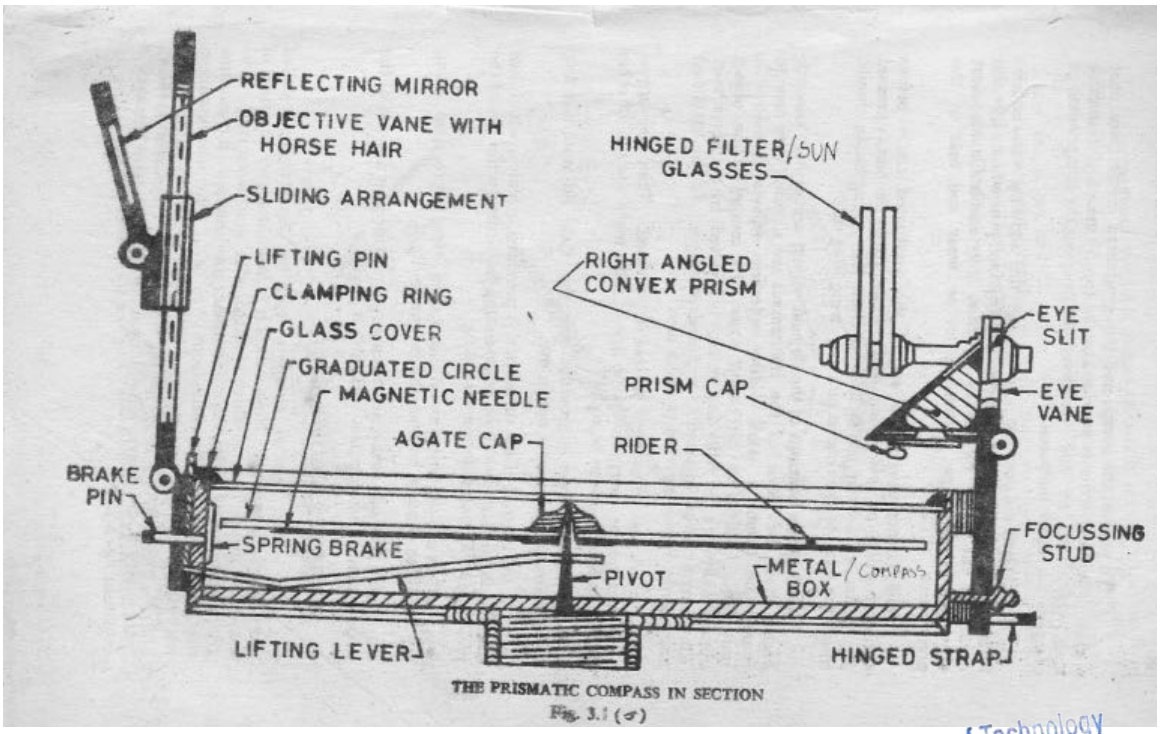
EXPERIMENT NO-4

AIM: Measurement of bearings of sides of traverse with prismatic compass and computation of correct included angle.

APPARATUS: Prismatic compass, ranging rod, chain, tape, peg Tripod stand , small pieces of stones.



THE PRISMATIC COMPASS SHOWING ITS VARIOUS PARTS



THE PRISMATIC COMPASS IN SECTION

Fig. 3.1 (a)

THEORY: The important parts of compass are:-

1) A box with graduated circle.
2) A magnetic needle
3) A line of sight

When the line of sight is pointed to point, the magnetic needle of compass points towards north (Magnetic meridian). The angle which this line of sight makes with the magnetic meridian is read on graduated circle.it is known as magnetic bearing of the line.

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

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.

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.

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

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.

1) **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 bt attaching it with a hook providing at the bottom or otherwise by holding it by hand.

2) **Levelling**:-After the compass is centred, 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.

3) **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

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.

1) Four ranging rods are fixed at different points i.e. A, B, C, D, E etc. such that it should be mutually visible and may be measured easily.

2) Measure the distance between them.

1) At point A the prismatic compass is set on the tripod Stand, centering and leveling is then properly done.

2) The ranging rod at B is ranged through sighting slits and objective vane attached with horse hair and reading on prismatic compass is noted down.

3) it is fore bearing of line AB. Then the prismatic compass is fixed at B and ranging rod at C. AND A are sighted. And reading is taken as forbearing of BC and back bearing Of AB.

