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Department of Civil Engineering

III SEMESTER

SURVEYING LABORATORY MANUAL

(Course Code: 18CVL38)

Prepared by

Shashank C. Bangi

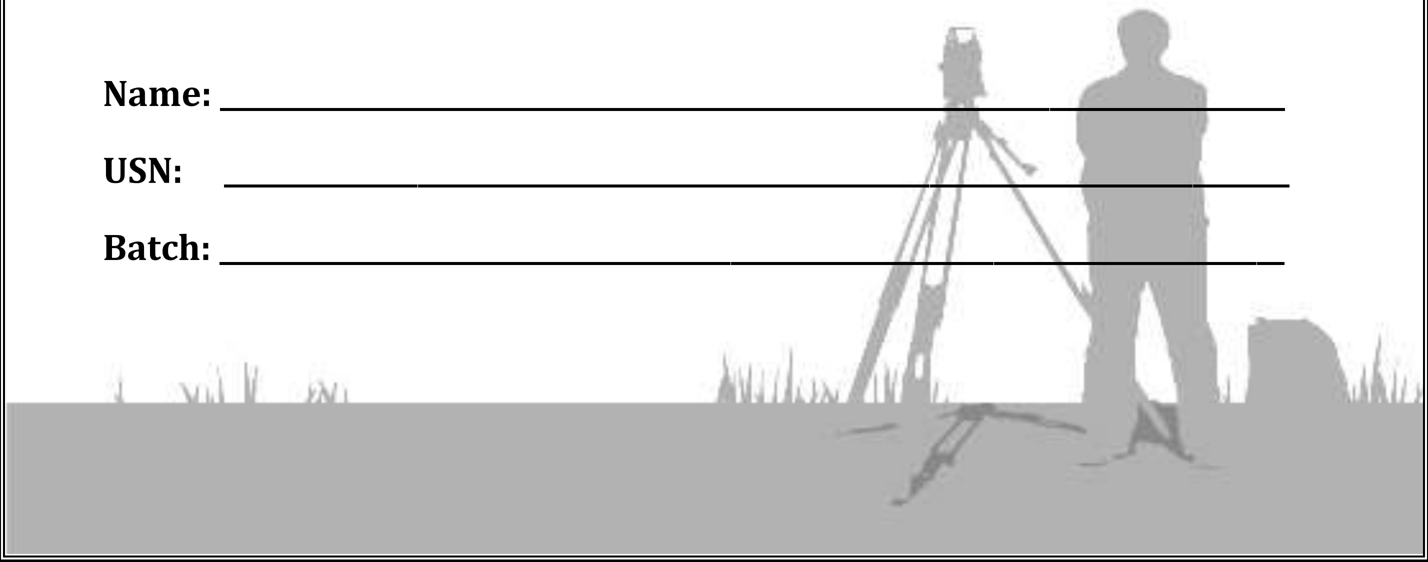
Asst Professor, Dept of Civil Engineering,

KLS, GIT, Belagavi.

Name: ______________________________

USN: ______________________________

Batch: ______________________________



Experiment: 1 **Date:**

Study of various instruments used in chain surveying and their uses

Aim: To Study the various instruments used in chain surveying.

Instruments required:

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

Theory:

1 a) Chain:

The chain is composed 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 chains
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

1b) 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.

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.

7. PLUMB BOB:

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

Observations and Tabulation:

Identify the instruments and tabulate the results

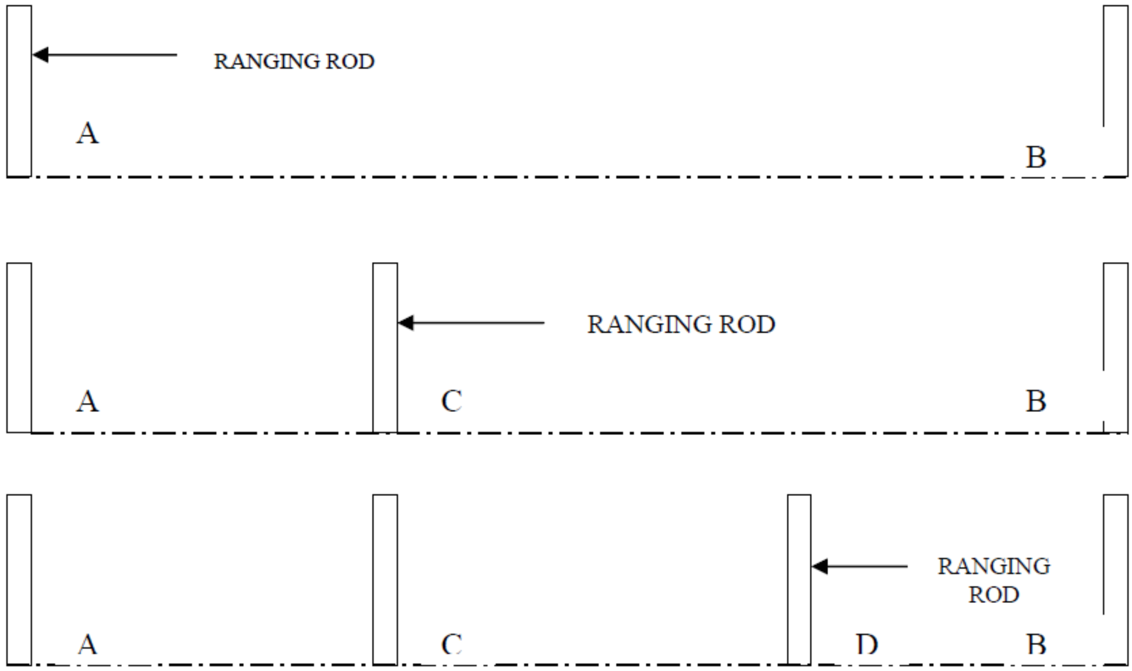
Sl No.	Instrument type	Observations	Result
01	Chain	Type of chain	
		length of chain	
		No. of links	
		length of each link	
02	Tape	Type of tape	
		length of tape	
		least count of tape	
03	Arrow	Length of arrow	
04	Ranging rod	Length of ranging rod	
		Length of strips	
05	Cross staff	Type of cross staff	
05	Offset rod	Length of offset rod	
06	Plumb bob	Identify the plumb bob	-------------

Experiment: 2 Date:

Determination of distance between two points using direct ranging

Aim: To measure distance between two points using direct ranging.

Instruments required: Chain, Tape, Arrows and Ranging rods.



Theory:

Direct ranging is done when two ends of the survey lines are inter-visible. In such cases, ranging can either be done by eye or through some optical instrument such as a line ranger or a theodolite.

