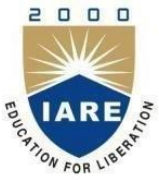
SURVEYINGANDGEOMATICSLABORATORY
LAB MANUAL

CourseCode	**:**	**ACSB03**
Regulations	**:**	**IARE –R18**
Semester	**:**	**III**
Branch	**:**	**CE**

Prepared by

Mr.B Suresh

AssistantProfessor



DEPARTMENT OF CIVIL ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

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Program Outcomes	
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend andwrite effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes(CE)	
PSO1	**Engineering Knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technicalcommunication**.**
PSO2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.
PSO3	**Self-Learning and Service:** Graduates will be motivated for continuous self learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.

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ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES			
S No	**Experiment**	**Program Outcome Attained**	**Program Specific Outcomes Attained**
1	SURVEY OF AN AREA BY CHAIN SURVEY (CLOSED TRAVERSE) AND PLOTTING.	PO 1	-
2	CHAINING ACROSS OBSTACLES.	PO 1 PO 2	PSO 1
3	SORTING TECHNIQUES	PO 5	-
4	SORTING TECHNIQUES	PO 5	PSO 1
5	SORTING TECHNIQUES	PO 1	-
6	SORTING TECHNIQUES	PO 2	PSO 1
7	SORTING TECHNIQUES	PO 2	-
8	SORTING TECHNIQUES	PO 1, PO 2	PSO 1
9	SORTING TECHNIQUES	PO 2	PSO 1
10	SORTING TECHNIQUES	PO 2	PSO 1
11	SORTING TECHNIQUES	PO 5, PO 9	-
12	SORTING TECHNIQUES	PO 5, PO 9	PSO 1
13	DISTANCE, GRADIENT, DIFFERENCE INHEIGHT BETWEEN TWO INACCESSIBLE POINTS USING TOTAL STATION	PO 5, PO 9	-

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Certificate

This is to Certify that it is a bonafied record of Practical work done by Sri/Kum._____bearingthe Roll No. _____ of _____ Class _____ Branch in the _____ laboratory during the Academic year_____under oursupervision.

Head oftheDepartment **LectureIn-Charge**

ExternalExaminer **InternalExaminer**

SURVEYING AND GEOMATICS LABORATORY

III Semester: CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB03	Core	0	0	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

COURSE OBJECTIVES:

I. Gain the practical knowledge on calculation of an area, volume of an irregular and regular land surface using chains and tapes.

II. Operate different types of instruments in surveying. Perform leveling and contouring of ground surfaces.

III. Apply knowledge of mathematics in surveying field to calculate areas and volumes for different projects Utilize total station and other modern survey instruments.

LIST OF EXPERIMENTS

Week -1	**SURVEY OF AN BY CHAIN SURVEY (CLOSED TRAVERSE) AND PLOTTING**
Batch I: Measurement of an area by chain survey Batch II: Measurement of an area by chain survey	
Week -2	**CHAINING ACROSS OBSTACLES**
Batch I: Chaining across obstacles Batch II: Chaining across obstacles	
Week -3	**DETERMINATION OF DISTANCE BETWEEN TWO INACCESSIBLE POINTS WITH COMPASS**
Batch I: Calculation of distance between two points with compass survey. Batch II: Calculation of distance between two points with compass survey.	
Week -4	**CORRECTION FOR LOCAL ATTRACTION BY PRISMATIC COMPASS**
Batch I: Corrections for local attraction by prismatic compass. Batch II: Corrections for local attraction by prismatic compass	
Week -5	**RADIATION METHOD,INTERSECTION METHODS BY PLANE TABLE SURVEY**
Batch I: Radiation method and intersection methods by plane table survey. Batch II: Radiation method and intersection methods by plane table survey	
Week-6	**AN EXERCISE OF LONGITUDINAL SECTION AND CROSS SECTION AND PLOTTING**
Batch I: An exercise of longitudinal section and cross section and plotting. Batch II: An exercise of longitudinal section and cross section and plotting.	
Week -7	**MEASURMENT OF HORIZONTAL ANGLES BY METHOD OF REPETITION AND REITERATION**
Batch I: Measurement of horizontal angles Batch II: Measurement of horizontal angles	
Week -8	**TRIGONOMETRIC LEVELING – HEIGHTS AND DISTANCE PROBLEMS**
Batch I: Trigonometric leveling- heights and distance problems Batch II: Trigonometric leveling- heights and distance problems	