4) Repeat the same procedure at the stations C, D etc.

Observation Table

Sr. no	Line	Observed bearing	Local attraction	error	Correction	Corrected bearing	Included angle
A	AB						
B	AD						
	BC						
C	BA						
	CD						
D	CB						
	DA						
	DC						

SAMPLE CALCULATION:- Error = observed bearing –corrected bearing

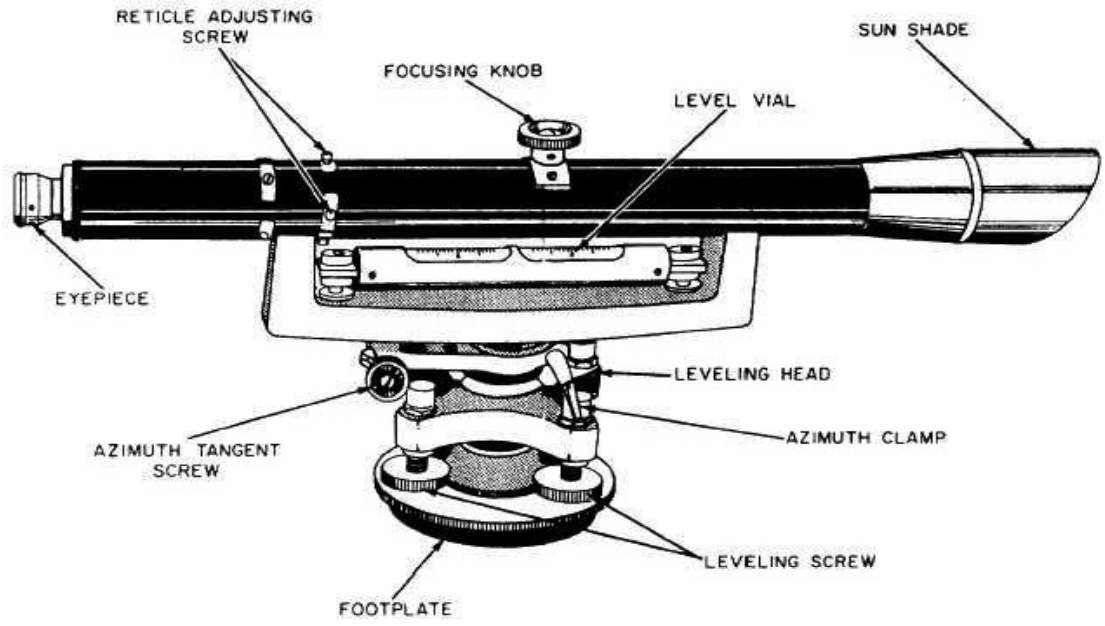
Check =(2n-4)x90^0

RESULT: The prismatic compass is studied and bearing of lines of traverse are Observed, the correction due to local attraction at affected station is done and corrected bearings are written in tabular form.

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

APPARATUS: Dumpy level, leveling staff

Figure:-



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.

consists of the following points:

1) Levelling Heads
2) Limb plate
3) 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 20

Focusing type.

Adjustment of the level

The level needs two type of adjustment

1) Temporary adjustment and
2) Permanent adjustment

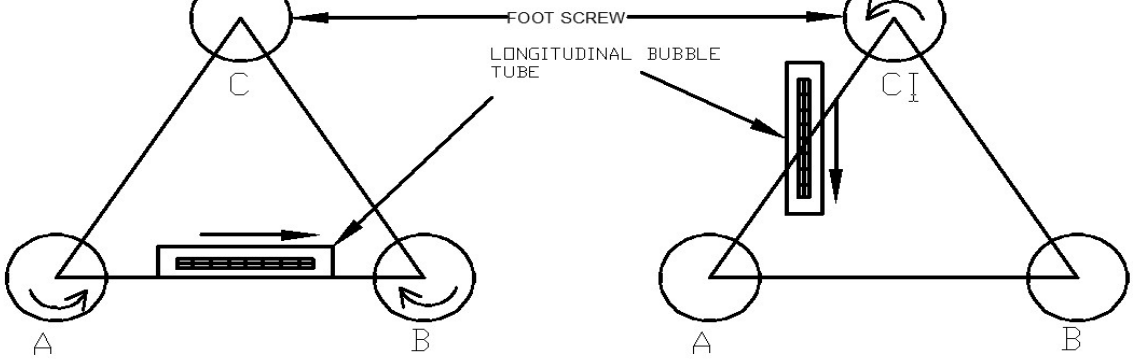
Temporary adjustments of dumpy level

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.