Code of signals for Ranging

S. No.	Signal by the Surveyor	Action by the assistant
1	Rapid sweep with right hand	Move considerably to the right
2	Slow sweep with right hand	Move slowly to the right
3	Right arm extended	Continue to move to right
4	Right arm up and moved to the right	plumb the rod to the right
5	Rapid sweep with left hand	Move considerably to the left
6	Slow sweep with left hand	Move slowly to the left
7	Left arm extended	Continue to move to left
8	Left arm up and moved to the left	Plumb the rod to the left

Procedure:

1. Fix the ranging rods at the two given stations, where distance between two points is to be determined on the ground. (say A & B)
2. The leader stand behind station A and directs the follower, with ranging rod to come in line with AB by signals of ranging (Code of signals for ranging)
3. When the ranging rod comes in the line of AB the leader directs the follower to fix the ranging rod in position (say C).
4. Let the intermediate point be C which should be less than 20m / 30 m (one chain length).
5. Now the follower with another ranging rod stands between A and B about 2/3 distance from A
6. The leader directs the leader to come in line of AB by using signals of ranging.
7. As and when the point is located in the line of AB the leader instructs to fix the ranging rod in position(say D).
8. Let the other intermediate position be D which is less than 20 m / 30 m from B
9. Now A, B, C and D are in one line.
10. Now the leader and follower measure the distance by measuring along A, C, D, B.

RESULT:

Number of intermediate points = ____________________

The distance between AB by chain = _______Chains & ______Links

The distance between AB by tape = __________ meters.

Exercise:

- Determine the distance between two points when two points are not inter-visible.
- Measure distance between two point on sloping ground.

Experiment: 3 Date:

Set out perpendiculars at various points on given line using cross staff, optical square, Chain and tape

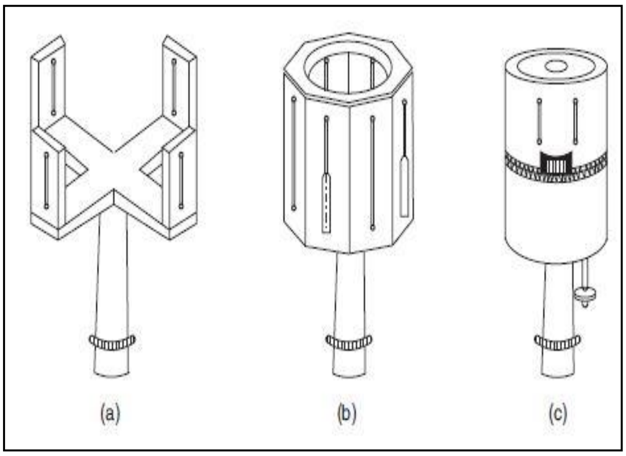
Aim: To set out perpendiculars at various points on given line using cross staff, optical square, Chain and tape

Instruments required: Chain, Tape, Arrows, Ranging rods, cross staff and optical square.

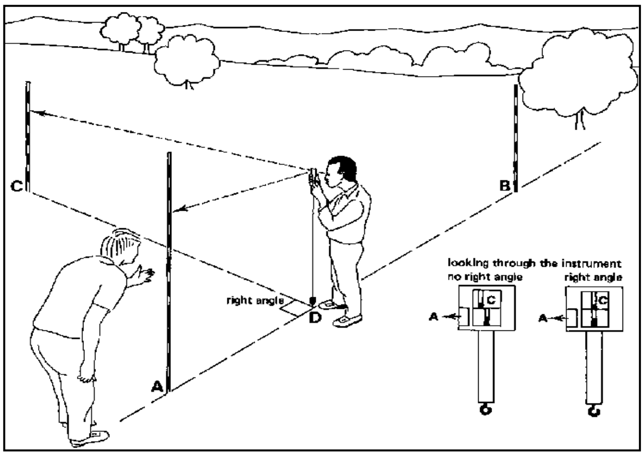
Set out perpendiculars at various points on given line using cross staff

Theory:-The cross staff consists of either a frame or a box with pairs of vertical slits and mounted on a pole for a purpose of fix range of the ground.

Diagram:



Cross Staff



Setting out a perpendicular using a Cross staff

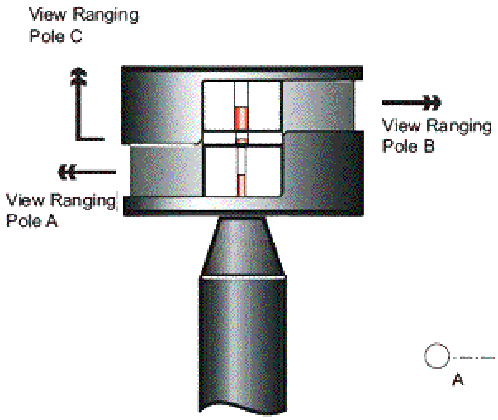
Procedure:-

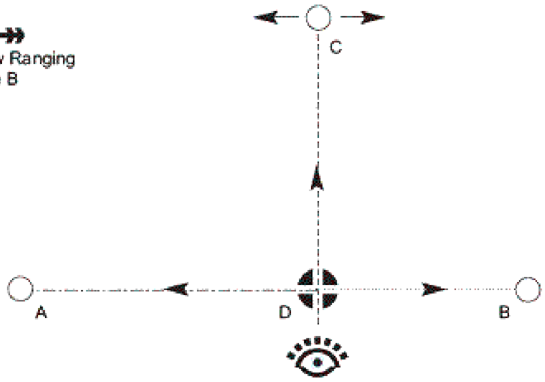
1. Select two points on a chain line say A and B. fix the ranging rod at A.
2. The cross staff is set up at a point 'D' on the chain line from which the perpendicular has to be erected.
3. Adjust the cross staff at 'D' such that the line of sight passes through ranging rod A.
4. Now the point along perpendicular line is to be fixed by viewing through the other pair of vertical slits which is at right angle to survey line AB.
5. Thus the point 'C' is fixed.
6. Join 'DC' which is the required perpendicular to the line AB.

Set out perpendiculars at various points on given line using optical square

Theory:- Optical square is some what more convenient and accurate instrument than the cross staff for setting out a line at right angles to another line.

