KOMAR UNIVERISTY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT

Engineering Surveying Manual

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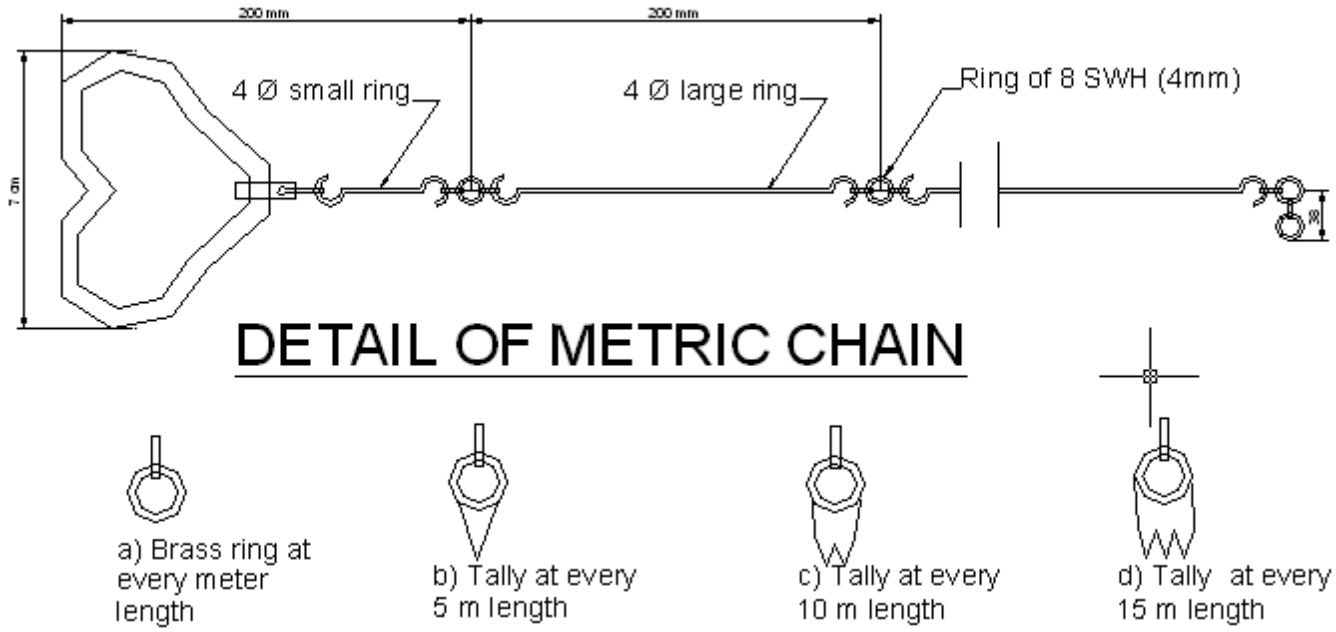
Contents

Experiment No.1: Measurement of distance by ranging and chaining.

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.

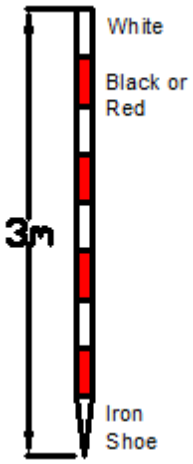


THEORY :

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.

The chain is composed of 100 or150 pieces of galvanized mild steel were 4mm 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 centers 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.

PROCEDURE:

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.

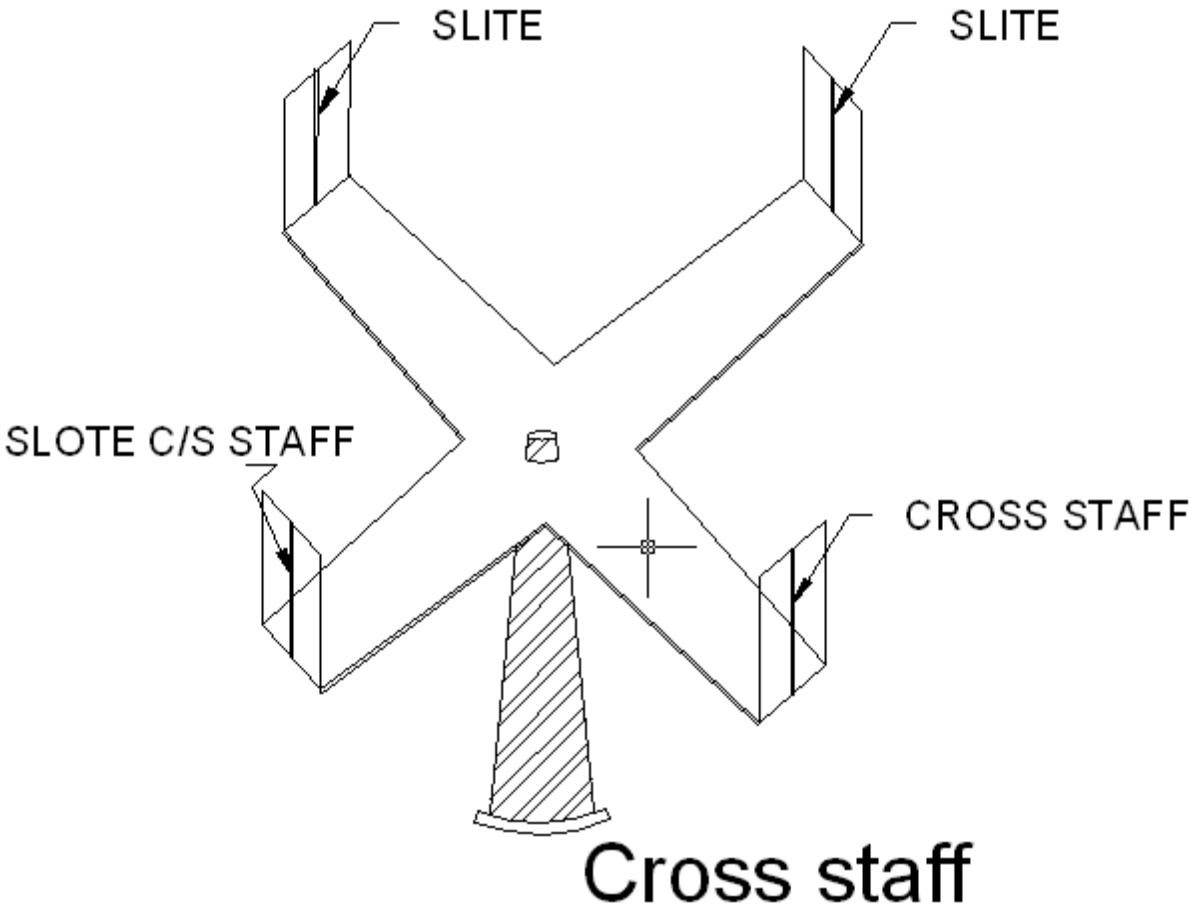
5) After ascertaining that three rods are in a straight line, ask the person to fix up the rod.