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.

c) 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

eye piece.

(d) 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.

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)

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 $\sum$B.S - $\sum$ 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.

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

the staff reading at the point is smaller or greater than that of proceeding point.

3) 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:-

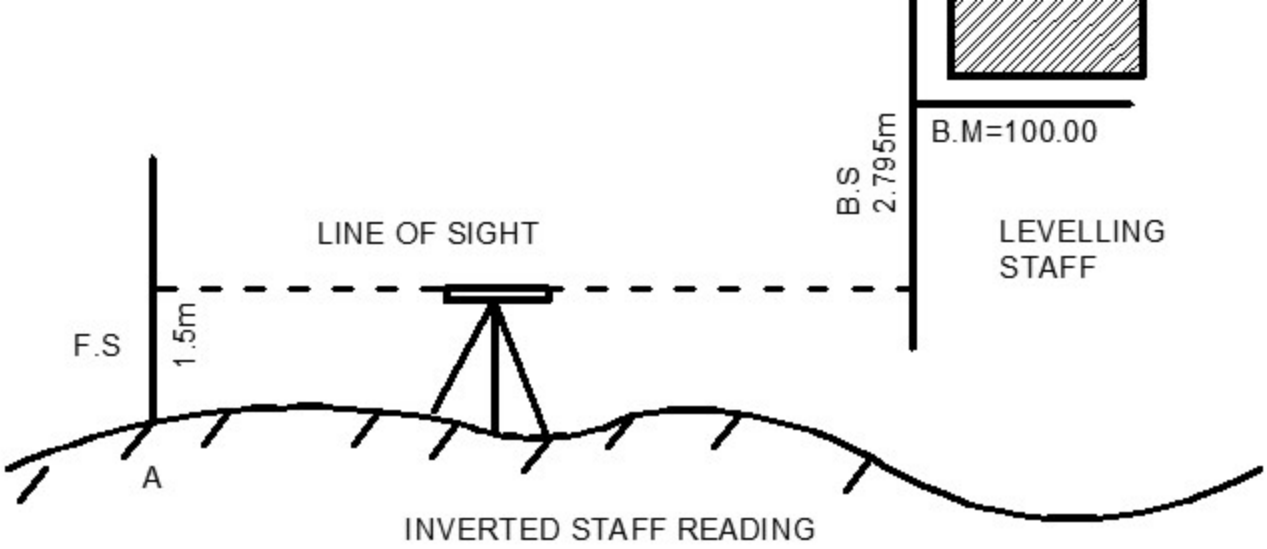
Station	Reading			Rise	Fall	Reduced Level	Remarks
	B.S	I.S	F.S				

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
-2.795		 1.500	97.215	100.000 95.715	B.M.Staff inverted Point A

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

The R.L. of such points may be worked at as:

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 or plane pf collimation method and are shown in observation table.

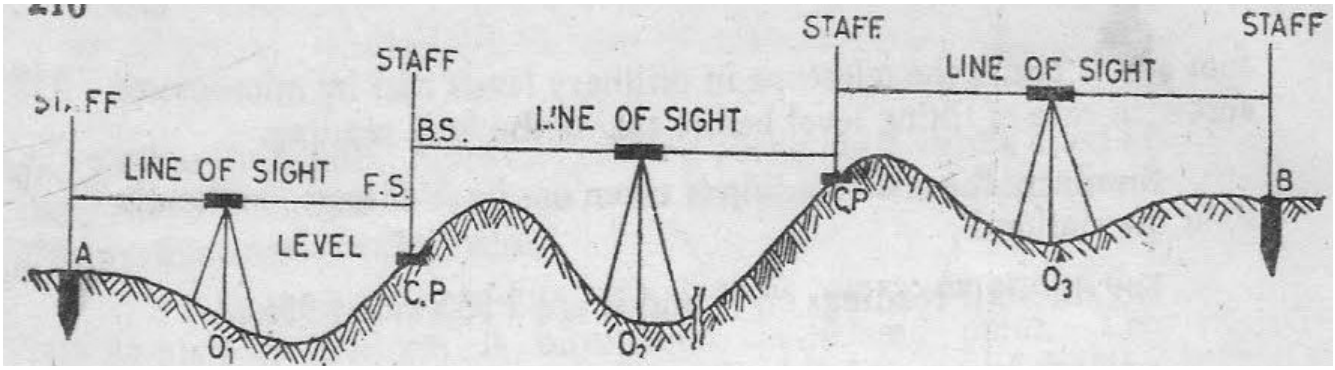
AIM : **Fixing bench mark with respect to temporary bench mark with dumpy level by fly leveling and check leveling.**