Week -9	**HEIGHTS AND DISTANCE USING PRINCIPLES OF TACHEOMETRIC SURVEY**
Batch I: Heights and distances using principles of tachometric survey. Batch II: Heights and distances using principles of tachometric survey	
Week -10	**CURVE SETTING- DIFFERENT METHODS**
Batch I: Curve setting: different methods. Batch II: Curve setting: different methods	
Week -11	**DETERMINATION OF AN AREA USING TOTAL STATION**
Batch I: Determination of an area using total station. Batch II: Determination of an area using total station.	
Week -12	**DETERMINATION OF REMOTE HEIGHT USING TOTAL STATION**
Batch I: Determination of remote height using total station. Batch II: Determination of remote height using total station	
Week -13	**CALCULATION DISTANCE,GRADIENT AND DIFFERENT HEIGHTS BETWEEN TWO INACCESSIBLE POINTS USING TOTAL STATION**
Batch I: Calculating distance, gradient and different heights between two inaccessible points using total station. Batch II: Calculating distance, gradient and different heights between two inaccessible points using total station	

LIST OF REFERENCE BOOKS:

1. H. S. Moondra, Rajiv Gupta, "Laboratory Manual for Civil Engineering", CBS Publishers Pvt .Ltd., New Delhi, 2nd Edition, 2013.
2. James M. Anderson, Edward M. Mikhail, "Surveying: Theory and Practice", Tata Mc Graw Hill Education, 2012.
3. S. S. Bhavikatti, "Surveying Theory and Practice", IK Books, New Delhi, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105104100/43
2. https://www.coloradomesa.edu/wccc/programs/land-surveying-geomatics.html.
3. https://books.google.co.in/books?id=FaCgAAQBAJ&printsec=frontcover&dq=surveying+and+geomatics+ONLINE+text+books&hl=en&sa=X&ved=0ahUKEwi1wP3x24HgAhUJ5o8KHS2EDzkQ6AEIMzAB# v=onepage&q&f=false

WEEK – 1

SURVEY OF AN AREA BY CHAIN SURVEY (CLOSING TRAVERSE) & PLOTING

OBJECTIVE:

To survey an open field by chain survey in order to calculate the area of the field.

RESOURCE:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Chain	Metric chain	20m or 30m	1
2	Tape	Linen Tape	20m	1
3	Ranging Rods		3m or 2m height	5
4	Arrows			5
5	Cross Staff			1

PRECAUTIONS:

1. Chain ages must be marked against the working edge of the offset scale.
2. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet.
3. Each triangle must be verified by measuring the check lines.

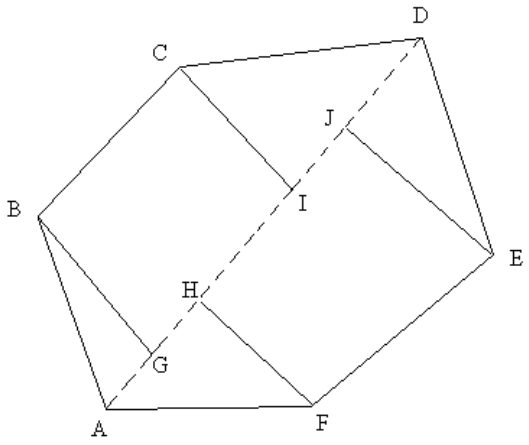


Fig: Survey of an Open Field (Closed Traverse)

PROCEDURE:

Ranging a line:

It is the process of establishing a number of intermediate points on a survey line joining two stations in the field, so that all the points on the line are in alignment and the length between stations may be measured accurately.
Two ranging rods are erected vertically at the end stations by two surveyors who are standing behind ranging rods. One of the surveyors from one of the end stations directs the assistant to hold the ranging rod vertically to establish an intermediate point and move the rod either to the left or right until the ranging rod is in alignment with the end stations. Finally, when the ranging is correct, the assistant is directed to fix the ranging rod at that point. All the directions from surveyor should be as per the Code of Signals given in Table 1.

Taking offsets:

The perpendicular distance measured right or left of the chain line to locate the details like corners, boundaries, culverts, etc is known as offset.

Offsets can be taken by two ways: 1. By Tape and 2. By Cross-Staff.

By Tape:

The leader holds the zero end of the tape at the point where the offset is to be taken and the follower swings off the tape in an arc across the chain line to left and right. The minimum reading of tape on the chain line gives the position of the foot of the perpendicular from the required point.