Diagram:



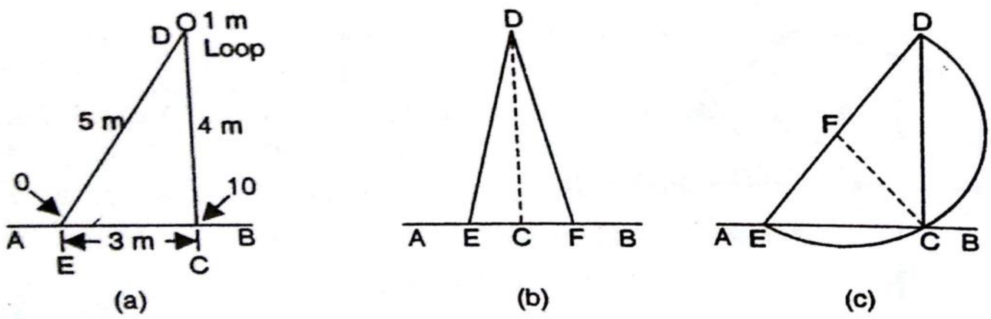


Procedure:-

1. Select two points on a chain line say A and B. fix the ranging rod at A.
2. The optical square is held on the line with its centre on the point 'D' at which perpendicular is erected
3. Adjust the cross staff at 'D' such that the surveyor can see ranging rod at 'A' through unsilvered bottom glass.
4. The surveyor then directs person, holding a ranging rod and stationing in a direction roughly perpendicular to the chain line, to move till the image of two ranging rods coincide.

Set out perpendiculars at various points on given line using Chain and tape

To Erect Perpendicular from a point on the chain line.

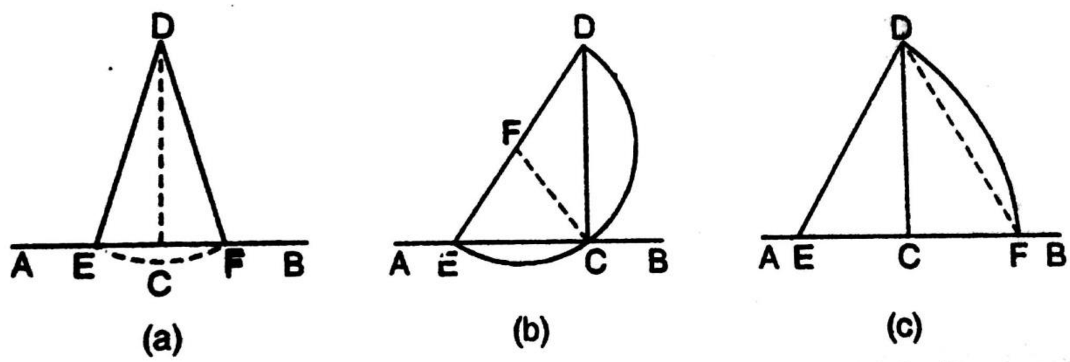


Method 1 (3-4-5 Method): Let AB be the chain line and let C be the point from where the perpendicular is required to be erected. Mark a point E on the chain line such that its distance from C is 3 m. Hold the 0 and 12 m end of the tape at C and the 3m end at E. Now hold the 8m end and move to the side of the line towards which the right angle is to be laid, stretch the tape tight and mark the point D.CD is the required perpendicular.

Method 2: Let AB be the chain line and let C be the point from where the perpendicular is to be erected. Select a points E and F equidistant from C. Hold the zero end of the tape at E and 10m end at F. Tide up 5m mark, stretch the tape tight and establish the point D. Join CD which is the required perpendicular.

Method 3: Let AB be the chain line and let C be the point from where the perpendicular is to be erected. Select any point F outside the chain line AB. With F as the center and FC as radius draw an arc to cut AB at E and C. Join FE and produce it to D such that FE = FD. Join CD, which is the required perpendicular.

To Erect Perpendicular from a point outside the chain line.



Method 1: Let D be the point from where the perpendicular is to be erected to the chain line AB. Select any point E on the line. With D as the center and ED as radius, draw an arc to cut the chain line at F. Bisect EF to get the point C, join CD, which is the required perpendicular.

Method 2: Let D be the point from where the perpendicular is to be erected to the chain line AB. Select any point E on the line. Join ED and bisect it at F. with F as the center and EF or ED as radius, draw an arc to cut the chain line at C. Join CD to get the required perpendicular.

Method 3: Let D be the point from where the perpendicular is to be erected to the chain line AB. Select any point E on the chain line. With E as the center and ED as radius, draw an arc to cut the chain line at F. Measure FD and FE and obtain point C on the chain line as FC= FD2/ 2FE. Join C and D, CD is the required perpendicular.

Observations:

Take measurements on the field, tabulate it and draw the neat sketches with appropriate scale.

Exercise:

- Set out a parallel line to chain line through a given point.
- Set out rectangle and hexagon using chain/tape and other accessories
- Conduct cross staff survey to locate the boundaries and determine the area of boundary.

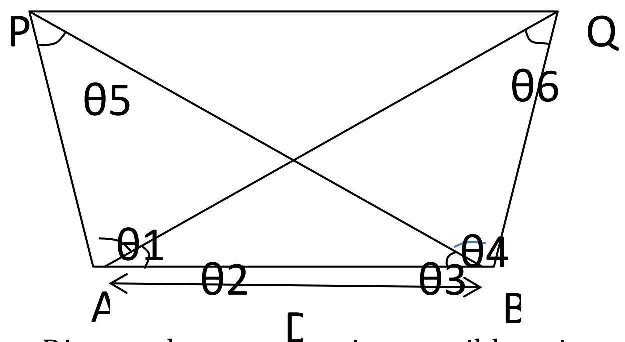
Experiment: 4 Date:

Determination of distance between two inaccessible points using compass

Aim: To determine the distance between two inaccessible points using compass.

Instruments required: Prismatic compass, arrows, chain, tape, ranging rods, pegs.

Diagram:



Distance between two inaccessible points

Theory: If there is an obstacle between two points due to which direct distance measurement is not possible those points are called as inaccessible points and distance between them is to be determined indirectly by following the procedure described below.