Apparatus: Dumpy level, leveling staff, tripod stand, arrows, pegs

Theory:

Fly leveling: - It is a very approximate from of levelling in which distances are not measured and sights are taken as large as possible . in this method a line of levels is run to determine approximately reduced levels of the points carried out with more rapidly and less precision.

Check leveling: The main purpose of this type of leveling is to check the values of the reduced levels of the bench marks already fixed. In this method only back sight and foresight are taken. There is no need of intermediate sights. However great care has to be taken for selecting the change points and for taking reading on the change points because the accuracy of leveling depends upon these.



1) Let A and B the two points as shown in figure They are too for apart .The position of each set up of level should be so selected that the staff kept on the two points is visible through the telescope.

2) Let O1, O2, O3 be the positions of the level to be setup. Choose the change points 1,2 etc. on a stable ground so that the position of the level should be midway between the two staff reading to avoid error due to imperfect adjustment of the level.

3) Now setup the level at O1 take the reading on the staff kept vertically on A with bubble central. This will be a back sight and R.L of the A is is to assumed or say known. Record these values in the same line in the level book.

4) Now select the position of C.P (1) so that the distance of it from O1 is approximately equal to that O1A

5) With the bubble in the centre take the reading of the staff held vertically over the change point. This will be a fore sight and book this value in the level book on the next line in the column provided.

6) Now shift the level to O2 and set up it there carefully, with the bubble in the centre take reading on the staff kept vertically as the fore sight over C.P(1). This will be a back sight, book it in the same line as the fore sight already recorded in the column provided.

7) Select another CP(2) on the stable ground as before so that station O2 is approximately midway between C.P (1) and C.P(2).

8) With the bubble central, take the reading on the staff kept vertically over the CP2.This will be fore sight and book it in the level book page in next line.

9) Repeat the process until the point B.M reached .The last reading will be a foresight

method.

11)Complete the remakes column also. Apply the arithmetical check

Observation table:-

Station	Readings		Height of instrument	Reduced Levels	Remarks
A	B.S.	F.S			
B					
C					
D					
E					

RESULT: The difference of level between the point be equal to R.L of the last point minus the R.L at the B.M is found to be ------

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.

simultaneously with the longitudinal section they may be taken at the hand level, level, abney level or theodolite

PROCEDURE:

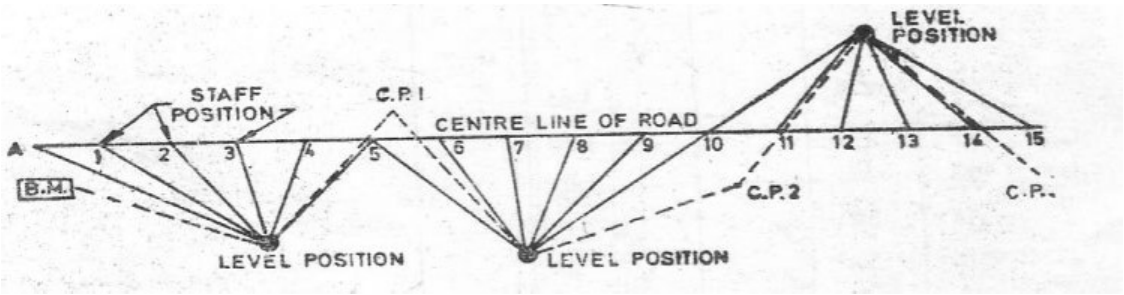
Let ABC be the line of section set out on the ground and marked with pegs driven at equal interval (say 20m to 30m) as in the figure. The level is set up generally on one side of the profile to avoid too short sight on the points near the instrument and care is taken to set up the level approximately 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.