By Cross-Staff:

The Cross-Staff is held vertically on the chain line approximately near the point where the offset is likely to fall. The Cross-Staff is turned until the signal at one end of the chain line is viewed through one pair of slits. The surveyor then takes a round and views through the other pair of silts. If the point to which the offset is to be taken is seen, the point below the instrument is the required foot of the offset. On the other hand, if the point is not seen, the surveyor moves along the chain line, without twisting the Cross-Staff, till the point appears.

Procedure for surveying the given open field (Closed Traverse):

ABCDEF is the required closed traverse open field to be surveyed for calculating the area as shown in Fig 1. From the station A the length of all the opposite corners such as AC, AD and AE are measured with a chain and the longest distance is considered for laying off the main chain line. In this case AD is the longest and a chain line running from A to D is laid.

Offsets to corner points B, C, E and F are now laid from the chain line AD either by tape or cross-staff and their foot of offsets are G, I, J, H respectively.

All the offset lengths GB, HF, IC and JE are measured either by chain or tape depending on the length of offsets. The distances

between all the points AG, GH, HI, IJ and JD are also measured along the chain line.

AREA CALCULATIONS:

Area No.	Base (m)	Height (m)	Area (m^2)

PRE LAB VIVA QUESTIONS:

1. How the chains are classified?
2. How many types of cross staves are there?
3. What is ranging?
4. What is closed traverse?

LAB ASSIGNMENT:

1.How many types of cross staves are available?
2.What is closed travers?

POST LAB VIVA QUESTIONS:

1. What is chains are working methods?
2. Using of the cross staves give an examples
3. What is tape surveying explain?
4. What is closed traverse how to use of them?

WEEK – 2

CHAINING ACROSS OBSTACLES

OBJECTIVES:

To survey an area by chain survey across obstacles and to calculate the obstructed lengths by using different methods.

RESOURCE:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Chain	Metric chain	20m or 30m	1
2	Tape	Linen Tape	20m	1
3	Ranging Rods		3m or 2m height	5
4	Arrows			5
5	Cross Staff			1

PRECAUTIONS:

1. Chainages must be marked against the working edge of the offset scale.
2. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet.
3. Perpendiculars must be erected carefully with full accuracy .

PROCEDURE:

Obstacles to Chaining:

During measurements, it is impossible to set out all the chain lines in a straightforward method because of a variety of obstacles to chaining and ranging in the field.

Obstacles to measurement:

The obstacles which do not obstruct the ranging (view) like ponds, rivers are known as Obstacles to Measurement.

Obstacles to alignment:

The obstacles which we cannot see across, i.e. both the chaining and ranging are obstructed, e.g. houses, stacks, etc. are known as Obstacles to Alignment.

Obstacles to measurement:

First Method:

Let ABCD be a chain line obstructed by a pond (Fig 1). Let BC be the obstructed length. Two offsets BE and CF of equal lengths are made at B and C and chaining is done along EF to measure the distance EF.

Now the required obstructed length BC is equal to the measured distance EF.

Therefore, BC = EF

Second Method:

Let AB be the obstructed length across the river (Fig 2). AC is laid off, of any convenient length, perpendicular to the required distance AB.

Now a perpendicular is laid off from C such that it meets the extended line of AB at D.

Triangles ABC and ADC are similar triangles.

From the principle of similar triangles,

AB / AC = AC / AD

Therefore, obstructed length AB = AC^2 / AD

Third Method:

Let AB be a chain line obstructed by a river (Fig 3). A point I is assumed anywhere in line with the required distance AB. A point H is taken in such a way that HJ = HI and HK = HB.

Now a point L is established in line AH and at the same time in the line JK produced.

Triangles KHL and ABH are similar triangles and their corresponding sides are equal to each other as the points K, B and I, J are equidistant either side from H.

Therefore, the obstructed length AB = KL

Obstacles to alignment:

First Method:

Let DE be the obstructed length across the building (Fig 4). A point C is assumed arbitrarily. E and C are joined such that EC = CB. Now D and C are also joined such that DC = CA.

Triangles CDE and CBA are similar triangles and their corresponding sides are equal to each other as points BE and AD are equidistant either side from C.

Therefore, obstructed length DE = BA

Second Method:

Let DE be the obstructed length across the building (Fig 5). A point F is established at equal distances from D and E at any convenient distance. Points H and G are established such that FH = FG.

Triangles FDE and FHG are similar triangles.