Procedure:

1. Let us say the inaccessible distance required is PQ.
2. Select line AB of known length approximately parallel to PQ.
3. Place prismatic compass at point A and center it and see to it that is parallel to Ground surface.
4. Measure bearing of line AP, AQ and AB.
5. Then shift compass to point B and in similar way measure bearings of lines BA, BP and BQ from observed bearing.
6. Distance between two inaccessible points is calculated with the help of the bearings taken and by applying trigonometric relationship

Tabulation:

Sl. No.	Instrument Station	Side	Bearings
1	A	AP	
		AQ	
		AB	
2	B	BQ	
		BP	
		BA	

1. Calculation of internal angles

Sl. No.	Angle	Difference in bearings	Internal angle
1	θ_1	Bearing of AQ- Bearing of AP	
2	θ_2	Bearing of AB- Bearing of AQ	
3	θ_3	Bearing of BP- Bearing of BA	
4	θ_4	Bearing of BQ- Bearing of BP	
5	θ_5	$180 - (\theta_1 + \theta_2 + \theta_3)$	
6	θ_6	$180 - (\theta_2 + \theta_3 + \theta_4)$	

2. Calculation of sides of triangles

By Sine rule, from triangle AQB

$AB/\sin\theta_6 = AQ/\sin(\theta_3 + \theta_4) = BQ/\sin\theta_2$

AQ=

BQ=

From triangle APB

$AB/\sin\theta_5 = AP/\sin\theta_3 = BP/\sin(\theta_1 + \theta_2)$

AP=

BP=

3. Calculation of distance PQ

By Cosine rule,

PQ = $\sqrt{AP^2 + AQ^2 - 2AP \text{ X } AQ \text{ X } \cos\theta_1}$

PQ =

<u>or</u>

PQ = $\sqrt{BP^2 + BQ^2 - 2BP \text{ X } BQ \text{ X } \cos\theta_4}$

PQ =

Result: The distance between two inaccessible points P & Q =

Exercise:

- Determine the distance between two inaccessible points using plane table
- Set out geometric figures such as hexagon, pentagon using prismatic compass and tape
- Measurement of bearing of the sides of a closed traverse & adjustment of closing error by Bowditch method and Transit method

Experiment: 5 Date:

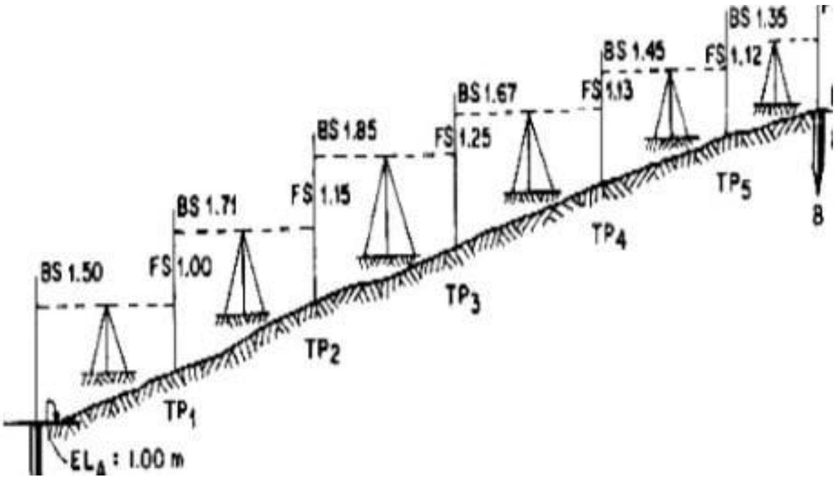
Fly leveling & fly back levelling: Height of the instrument and Rise & Fall methods

Aim: : To determine difference in elevation between two points & conduct fly back leveling using HI and Rise & Fall methods.

Instruments required: Auto Level, leveling staff and Tripod

Theory: it is the method of direct leveling the object of which is to determine the difference in elevation of two points. When the points are apart, it may be necessary to shift and set up the instrument several times and thus it is named as 'Fly Leveling'.

Fly leveling is conducted when the benchmark is very far from the work station. In such case, a temporary bench mark is located at the work station which is located based on the original benchmark. Even it is not highly precise it is used for determining approximate level.



Fly levelling

Procedure:

1. Let A and B the two points whose difference in elevation is to be found out. Set the instrument at about 50m to 60m from the point A (BM) and carry out the necessary adjustments,(temporary adjustments)
2. Hold the staff at A and note down staff reading (BS). Shift the staff and hold it at any point (say p) about same distance (50m to 60m) and note down staff reading (FS).
3. Shift the instrument to the next station again at about same distance from p and holding the staff at p note down staff reading (BS). Shift the staff and hold it at any point (say q) about same distance(50m to 60m) and note down staff reading (FS)
4. Repeat the procedure until the point B is reached,
5. To check the accuracy in fieldwork, the fly back levels are taken from point B to point A in a similar way by taking only BS and FS preferably through different routes.

Fly Levelling, HI method

Station	BS	IS	FS	HI	Reduced Level	Remark

Fly back Levelling, Rise and Fall method

Station	BS	IS	FS	Rise	Fall	Reduced Level	Remark

Experiment: 6 **Date:**

Profile leveling for water supply /sewage line

Aim: To conduct profile levelling for water supply / sewage line and to draw the longitudinal section to determine the depth of cut and depth of filling for a given formation level.

Instruments required:

a. Dumpy level with tripod
b. Prismatic compass
c. Chain
d. Tape
e. Ranging rods
f. Arrow pins
g. Leveling staff!

Theory: Profile leveling is the process of determining the elevations of points along a fixed line such as center line of a railway, highway, canal, water supply and sewer. The fixed line may be a single straight line or a series of straight lines connected by curves. It is also known as longitudinal sectioning. By means of such sections it is possible to study the relationship between the existing ground surface and the levels of the proposed construction in the direction of its length. The profile is usually plotted on specially prepared profile paper, on which the vertical scale is much larger than the horizontal, and on this profile, various studies relating to the fixing of grades or formation lines and the estimation of depths, volume of earthwork and estimating of costs are made.

Plotting of profile: The horizontal distances are plotted along the horizontal axis to some convenient scale (1 cm = 10 m) and mark the distances. The elevations are plotted along the vertical axis (1 cm = 1 m). The two coordinates (i.e. horizontal distances and vertical elevation) thus plot each ground point. Join the various points so obtained by straight lines.