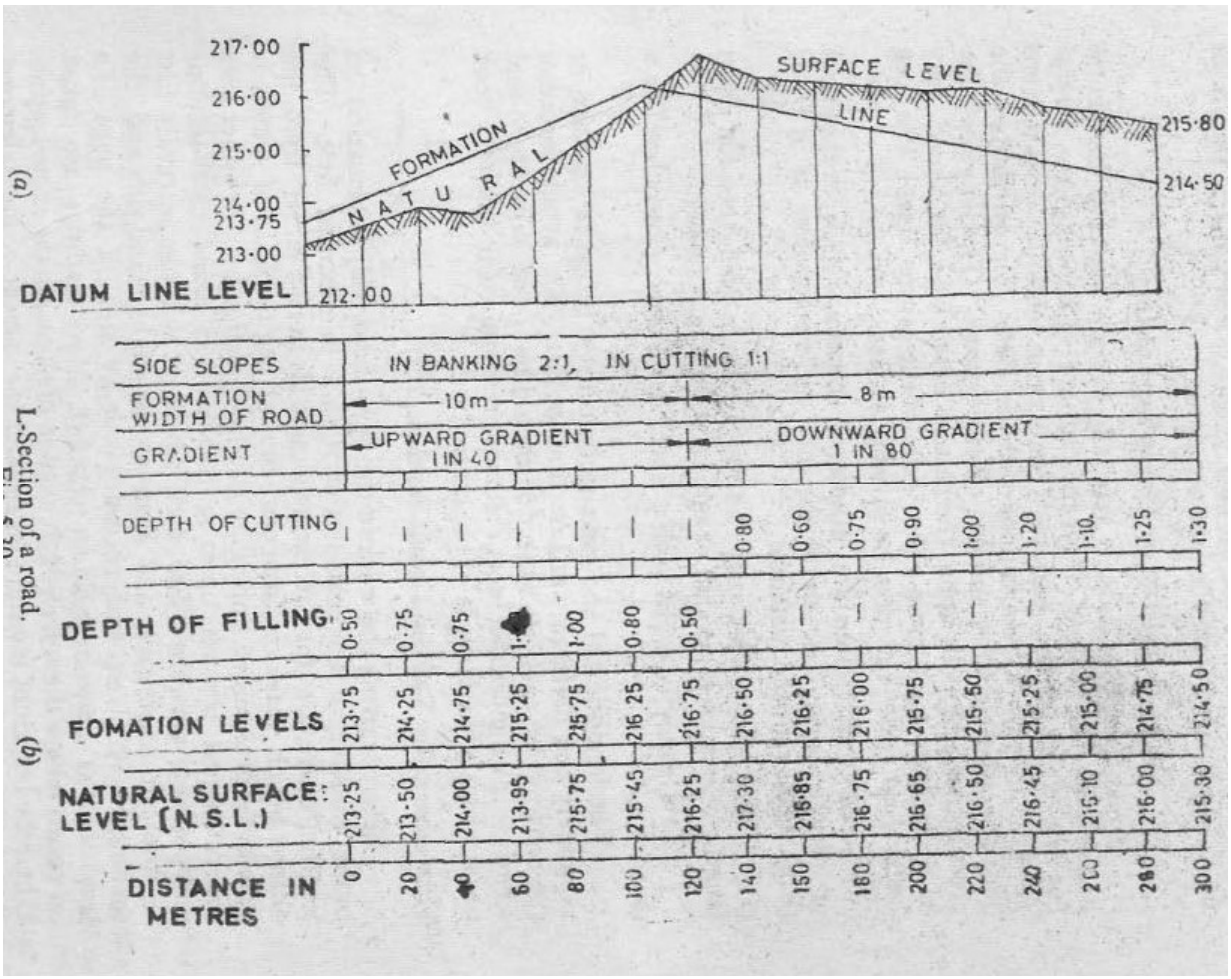
The fore and back bearing of the section line should betaken and recorded. Next sketches of the bench mark, change points, and other feature such as nallah, a road,

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



When ever 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		

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Department of Civil Engineering