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

Experiment No 2. Locating various object by chain & cross staff survey

AIM : Locating various object by chain & cross staff survey

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

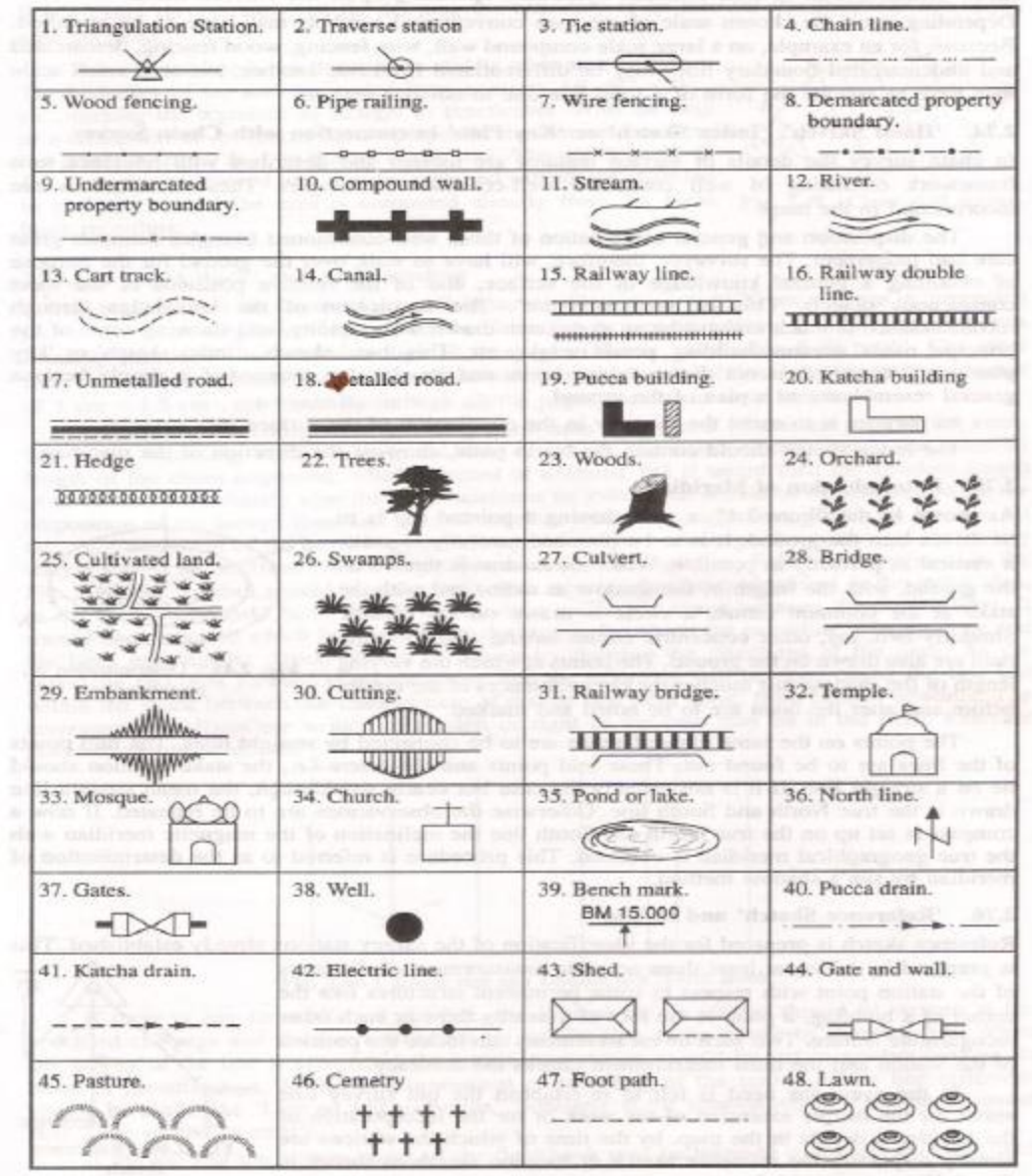


Cross staff

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.

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



Procedure –

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 change 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.

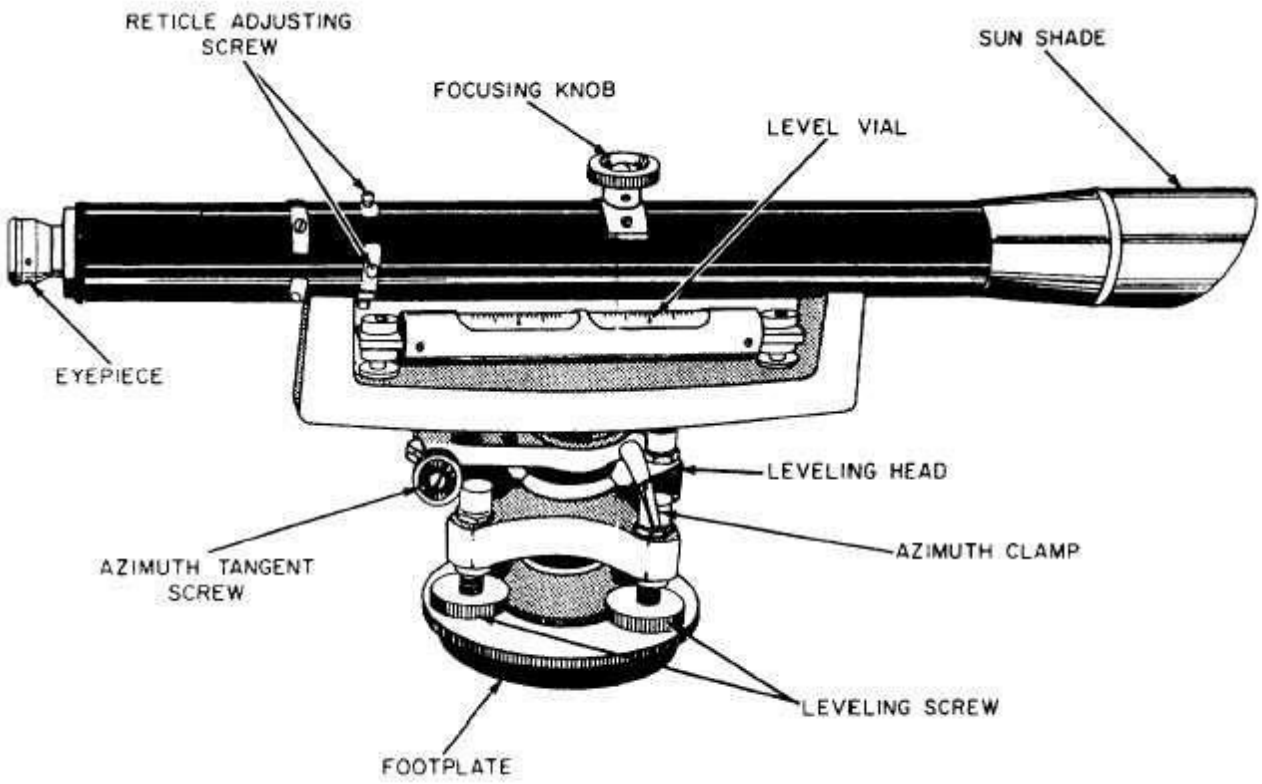
2) To set a perpendicular to the chain line at a given point one pair of slits is oriented in the direction of chain line by looking at the ranging rod fixed at the forward and by looking through the other pair of slits ranging rod is fixed in the direction of the line of sight provided by this pair.