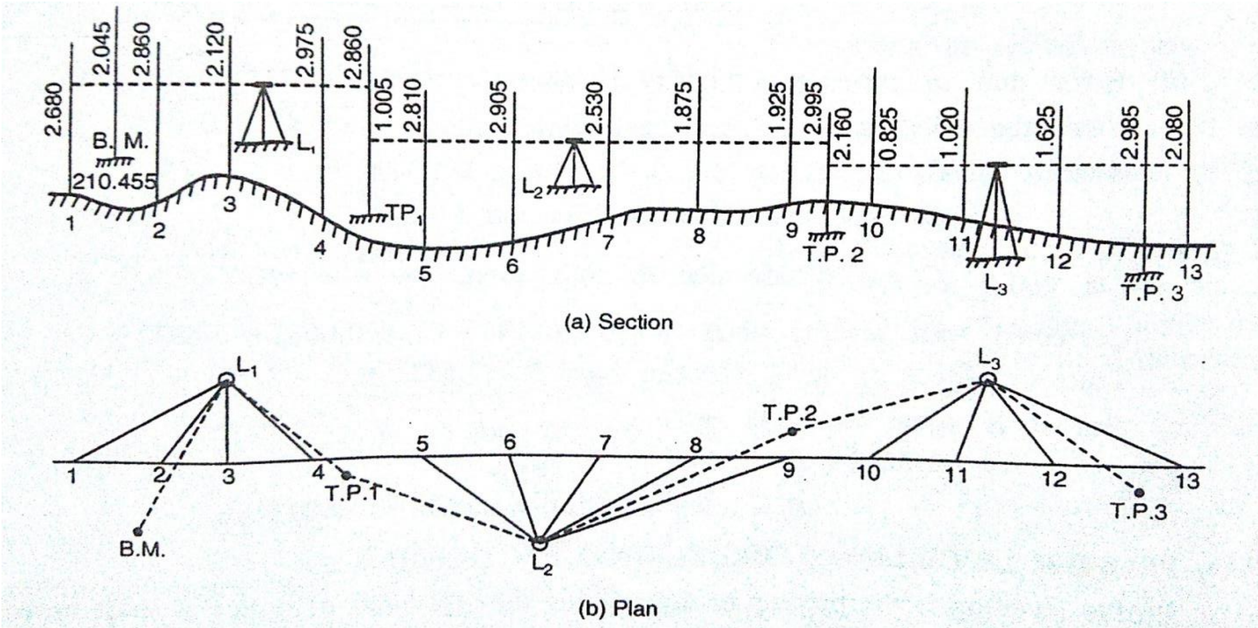
Calculation of depth of cut and depth of fill:

On the profile plot draw the formation line at a required gradient. Calculate the R.L.'s of formation line at each of the marked intervals. Then,

Depth of cut or fill = R.L. of ground point – R.L. of formation point

If R.L. of ground point is greater than R.L. of formation point, it is depth of cut else depth of fill. Calculate the depth of cut / fill at each of the marked intervals and tabulate the results as shown.

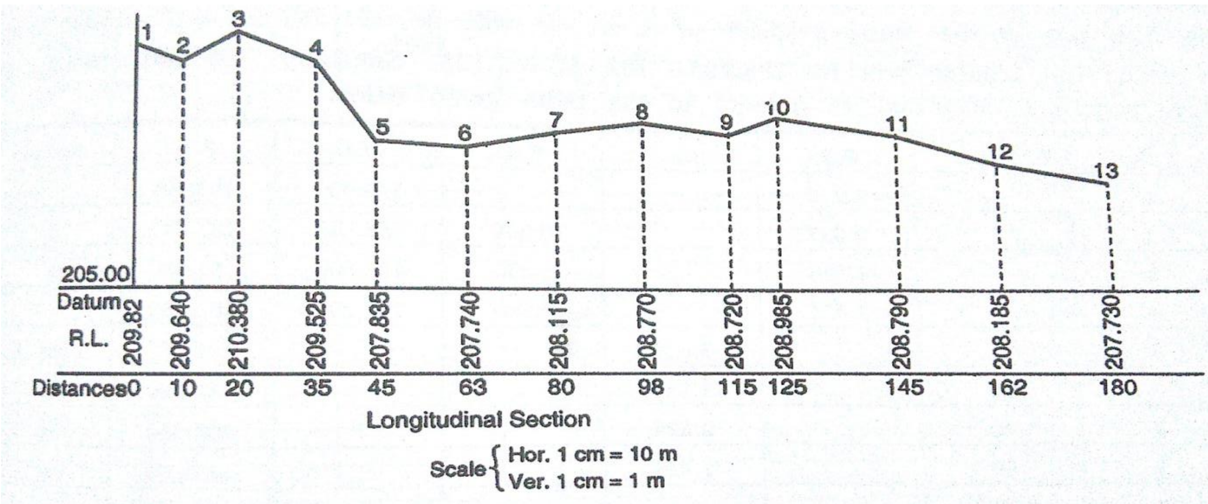
Profile



levelling

Procedure:

1. Fix the



center line alignment for the project under consideration.

2. Mark the points on this alignment at regular intervals by means of arrow pins.
3. Note down the bearings of each section of line by setting the prismatic compass at each of the turning points.
4. Set up the Dumpy level to one side of the profile line and note down the BS reading by holding the staff on the nearby B.M. and calculates the HI for the first station.
5. Hold the staff at each of the point marked on the profile line and note down the I.S.
6. When the readings on the staff are not very clear, note down the staff reading FS by holding the staff on a permanent point.
7. Shift the instrument and set it further equalizing the length of FS and BS and then note down the BS
8. Repeat the procedure from step (4^{th}) onwards till the end of the profile line.

Exercise:

- Conduct cross section levelling and draw the cross section to determine the depth of cut and depth of filling for a given formation level.

Profile Levelling

Station	Bearing	Distance	BS	IS	FS	HI	RL	Gradient	RL of FL	Dept of cut	Dept of Fill	Remarks

Experiment: 7 Date:

Introduction to Theodolite

Theodolite: The theodolite is the 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.

1) Transit theodolite
2) Non-transit theodolite

A theodolite is called transit theodolite when its telescope can be rotate 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 tribrach is supported by means of four or three leveling screws by which the instrument may be leveled.

3) The 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.

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) Clamps and tangent screws: There are two clamps and associated tangent screws with the plate. These screws facilitate the motion of the instruments in horizontal plane. Lower clamp screw locks or releases the lower plate. When this screw is unlocked both upper and lower plates move together. The associated lower tangent screw allows small motion of the plate in locked position. The upper clamp screw locks or releases the upper vernier plate. When this clamp is released the lower plate does not move but the upper vernier plate moves with the instrument. This causes the change in the reading. The upper tangent screw allows the fine adjustment

9) Vertical circle clamp and tangent screw: Clamping the vertical circle restricts the movement of telescope in vertical plane.

10) Altitude level: A highly sensitive bubble is used for levelling particularly when taking the vertical angle observations

11)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.

Important Definitions

Face Right: When the vertical circle of a theodolite is on right of the observer, the position is called face right and observation made is called face right observation.

Face Left: When the vertical circle of a theodolite is on left of the observer, the position is called face left and observation made is called face left observation. By taking the mean of both face readings, the collimation error is eliminated.

Telescope Normal: The telescope is said to be normal or direct when its vertical circle is to the left of the observer and bubble is up.

Telescope Inverted: The telescope is said to be inverted when its vertical circle is to the right of the observer and the bubble is down.

Changing face: Revolve the telescope by 180°in vertical plane about horizontal axis. Again revolve the telescope in horizontal plane about vertical axis.