Basic Civil Engineering

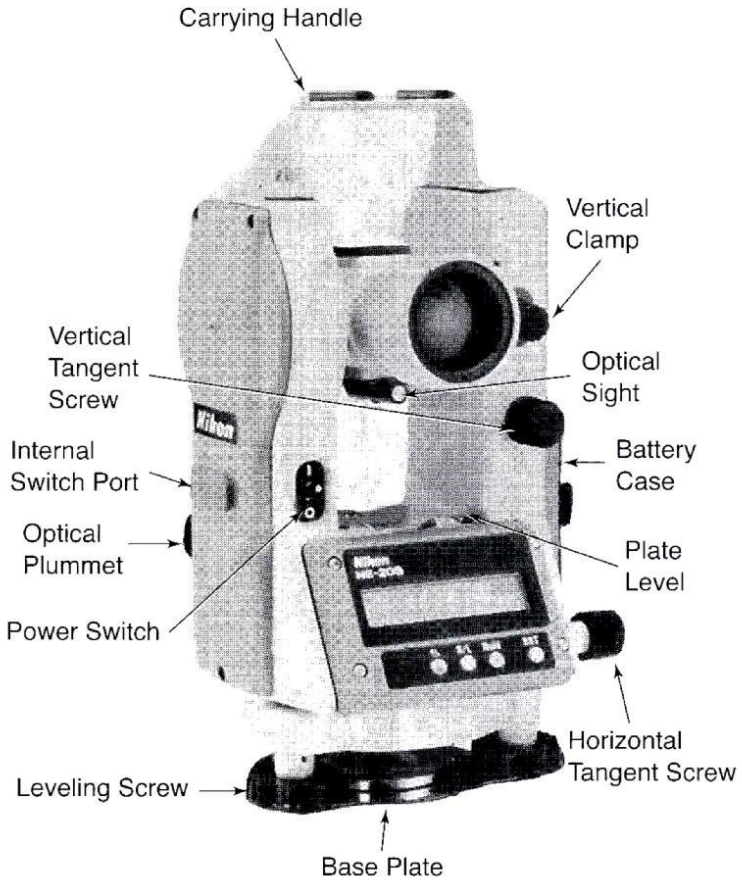
USE OF ELECTRONIC THEODOLITE & TOTAL STATION

OBJECTIVE: Practice surveying work with electronic theodolite and total station

APPARATUS: Peg, Total station, Electronic Theodolite, Prism, Prism rod.

ELECTRONIC THEODOLITE:

- Electronic read out 1" eliminate mistakes and reading the angles.
- Precision varies from 0.5" – 20"
- Zero is set by a button.
- Repeated angle averaging.
- Replacing optical theodolite (It is less expensive to purchase and maintain).



Electronic theodolite

For Techno India NJR Institute of Technology
पंकज पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

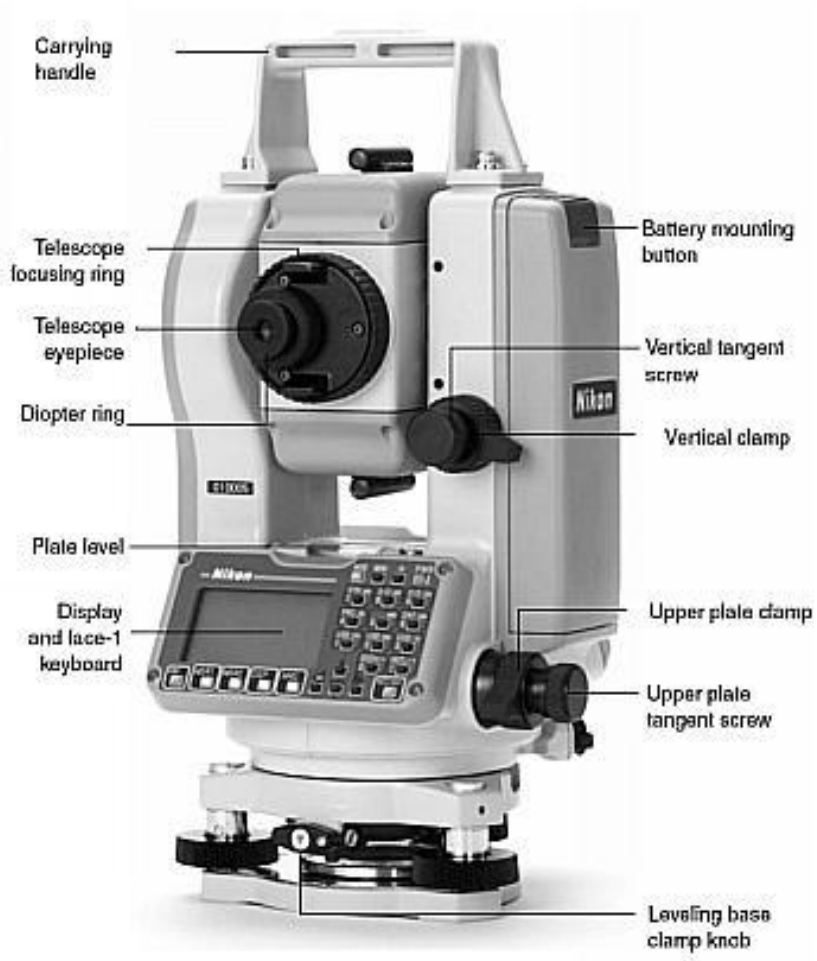
TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Department of Civil Engineering