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

Experiment No 3. Determination of elevation of various points with dumpy level by collimation plane

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

APPARATUS: Dumpy level, leveling staff



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 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 seconds 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

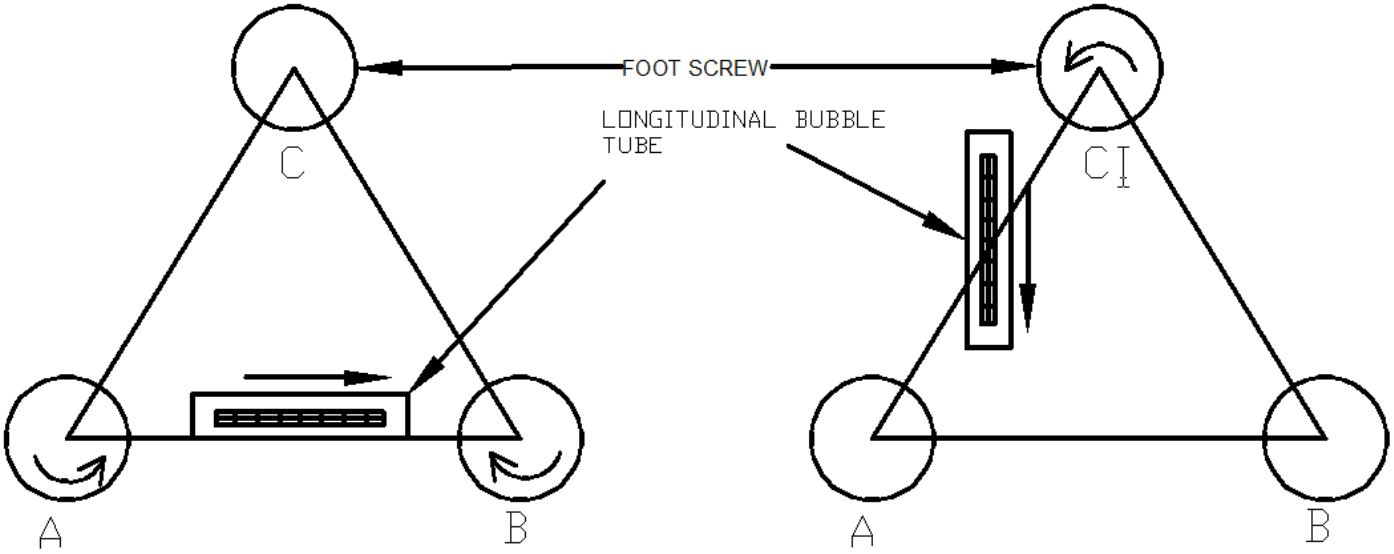
1) Fixing the instrument in the tripod:- the tripod legs are well spread on the ground with tripod head nearly level and at convenient height. Fix up the level on the tripod.

2) Leg adjustment:- Bring all the foot screws of the level in the center 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 particular graduation position to suit his eyes,This will save much time of focssing 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).

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 KB.S - K 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.

2) 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.

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				

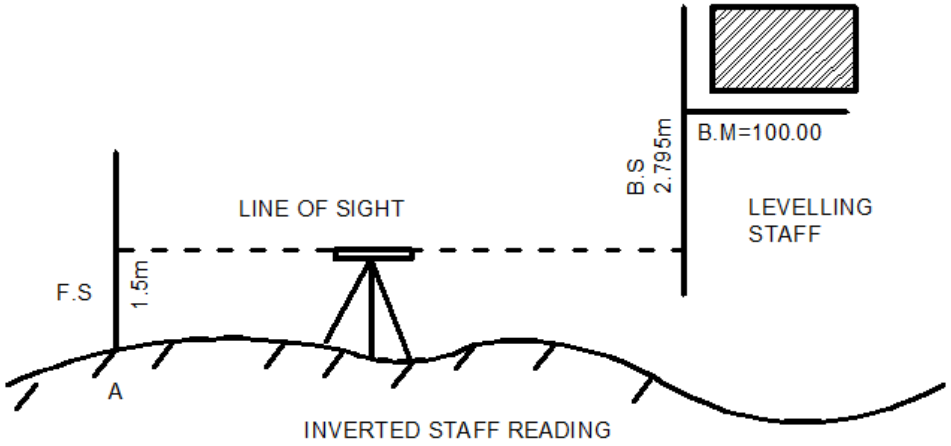
Arithmetic check:-

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.

KB.S-KF.S =KRISE -KFALL =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			97.215	100.000	B.M.Staff inverted
		1.500		95.715	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.

Experiment No 4.Fixing bench mark with respect to temporary bench mark with dumpy level by fly leveling and check leveling.