From the principle of similar triangles,

DE / DF = HG / HF

Therefore, obstructed length DE = (HG X DF) / HF

FIGURE:

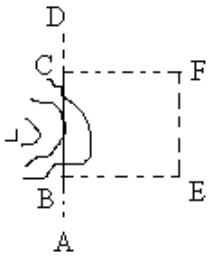


Fig 1

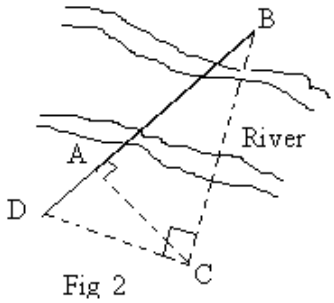


Fig 2

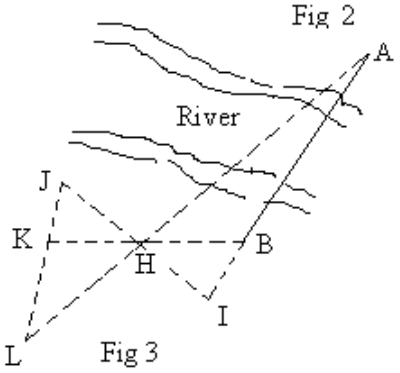


Fig 3

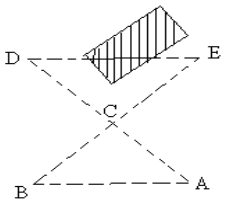


Fig 4

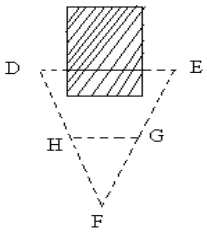


Fig 5

CALCULATIONS:

RESULT:

PRE LAB VIVA QUESTIONS:

1. What is obstacle to chaining?
2. What is obstacle to ranging?
3. What is the least count of metric chain?
4. What is indirect ranging and how it can be done?

LAB ASSIGNMENT:

You are required to conduct the experiment by adopting above procedure for a given obstacle.

POST LAB VIVAQUESTIONS:

1. How the offsets are taken in the field without cross staff?
2. What are the precautions are to be taken in indirect ranging?
3. What is obstacle to chaining and ranging both?
4. What is line ranger?

WEEK – 3

DETERMINATION OF DISTANCE BETWEEN TWO INACCESSIBLE POINTS WITH COMPASS

OBJECTIVES:

To determine distance between two inaccessible points using Prismatic Compass.

RESOURCE:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Chain	Metric chain	20m or 30m	1
2	Tape	Linen Tape	20m	1
3	Ranging Rods		3m or 2m height	3
4	Arrows			5
5	Compass		Prismatic Compass	1
6	Tripod		Compass Tripod	1

PRECAUTIONS:

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

PROCEDURE:

Temporary Adjustments of Compass:

Centering:

A tripod is placed over the station with its legs spread well apart so that it is at a workable height. The compass is fixed on the tripod. It is then centered over the station where the reading is to be taken. A plumb bob is hung from the center of compass. In case the arrangement for a plumb bob is not provided, a stone is dropped from below the compass and it should fall on the peg marking the ground station.

Levelling:

The compass is levelled by eye judgment. This is essential so that the graduated ring swings freely.

Focusing the Prism:

The prism is moved up or down till the figures and graduations are seen clearly.

Inaccessible Distance:

When two points are too far away, unreachable and the chaining between them is difficult, the distance between these two points is called Inaccessible Distance. But the two points are visible to each other.

Taking a Reading with Prismatic Compass:

The compass is rotated until the point or object and the cross hair at object vane coincide. Now the reading on the graduated ring is taken by observing through the prism which is provided just below the eye vane. The reading that coincides with the cross hair should be taken. The break pin which is provided below the object vane should be pressed down while taking reading to avoid oscillations of graduated ring.

Measuring Angle between Two lines:

Let ABC be a traverse of which the angle at B to be measured (Fig 1). The compass is set up at point B and then the point A is sighted and the reading on graduated ring is noted down. Now the instrument is rotated towards point C and the reading on graduated ring is noted down. The difference of those two reading gives the angle at B which is an angle between line BA and line BC.

Measuring Inaccessible Distance Between Two Points:

Let A and B be the two inaccessible points whose distance to be measured (Fig 2). A point C is established at a reasonable distance from A. Let a, b, c be the distances of sides CB, AC, AB respectively out of which c is the inaccessible length.