TOTAL STATION

A total station is an electronic/optical instrument used in modern surveying.

The total station is an electronic theodolite (transit) integrated with an electronic distance meter (EDM) to read slope distances from the instrument to a particular point. It records all the data digitally and it used later to prepare survey map or plan. It is also used to set out the works.



Total Station

Survey with Electronic Theodolite & Total station

1. Set out simple circular curve with help of electronic theodolite.
2. Carry out traverse survey with help of Total station.

Marks Obtained:	Signature of Faculty:	Date:

For Techno India NJR Institute of Technology
Dr. Pankaj Kumar Porwal
(Principal)

Aim of the experiment: To determine the pH value of the given samples of Water

Apparatus required:

1. Test tube
2. Beaker
3. Electrometric apparatus

Theory:

pH is the term used universally to express the intensity the acidity and alkalinity of a solution. It is a way expressing hydrogen ion concentration or more precisely hydrogen in activity. pH is the negative logarithm of hydrogen ion concentration to base 10.

$pH = -\log_{10} [H^+]$

-Higher pH value means lower H+ ion concentration.

- Entire concentration of H^+ ions does not correspond to the measurement of pH due to ionic interaction among themselves. Measurement of pH of water relates only to the active portion of the H+ ion concentration .Water is a poor electrolyte and only a small portion of it dissociates as

$$H2O \rightarrow H^+ + OH^-$$

- According to the law of mass action of physical chemistry ionization constant k at equilibrium

Is given by

$$K=[H^+][OH^-] /H_2O$$

- At 25°c value of k is $1.82 * 10^{-16}$ and density of water is 0.997 gm/cm^3.

- Molar concentration of water in 1 liter = 997/18 = 55.39

Moles/Liter $[H+][OH-] = k[H2O] = 1.82*10^{-16} *55.39$

$=1.0*10^{-14}$

-In pure water the concentration of H^+ ion and OH^- ion are equal or $[H^+] = [OH^-]=10^{-7}$ moles/liter i.e. Concentration of H^+ or OH^- per litre of pure water is $1/10^7$ moles.

-But this figure inconvenient for use. Therefore, logarithm of its reciprocal is used for indicating the pH value accordingly, pH of neutral water

$$Log_{10} (1/[H^+])=7$$

- When the pH value is in between 0 to 7, water is acidic and when the pH value is in between 7to 14, water is alkaline

Significance:-

1. In the coagulation process, chemicals used have higher efficiencies within a certain pH value range. Hence determination and adjustment of pH is very important for effective and economic coagulation.
2. In corrosion control, the pH of water should be maintained at appropriate level as water of low pH is highly corrosive and damages the pipe lines and valves etc.
3. In disinfection of water by excessive line treatment.
4. In water softening process by lime soda.
5. In sewage and industrial waste treatment employing biological treatment:
6. The portability of water also depends on pH value

Determination pH by electrometric method:-

Principle:-

The basic principle of electrometric pH measurement is determination of the activity of the hydrogen ion by potentiometric measurement using a standard hydrogen electrode and a reference electrode. It consists of potentiometer, glass, electrode, a reference electrode and a temperature compensating device to complete pH meter.