Temporary adjustments of theodolite

1. Centering: This involves setting the theodolite exactly over the station mark or on the station peg. It is done by the following steps.

- The plum bob is suspended from a small hook attached to the vertical axis of the theodolite.
- The instrument is placed over the station mark with the telescope at a convenient height and with the tripod legs set well apart.
- Two legs of the tripod are set firmly into the ground and the third leg is moved radially to bring the plumb bob exactly over the station mark. Then the third leg is also pushed into the ground.
- If the instrument has a shifting head ,the instrument is roughly centered over the station mark and then by means of the shifting head ,the plumb bob is brought exactly over the station mark.

2. Levelling: Having centered and approximately leveled, the instrument is accurately leveled with reference to the plate level by means of leveling (or foot) screws. So that the vertical axis is made truly vertical

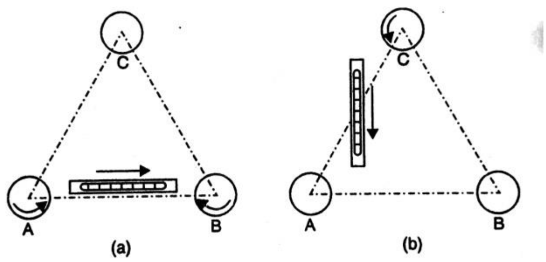


FIG. 6.7. LEVELLING UP WITH THREE FOOT SCREWS.

Process of leveling the instrument:

(a) Loosen all the clamps and turn the instrument about either of its axis until the longer plate level is parallel to the pair of foot screws, the other plate level will then be parallel to the line joining the third screw and the midpoint of the line joining the first pair.

(b) Bring the long bubble to the centre of its run by turning both screws equally either both inwards or both outwards.

(c)Rotate the instrument about 90^0 and Similarly bring the bubble to the center of its run by turning third leveling screw.

(d) Repeat the process until finally both bubbles are exactly centered.

If the vertical angles are to be measured the instrument should be levelled with reference to the altitude level fixed on the index arm. To do this,

(a)First level the instrument by the plate levels. Then turn the telescope. So that the altitude level is parallel to the line joining a pair of foot screws. Bring the bubble to the center of its run by means of these screws.

(b)Turn the telescope through 90° and bring the bubble exactly to the mid position by the third leveling screw. Repeat until the bubble remains central in these two positions.

3. Focussing: This is done in two steps.

1)Focusing the eyepiece for distinct version of the cross hairs at diaphragm. 2)Focusing the object glass for bringing the center of the object on the plane of the diagram.

(1)Focussing the eyepiece: Point the telescope towards the sky or hold a sheet of white paper infront of the object glass ,and move the eyepiece in and out until the cross hairs are seen quite distinctly and clearly (appear sharp and black)

(2) Focusing the object glass: There will be an apparent movement of the image relatively to the cross hairs when the observer moves his eyes. The apparent movement being called the parallax. To eliminate it, direct the telescope towards the object and turn the telescope towards the object and turn the focusing screw until the image appears clear and sharp.

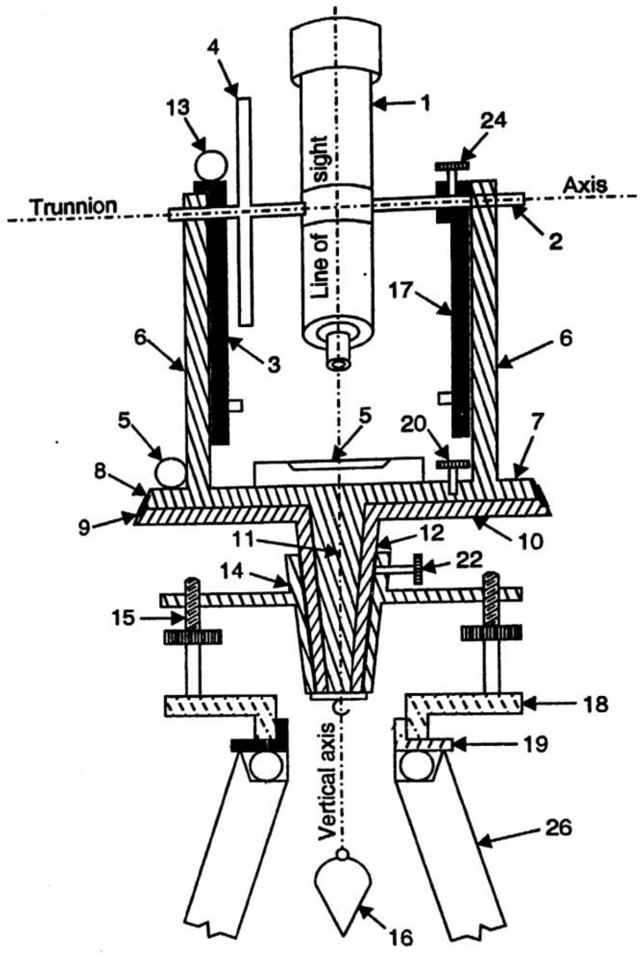


FIG. 6.1. THE ESSENTIALS OF A TRANSIT.

1. TELESCOPE
2. TRUNNION AXIS
3. VERNIER FRAME
4. VERTICAL CIRCLE
5. PLATE LEVELS
6. STANDARDS (A-FRAME)
7. UPPER PLATE
8. HORIZONTAL PLATE VERNIER
9. HORIZONTAL CIRCLE
10. LOWER PLATE
11. INNER AXIS
12. OUTER AXIS
13. ALTITUDE LEVEL
14. LEVELLING HEAD
15. LEVELLING SCREW
16. PLUMB BOB
17. ARM OF VERTICAL CIRCLE CLAMP.
18. FOOT PLATE
19. TRIPOD HEAD
20. UPPER CLAMP
22. LOWER CLAMP
24. VERTICAL CIRCLE CLAMP
26. TRIPOD