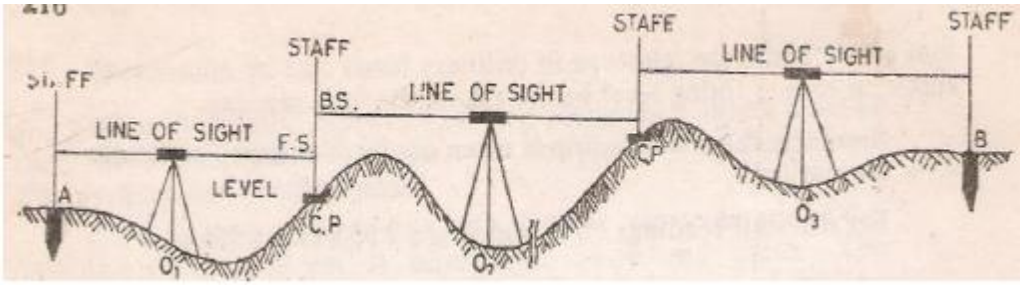
AIM : Fixing bench mark with respect to temporary bench mark with dumpy level by fly leveling and check leveling.

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.



PROCEDURE:

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.

10) Now find out the reduced levels by height of instrument method or by rise and fall 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 ------

Experiment NO 5. AIM: L-Section and cross section of the road (one full size drawing sheet each for L- section and cross section)

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.

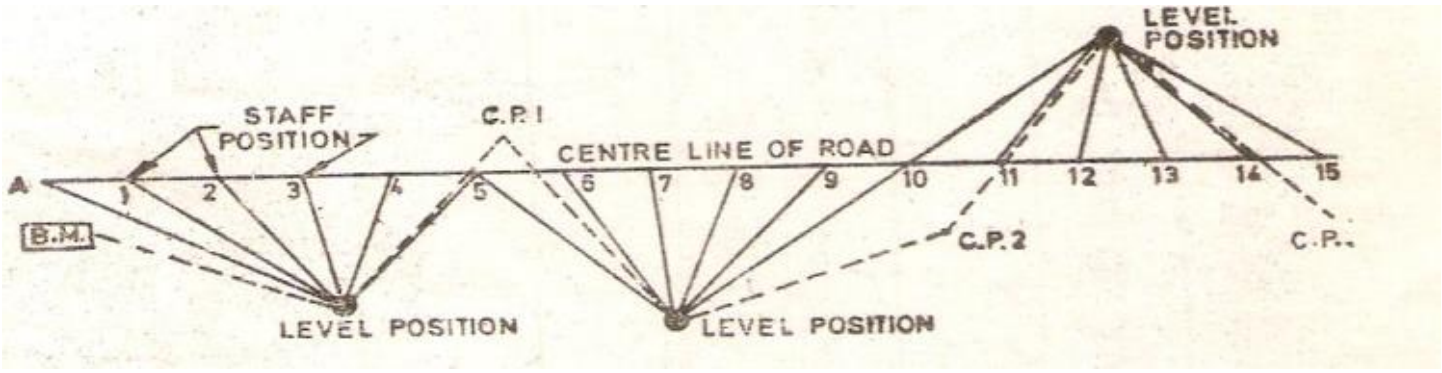
THEORY:

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

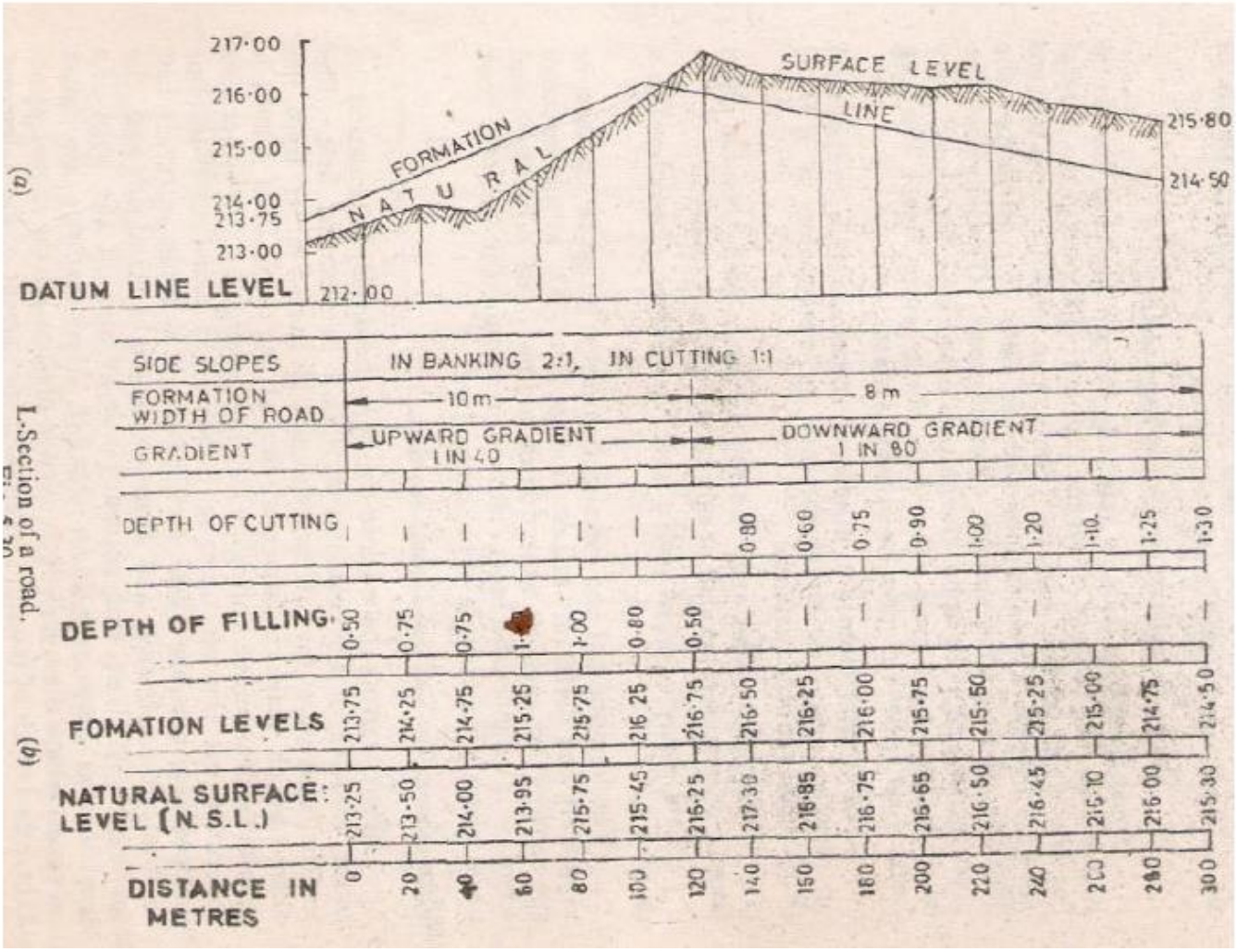
PROCEDURE:

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

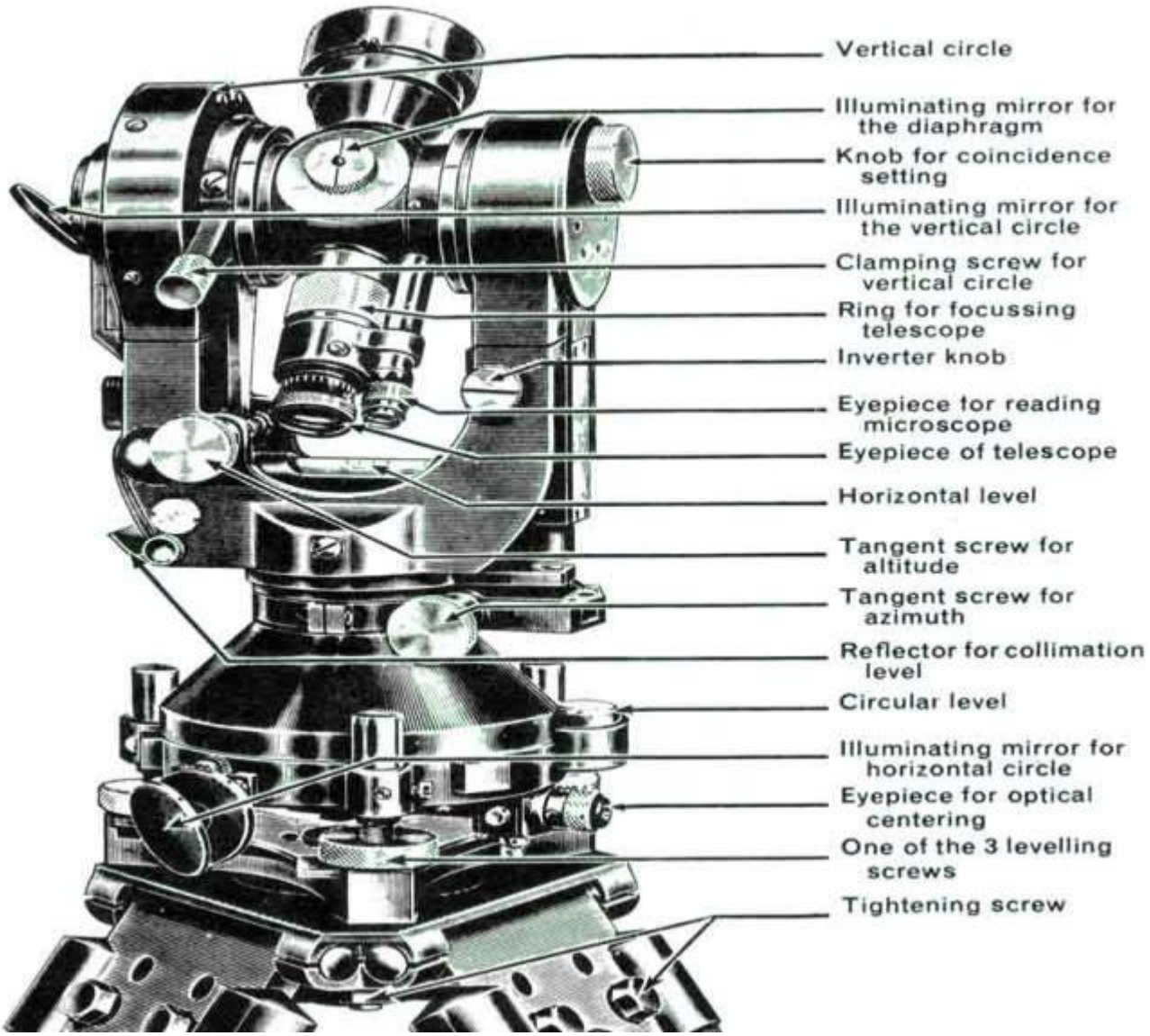
Whenever leveling operation is carried out the staff reading taken in the field are entered in the note book called a Level-Book. Each page of it has the following columns which help in booking of reading and reduction of levels. Page of Level-Book

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 NO 6. Measurement of horizontal angles theodolite by method of repetition

AIM : Measurement of horizontal angles theodolite by method of repetition

APPARATUS:- Theodolite , Ranging rod, pegs etc.



THEORY :

Theodolite : The theodolite is the most intricate and accurate instrument used for measurement of horizontal and vertical angles. It consists of telescope by means of which distant objects can be sighted. The telescope has two distinct motions on in the horizontal plane and the Other in the vertical plane. The former being measured on a graduated Horizontal vertical circle of two verniear. Theodolite are primarily classified as

1) Transit theodolite

2) Non-transit theodolite

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

Various parts of transit theodolite

1) Telescope: it is an integral part and is mounted on the spindle known as horizontal axis or turn on axis. Telescope is either internal or external focusing type.

2) The leveling head: It may consists of circular plates called as upper and lower Parallel plates. The lower parallel plate has a central aperture through which a plumb bob may be suspended. The upper parallel plate or tribranch is supported by means of four or three leveling screws by which the instrument may be leveled.

3) To lower plate or screw plate: It carries horizontal circle at its leveled screw. It carries a lower clamp screw and tangent screw with the help of which it can be fixed accurately in any desired position.

4) The upper plate or vernier plate:- it is attached to inner axis and carries two vernier and at two extremities diametrically opposite.

5) Compass: the compass box may be either of circular form or of a rough type. The former is mounted on the vernier plate between the standards while the latter is attached to the underside of the scale or lower plate or screwed to one of the standards. Modern theodolite is fitted with a compass of the tubular type and it is screwed to one of the standards.

6) Vertical circle: the vertical circle is rigidly attached to the telescope and moves with it. It is silvered and it is usually divided into four quadrants.

7) Index bar or T-frame: the index bar is T shaped and centered on horizontal axis of the telescope in front of the vertical axis. It carries two vernier of the extremities of its horizontal arms or limbs called the index arm. The vertical leg called the clip or clipping screws at its lower extremity. The index arm and the clipping arm are together known as T-frame.