Procedure:-

1. Before use the electrode was rinsed blot and dried using a soft tissue paper.
2. The instrument was cal liberated with standard buffer solution (7.0 pH).
3. Then the electrode was removed from standard solution to rinsed blot and dry.
4. The electrode was dipped in the sample whose pH was to be measured.
5. The sample was stirred to ensure homogeneity and to minimize CO_2 entrainment.
6. Finally pH was noted from the reading of the pH meter.

Tabulation:-

(pH of the samples are noted at 29.1^0c)

SL.NO	Name of the sample	Source	Ph
01	Sample-1	Industrial Water	6.78

02	Sample-2	Drainage Water	7.13
03	Sample-3	Muddy Water	6.75
04	Sample-4	Tap Water	7.67

Result:-

The pH of laboratory waste was found out to be 6.78 for industrial water, 7.13 for drainage water, 6.75 for muddy water and 7. 67 for tap water at temperature 29.1^0c

Discussion:

1) Is pH of water affected by rise in temperature?

Ans) Temperature plays a significant role on pH measurement. As the temperature rises molecular vibration increases, which result in the ability of water to ionize and form hydrogen ions in the ability of water to ionize and form hydrogen ion . Yes, it does change the pH as a result it drops down.

2) Define pH.

Ans) pH is a scale used to specify how acidic or basic a water-based solution .As it is the negative logarithm of the hydrogen ion concentration.

$$pH = \log_{10} [H^+]$$

3) What do you mean by pOH?

Ans) The 'p' means potential and 'OH' means hydroxide OH^- in the hydrogen ion. pOH is the inverse log of the concentration hydroxide in a solution.

$$P[OH] = -\log_{10} [OH^-] .$$

Aim of the experiment: To determine the hardness of the given water samples.

Apparatus Required:

1. Burette,
2. Bottle with stopper and
3. pipette

Chemicals required-

1. Soap Solution (Wanklyn solution)

Theory

Hardness are generally considered to be those water which are required considerable amount of soap to produce a foam as lather. Hardness is caused due to the multivalent metallic cations in the solution. The multivalent metallic ions are most abundant in natural waters are calcium and magnesium. Other may include in the form of fe^{2+}, Sr^{2+}, Mn^{2+} and Al^{3+}. The latter are found in much smaller quantities than calcium and magnesium and for all practicle purposes, hardness may be represented as the sum of the calcium and magnesium ions.

Hardness are classified as carbonate and non-carbonate hardness, depending upon the anions with which it associates. The hardness which is equivalent to alkalinity as termed as carbonate hardness, with any remaining hardness being called as non-carbonate hardness. The temporary hardness or the water containing carbonates and bicarbonates can be simply removed by just adding lime to it or by boiling it. Such hardness is called temporary hardness or carbonate hardness. The Sulphates, chlorides and nitrates of calcium and magnesium by simple boiling and it requires special treatment for softening such hardness is known as permanent hardness or non-carbonate hardness.

Hardness is measured in mg/l of caco3 and depending upon that value, water is classified as follows:-

Classification of water hardness

Soft	0-75
Moderately hard	75-150
Hard	150-300
Very hard	>300

Significance-

1. Soap consumption by hard water represents an economic loss to the water uses.
2. The precipitate by hardness and soap adheres to the surface of the tubs, skins and dishwashs may stain dishes clothing and other items.
3. Residue of hardness of soap may remain in the pores of the clothes so the skin may feel rough and uncomfortable.
4. Boiler scale, the result of carbonate hardness precipitate may cause considerable economic loss through hardness of water heaters and hot water pipes.
5. Food cooked in hard water become tasteless.

SOAP SOLUTION METHOD:

1. 50ml of sample water was taken in a bottle.
2. Wanklyn solution was taken in the burette. It was added to the water sample by 0.5ml at a time.
3. The combination was shaken vigorously and kept for 5 minutes horizontally on the table. When sufficient lather was formed so that the water level is not visible from the top was the end point. The difference between the soap solution consumed and lather factor gives the value of the hardness.

Calculation:

Lather factor=x
Initial burette reading=a
final burette reading=b
so,amount of soap consumed=b-a=c
subtracting lather factor=c-x=d
1ml of soap solution = 1mg of calcium carbonate
d ml of soap solution = d ml of calcium carbonate
50 ml of water contains d mg of calcium carbonate
1000ml of water contains = d*1000/50=e mg of calcium carbonate