Now distance b is measured as it is accessible to point A. The angles Q_A and Q_c are measured with a compass as described before.

The angle Q_B can be calculated from,

$$Q_B = 180 - (Q_A + Q_c)$$

The inaccessible length c can be calculated from Sine Rule.

$$a / \text{Sin } Q_A = b / \text{Sin } Q_B = c / \text{Sin } Q_c$$

$$b / \text{Sin } Q_B = c / \text{Sin } Q_c$$

Therefore, $c = (b \text{ X Sin } Q_c) / (\text{Sin } Q_B)$

FIGURE:

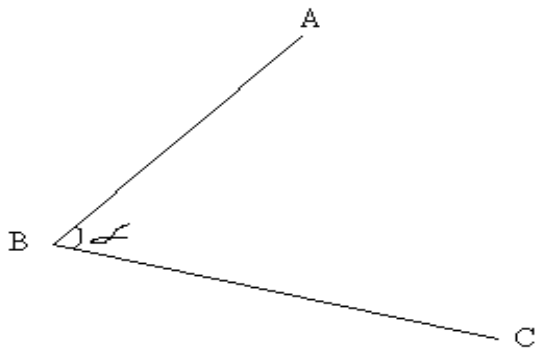


Fig 1

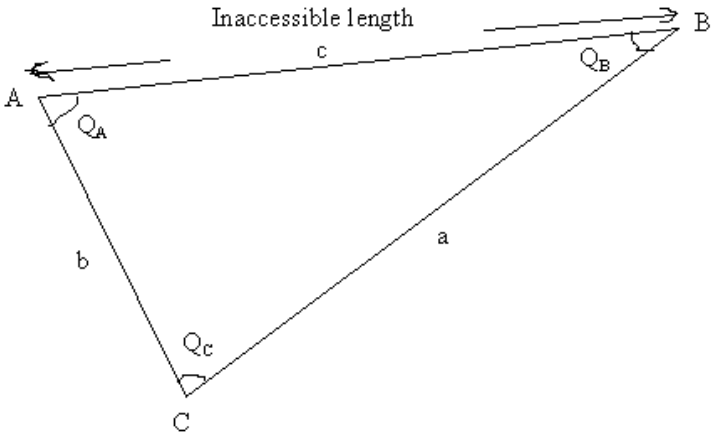


Fig 2

CALCULATIONS:

RESULT:

PRE LAB VIVA QUESTIONS:

1. What are the differences between prismatic and surveyors compass?
2. What is Azimuth?
3. What is the least count of prismatic compass?
4. What is WCB and RB?

LAB ASSIGNMENT:

You are required to calculate the distance between two inaccessible points by adopting above procedure.

POST LAB VIVA QUESTIONS:

1. How the readings on a prismatic compass are marked?
2. What are the precautions are to be taken while conducting experiment?
3. What are inaccessible points?

WEEK – 4

CORRECTION FOR LOCAL ATTRACTION BY PRISMATIC COMPASS

OBJECTIVES:

To survey an area (Closed Traverse) by Compass Survey and to plot the area after correcting the local attraction

RESOURCE:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Tape	Linen Tape	20m	1
2	Ranging Rods		3m or 2m height	3
3	Arrows			5
4	Compass		Prismatic Compass	1
5	Tripod		Compass Tripod	1

PRECAUTIONS:

1. The plan must be so oriented on the sheet that the north side of the survey lies towards the top of the sheet
2. Temporary adjustments must be done carefully.
3. Compass readings must be taken with full accuracy
4. Care must be taken while centering the compass.

PROCEDURE:

Whole Circle Bearing (WCB):

The bearing of line that is always measured clockwise from the north point of the reference meridian towards the line right round the circle is known as Whole Circle Bearing (WCB). WCB will have values between 0^0 and 360^0. Q_1, Q_2, Q_3, etc in Fig 1 represent WCBs.

Fore or Forward Bearing (FB) (WCB System):

The bearing of line in the direction of progress of the survey is called Fore or Forward Bearing.

Back or Reverse Bearing (BB) (WCB System):

The bearing of a line in the opposite direction of progress of the survey is known as Back or Reverse Bearing.

The bearing of a line is indicated in the order in which the line is lettered. Thus, the bearing from A to B (Fig 2) is the fore bearing Q of the line AB, whereas the bearing of line AB in the direction B to A is its back-bearing P.

Calculation of Included Angles from Fore Bearing and Back Bearing:

Included angle is an angle between two lines. Included angles may be exterior or interior.