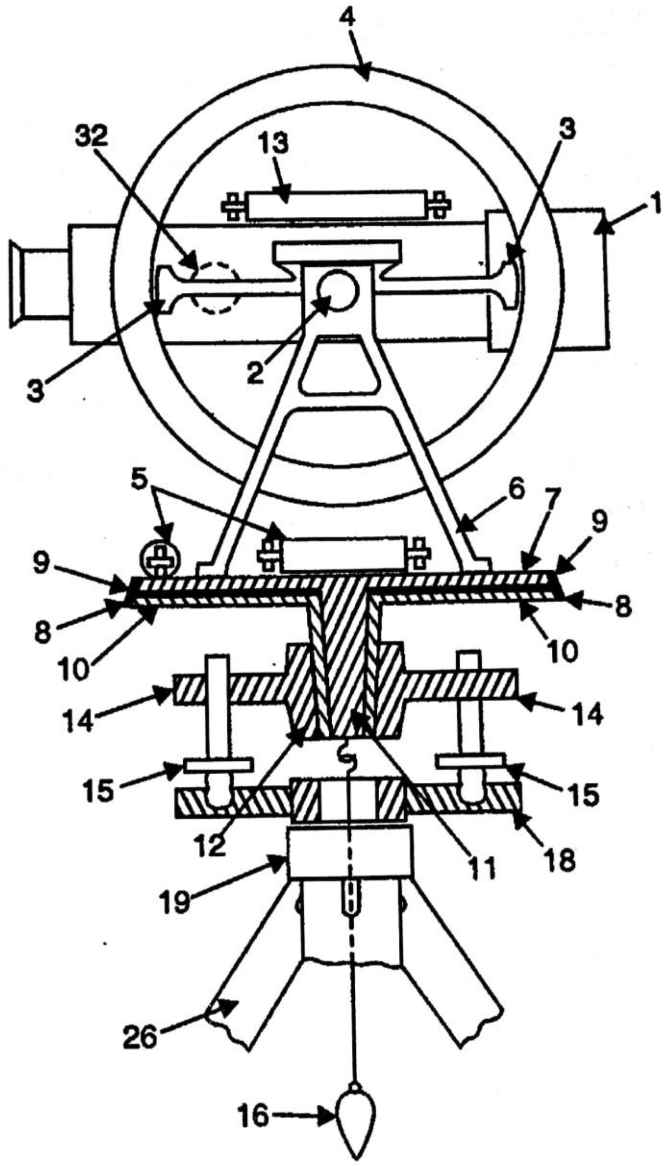
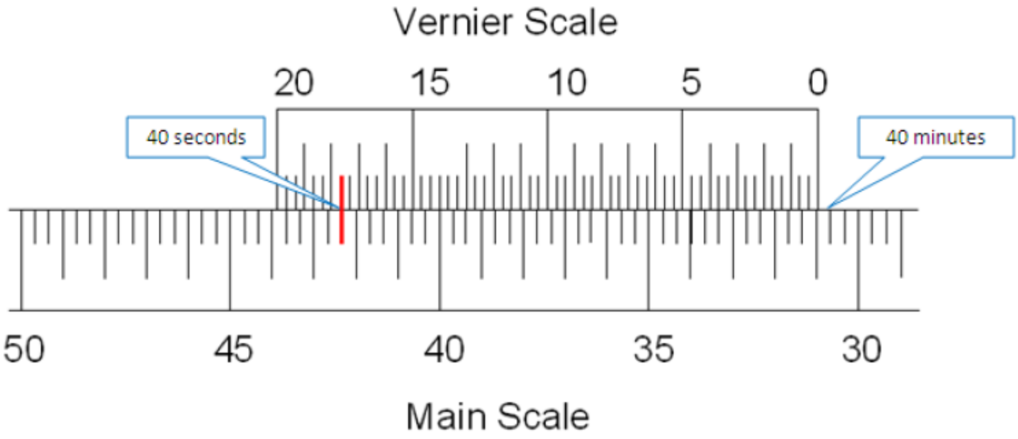


FIG. 6.2. THE ESSENTIALS OF A TRANSIT.

1.	TELESCOPE	11.	INNER AXIS
2.	TRUNNION AXIS	12.	OUTER AXIS
3.	VERNIER FRAME	13.	ALTITUDE LEVEL
4.	VERNIER CIRCLE	14.	LEVELLING HEAD
5.	PLATE LEVELS	15.	LEVELLING SCREW
6.	STANDARDS (A-FRAME)	16.	PLUMB BOB
7.	UPPER PLATE	18.	FOOT PLATE
8.	HORIZONTAL PLATE VERNIER	19.	TRIPOD HEAD
9.	HORIZONTAL CIRCLE	26.	TRIPOD
10.	LOWER PLATE	32.	FOCUSING SCREW

Method of taking reading:



	o	'	"
Main Scale	30	40	
Vernier Scale		17	40
Reading	**30**	**57**	**40**

Tabular column for measurement of horizontal angle

Instrument at	Sighted to	Face: Left Swing : Right											Face : Right Swing : Right											Avg. Horizontal angle		
		A			B		Mean			Horizontal angle			A			B		Mean			Horizontal angle					
		0	'	"	'	"	0	'	"	0	'	"	0	'	"	'	"	0	'	"	0	'	"	0	'	"

Tabular column for measurement of vertical angle (Base is accessible method):

Instrument at	Sighted to	Face: Left											Face : Right											Avg. Vertical angle		
		C			D		Mean			Vertical angle			C			D		Mean			Vertical angle					
		0	′	″	′	″	0	′	″	0	′	″	0	′	″	′	″	0	′	″	0	′	″	0	′	″
P	Q																									

Experiment: 8 **Date:**

Determination of the elevation of an object using single plane method (Base is accessible)

Aim: To determine the elevation of an object using single plane method when base is accessible.

Instruments required: Theodolite, tape, leveling staff, ranging rod, arrow.

Theory: Trigonometric Levelling is the process determining the differences of elevations of stations from observed vertical angles and known distances, which are assumed to be either horizontal or geodetic lengths at mean sea level. The vertical angle may be either measured by theodolite and the horizontal distances may either be measured or computed. The methods are broadly classified in two classes.

I) Single plane method

a) Base of object accessible

b) Base of object inaccessible

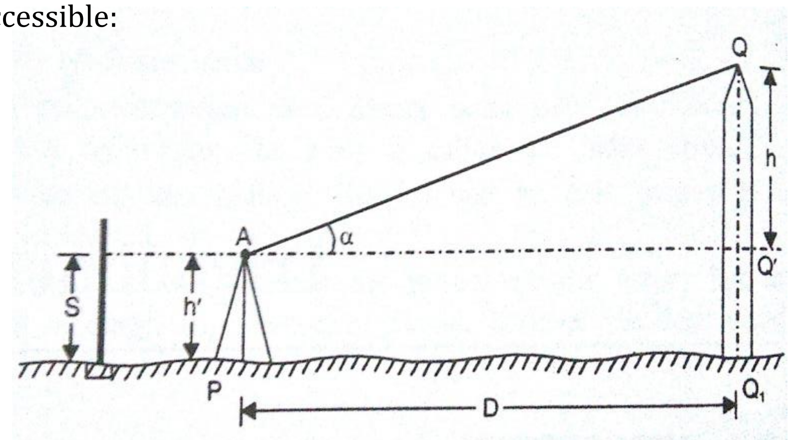
i) Instrument axis at both inst. Stations at same level

ii) Instrument axis at both inst. Stations at different level.

iii) Instrument axis at both inst. Stations at very different level.