8) Plumb bob: To centre the instrument exactly over a station mark, a plumb bob is suspended from the hook fitted to the bottom of the central vertical axis. Repetition method of measuring Horizontal angles when it is required to measure horizontal angles with great accuracy as in the case of traverse, the method of repetition may be adopted. In this method the same angle is added several times by keeping the vernier to remain clamped each time at the end of each measurement instead of setting it back to zero when sighting at the previous station. The corrected horizontal angle is then obtained by dividing the final reading by the number of repetitions. Usually six reading, three with face left and three with face right, are taken The average horizontal angle is then calculated.

PROCEDURE:-

1) Let LOM is the horizontal angle to be measured as shown in fig. O is the station point fixed on the ground by a peg. Set up the theodolite over the peg ‘o’ and level it accurately.

2) Set the horizontal graduated circle vernier A to read zero or 360° by upper clamp screw and slow motion screw. Clamp the telescope to bisect the bottom shoe of the flag fixed at point ‘L’ and tighten the lower clamp. Exactly intersect the centre of the bottom shoe by means of lower slow motion screw. Check that the face of the theodolite should be left and the telescope in normal position.

3) Check the reading of the vernier A to see that no slip has occurred .Also see that the plate levels are in the centre of their run. Read the vernier B also.

4) Release the upper clamp screw and turn the theodolite clockwise. Biset the flag bottom shoe fixed at point M by a telescope. Tighten the upper clamp screw and bisect the shoe exactly by means of upper slow motion screw.

5) Note the reading on both the vernier to get the approximate value of the angle LOM.

6) Release the lower clamp screw and rotate the theodolite anticlockwise ai azimuth. Bisect again the bottom shoe of the flag at 'L' and tighten the lower clamp screw. By means of slow motion screw bisect exactly the centre of the shoe.

7) Release now the upper clamp screw and rotate the theodolite clockwise. Bisect the bottom shoe of the flag fixed at M and tighten the upper clamp screw. By means of slow motion screw bisect exactly the centre of the shoe. The vernier readings will bw now twice the of the angles.

8) Repeat the process until the angle is repeated the required number of times (usually

3). Add 360° for every complete revaluation to the final reading and divided the total angle by number of repetitions to get the value of angle LOM.

9) Change the face of the theodolite the telescope will now be inverted. Rrpeat the whole process exactly in the above manner and obtain value of angle LOM.

10) The average horizontal angle is then obtained by taking the average of the two angles obtained with face left and face right.

11) Usually three repetitions face left and three with face right should be taken and the mean angle should be calculated.

Observation Table:- Repetition method of measuring horizontal angle

S.N.	Instrument Station	Shifted to	Face left readings			
		Venier A 0,I,II	Venier B 0,I,II	Total angle	No of Repetition	Mean horizontal angle 0,I,II
	o	L				
		M				
		L				
		M				
		L				
		M				

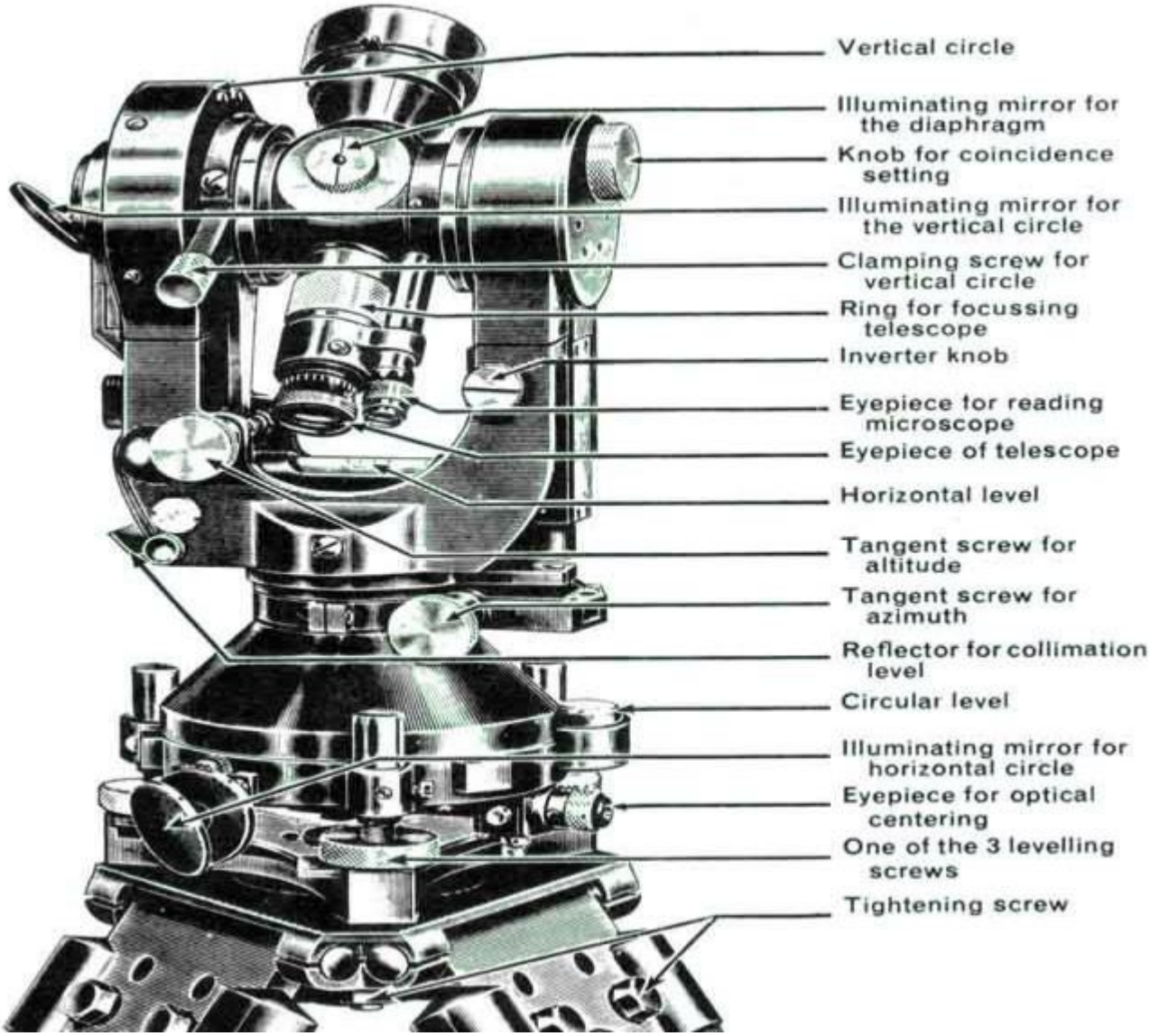
S.N.	Instrument Station	Shifted to	Face Right readings				
		Venier A 0,I,II	Venier B 0,I,II	Total angle 0,I,II	No of Repatition	Mean horizontal angle 0,I,II	Average horizontal angle 0,I,II
	o	L					
		M					
		L					
		M					
		L					
		M			3		

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

Experiment NO 7. Measurement of vertical Angles with Theodolite

AIM: Measurement of vertical Angles with Theodolite

APPARATUS:- Theodolite, three ranging rods,



THEORY:

Theodolite is an instrument designed for the measurement of horizontal and vertical angle. It is most precise method it is also used for laying of horizontal angles Locating points on line prolonging the survey line establishing the gradient, determination of difference in the elevation setting out curve .Theodolite are of two types transit and non transit. Transit theodolite is commonly used now a days .in transit theodolite telescope can be revolved a complete revolution about its horizontal axis in a vertical plane. A transit theodolite consists of essential part.