II) Double plane method

a) Base of object accessible:



Procedure:

1. Set up the instrument at P and make all the temporary adjustments.
2. With face left , set the Vernier C and D to zero and note down the staff reading on the B.M.
3. Direct the telescope to point Q and note down the vernier reading C and D. The mean of the two Vernier readings, give required vertical angle α.
4. Change the face of the instrument, i.e. with face right and repeat step 2 and 3.
5. Measure the horizontal distance 'D' from instrument station to base of the point 'Q' in straight line.

Observations:

B.M =

Staff reading on B.M = S=

Horizontal distance 'D' =

Calculation:

h= D tan α.=

R.L of Q = B.M + h + S=

Results:-R.L of top of object Q =.

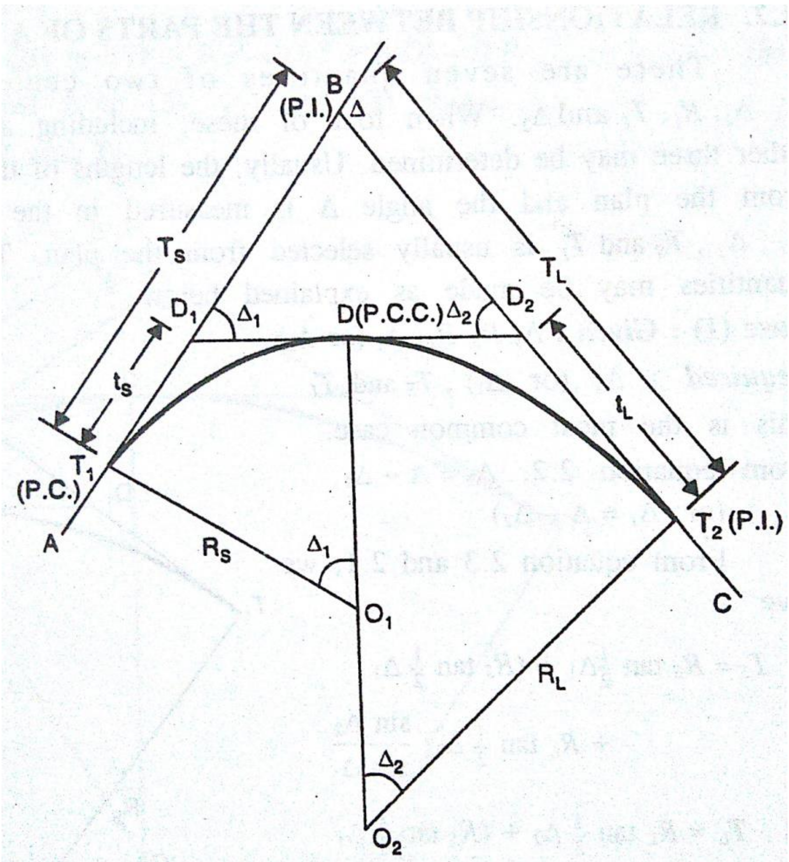
Experiment: 9 Date:

Compound curve by deflection angle method

Aim: To set out compound curve by deflection angle method.

Instruments used: Theodolite, Compass, Ranging roads, Tape, Arrows.

Theory: A compound curve consists of two or more simple arcs that bends in the same direction and their centers of curvature being on the same side of common tangent.



Procedure:

1. Locate tangent points T_1 and T_2 by measuring tangent length $T_s = t_s + (t_s + t_l))$ sin $\triangle_2$/sin $\triangle$ and $T_l = t_l + (t_s + t_l)$ sin $\triangle_1$/sin $\triangle$from the intersection point V along the rear and forward tangent respectively
2. Set up the theodolite at tangent point T_1 and orient the line of collimation along the rear tangent with venire A set to zero.

3. Set the first deflection angle $\triangle_1$ for the first point on the smaller arc. The line of collimation will now be along T_1A.
4. With zero end of the tape at T_1 and radius equal to first sub-chord length c_1 hold the ranging rod at that distance till it is bisected.
5. Repeat the procedure by setting the successive deflection angles and measuring the chord lengths from the previously fixed point till the point of compound curvature D is reached.
6. Shift the instrument at point D and take a back sight on T_1 with venire A set to (360 - $\triangle_1/2$) reading, unclamp the upper plate, swing right till the venire A reads zero. Clamp the upper plate and transit the telescope, the line of collimation will be along the common tangent.
7. Again set the first deflection angle $\triangle_1$ for the first point on the larger arc. The line of collimation will now be along DA′
8. With zero end of the tape at D and radius equal to first sub-chord length c_1', hold the ranging rod at that distance until it is bisected.
9. Repeat the procedure till the point of tangency T_2 is reached.

Tabular column:

Point	Chainage	Chord lengths	Tangential angles			Deflection angles			Theodolite Readings			Remarks
			°	ʻ	"	°	ʻ	"	°	ʻ	"	
T1												Tangent pt. T1
D												Smaller arc
E												
F												
G												
H												
M												Point of compound curvature
D’												Larger arc
E’												
F’												
G’												
H’												
I’												
T2												Tangent pt. T2

$$Check = \quad T_1DT_2 = 180 - \frac{(\Delta_1 + \Delta_2)}{2}$$

Experiment: 10 Date:

Set out the center line of a simple rectangular rooms (Framed Structure) using double baseline method

Aim: To set out the center line of a simple rectangular rooms (Framed Structure) using double baseline method.

Instruments required: Tape, Arrows**,** Set Square and Thread

Theory: Layout of a building or a structure shows the plan of its foundation on the ground surface according to its drawings, so that excavation can be carried out exactly where required and position and orientation of the building is exactly specified. It is set out according to foundation plan drawings and specifications provided by the engineer or an architect.

BASELINE: A baseline is a straight reference line with respect to which corners of the building are located on the ground. It may be outer boundary of a road or curb or boundary of the area or simply a line joining any two points.

Procedure:

1. Establish the double baseline from reference points. Drive two pegs at the ends of the base lines and stretch the thread between the pegs
2. Calculate the distance of offset from a given foundation plan (from baseline to center line of column)
3. Measure the calculated offsets from foundation plan to each of center line of column at right angles to the base line using cross staff, optical square or 3-4-5 method and drive the pegs at each of these points.
4. Check the accuracy of setting out corner points by measuring diagonal distance.
5. Stretch the thread between the pegs along which excavation for foundation is to be done and put the lime powder along these lines.