1) Leveling head: It supports the main working parts of the instrument and screws on a tripod. The head comprises of two parts

a) A leveling foot screws for leveling the instrument i.e. for marking vertical axis truly vertical.

b) A movable head or centering arrangement for centering the vertical axis accurately over a station point.

2) A lower level circular horizontal metal plate: It carries a circular graduated arc . The lower plate is attached to a vertical metal spindle (outer axis) which works in vertical bearing and a form a part of leveling head. It may be graduated in degree and half degree or a degree 1/3 of degrees .the upper plate carries an index and vernier or micrometer towards fine reading on gradated horizontal circle .the upper plate carries standard use of for supporting the telescope and the spirit level used for leveling the instrument.

3) A telescope: The telescope is pivoted between the standard at right angles to the horizontal axis . It can be rotated about its horizontal axis in a vertical plane. The telescope is provided with the focusing screw, Clamping screw and tangent screw.

4) A circular graduated are carried on vertical circle: It is attached to the horizontal axis of the telescope, it is usually divided into 4 quadrants, but in some instruments it is graduated continuously from 0-3600.the graduation in each quadrant are numbered from 0-900 in opposite direction. The subdivisions of vertical circle are similar to those of vertical circle.

MESURMENT OF VERTICAL ANGLE

A vertical angle is the angle between the inclined line of sight to an object and the horizontal. It may be an angle of elevation or on angle of depression according as the point is above or below the horizontal plane passing through the trunnion axis of the instrument. To measure angle of elevation or depression LOM shown in fig. proceed as follows:

1) Set up the theodolite at station point O and level it accurately with reference to the altitude level.

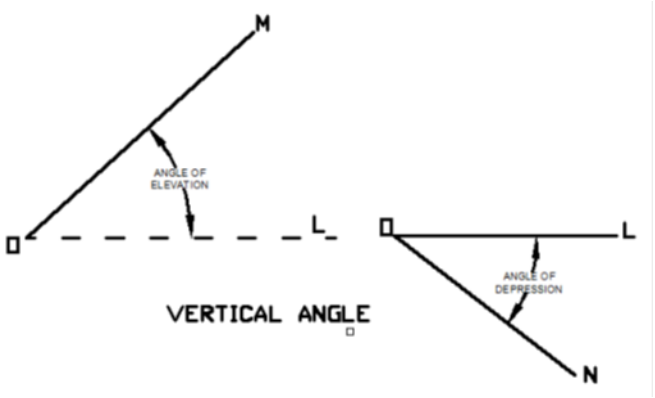
2) Set vertical verniers C and D exactly to zero by using the vertical circle clamp and tangent screw, while the altitude level should remain in the centre of its run. Also the face of the theodolite should be left.

3) Release the vertical circle clamp screw and rotate the telescope in vertical plane so as to bisect the object M. tighten the vertical circle clamp and exactly bisect the object by slow motion screw.

4) Read both verniers C and D. the mean of the tow readings gives the value of the required angle.

5) Similar observation may be made with other face. The average of the tow values thus obtained gives the value of the required angle which is free from instrumental errors.

6) Similarly the angle of depression can be measured following the above steps.



To measure the vertical angle between two points L and M

Some times it is required to measure vertical angle between two points L and M . There can be three possibilities.

(a) One point is above the line of sight and the other is below the line of sight then angle LOM as shown in fig will be equal to (<P +<Q)

(b) Both the points are above the line of sight. Then the angle LOM= <P -<Q

(c) Both the points are below the line of sight, then the angle LOM= <P -<Q

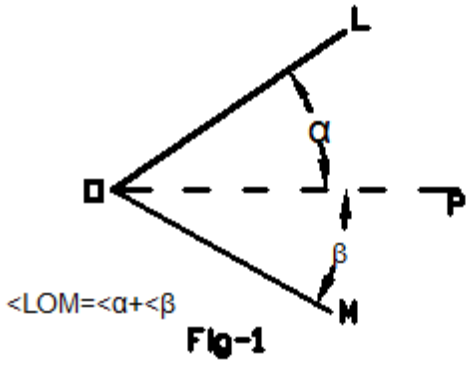


Fig-1

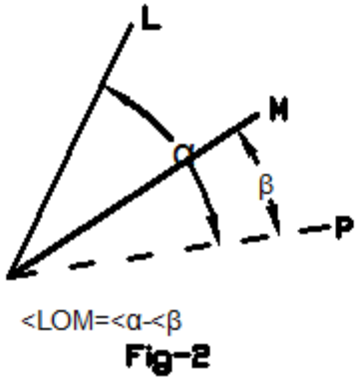


Fig-2

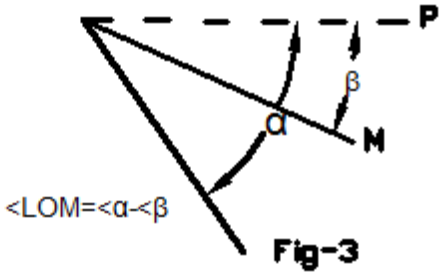


Fig-3

To measure the angle between two points L and M proceed as follows

1) Set the theodolite at station point O and accurately level it.

2) Bisect the flag at L as explained already and take the reading on the verniers C and D. Calculate the mean angle.

3) Bisect the flag at M as before and take the reading on the verniers C and D. Calculate the mean angle.

4) The sum or difference of these angles will give the value of the vertical angle between points L and M.

Observation table:-

S.N.	Instrument Station	Sighted to	Face left readings			
			Venier C 0,I,II	Venier D 0,I,II	Mean Angle	Vertical Angle
	o	P				
	(+ve)	L				
	(-ve)	M				

S.N.	Instrument Station	Sighted to	Face Right readings				Average Vertical Angle 0,I,II	Remarks
			Venier C 0,I,II	Venier D 0,I,II	Mean Angle 0,I,II	Vertical Angle 0,I,II		
	o	P						
	(+ve)	L						
	(-ve)	M						

Result: The average value of vertical is found to be----------.

Experiment NO 8. Counter plan of given area

AIM : Counter plan of given area

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

THEORY:

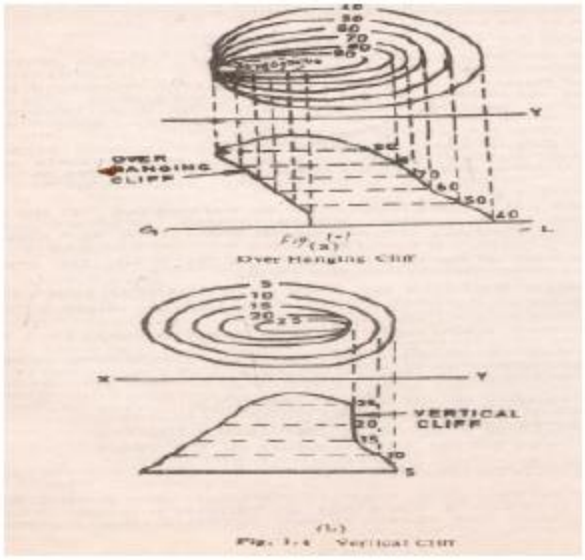
CONTOURING: The elevation and depression the undulations of the surface of the ground are shown as map by interaction of level surface with by means of contour line. a contour may be defined as the line of intersection of a level surface with the surface of the ground. Characteristics of Counter Lines

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

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

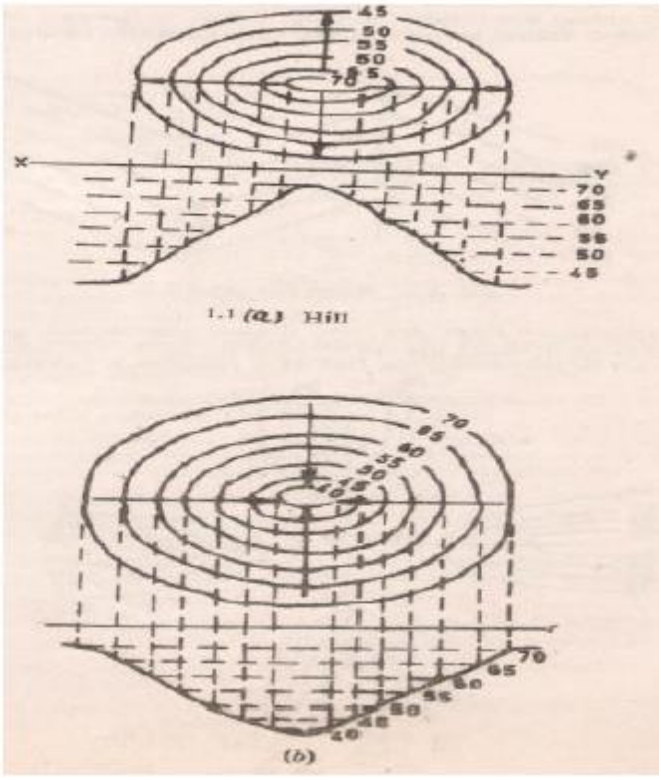
2) Contour lines close together represent steep ground, while uniform slope is indicated when they are uniformly spaced. A series of straight, parallel and equally spaced contours show a plane or flat surface.

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 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.

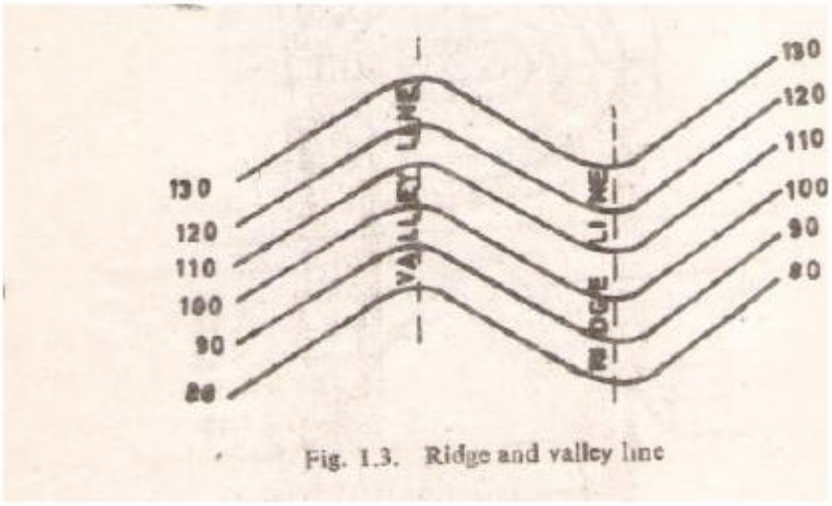


Fig. 1.3. Ridge and valley line

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.

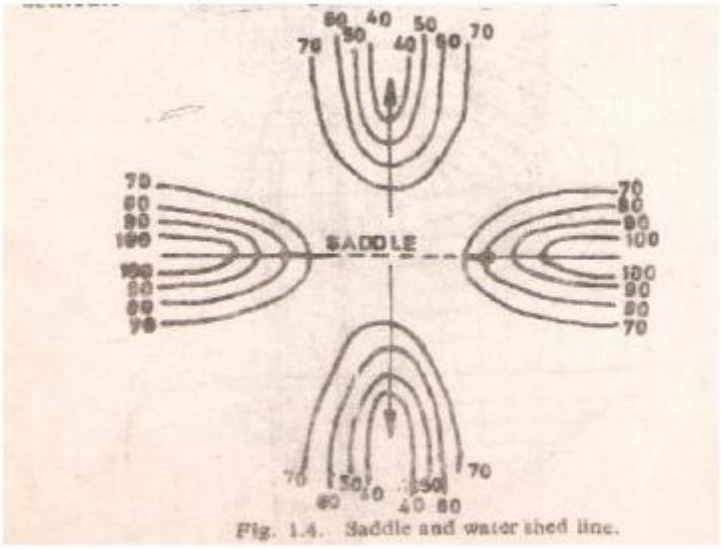


Fig. 1.4. Saddle and water shed line.

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:

a) 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 contour 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.