Included angle between two lines is obtained by the following formula,

Included Angle = Fore Bearing of Next Line – Back Bearing of Previous Line

In Fig 3 the included angle between line AB and line BC is,

= FB of line BC – BB of line AB

If the calculated included angle comes out as a negative value, 360^0 is added to it.

Since traversing in this case is done in clockwise direction, the included angles will be exterior only.

Taking Fore Bearing and Back Bearing of a line with Prismatic Compass:

While taking Fore Bearing of a line, the compass is kept over the starting point of line while running from clockwise direction in the traverse. The line of sight is kept along N – S direction such that the bearing under the prism should read 0^0. Now the compass is turned in clockwise direction only until the line of sight coincides with the ranging rod placed at the end point of line. While taking Back Bearing of a line, the compass is shifted to the end point of line and same procedure is followed as it is followed while taking Fore Bearing. The Fore Bearing and Back Bearing of all lines of closed traverse (Fig 4) are measured by a Prismatic Compass.The distances of all lines of closed traverse are measured with a chain. All the values are tabulated as below.

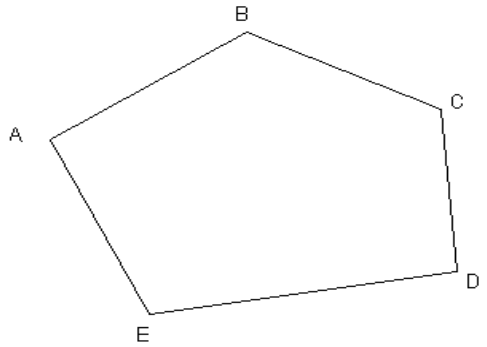


Fig 4

Theoretical sum of included angles can be calculated by,

$(2n + 4) \times 90^0$

Where n = Number of sides of closed traverse.

The Error in the actual included angles can be calculated by,

Error = (Theoretical Sum of Included Angles – Total Actual Included Angles) / n

Where n = Number of sides of closed traverse.

If the Error is positive, add this error to each actual included angle and if the Error is negative, deduct this error from each actual included angle.

Therefore, Corrected Included Angle = Actual Included Angle + Error, if positive.

Corrected Included Angle = Actual Included Angle – Error, if negative.

Check:

Sum of Corrected Included Angles = Theoretical Sum of Included Angles.

Calculation of internal included angles:

Internal Included Angle between two lines can be calculated by,

Internal Included Angle = 360^0 – External Included Angle

CALCULATIONS:

Line	Observed		Difference (FB of Next Line – BB of Previous Line)	Included Angle	Theoretical Sum of Included Angles	Error	Corrected Included Angle	Distance	Remarks
	FB	**BB**							
AB			FB of AB – BB of EA						
BC			FB of BC– BB of AB						
CD			FB of CD- BB of BC						
DE			FB of DE- BB of CD						
EA			FB of EA- BB of DE						
Total				**----**			**----**		

RESULT:

PRE LAB VIVA QUESTIONS:

1. What is Fore Bearing and Back Bearing?
2. What is magnetic Declination?
3. What is local attraction?
4. What is WCB and RB?
5. What is an included angle?

LAB ASSIGNMENT:

You are required to Survey a given area by prismatic compass (Closed Traverse) by adopting above procedure.

POST LAB VIVA QUESTIONS:

1. How the check is to be performed?
2. What are the differences between prismatic and surveyors compass?
3. How to eliminate local attraction?
4. What is magnetic dip?

WEEK – 5

RADIATION METHOD, INTERSECTION METHODS BY PLANE TABLE SURVEY

OBJECTIVES:

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

RESOURCE:

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

PRECAUTIONS:

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

PROCEDURE:

Radiation Method:

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

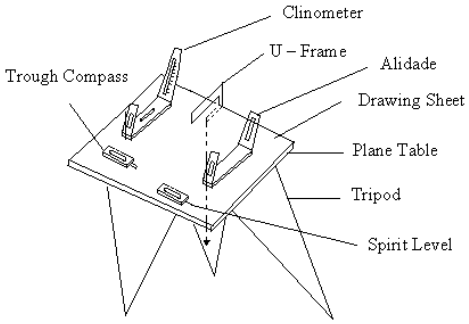
A station O is selected such that all other stations A, B, C and D are accessible and visible from O (Fig 2). N – S direction is plotted. The plane table is setup at O. The alidade is placed at ‘o’ and rays are drawn from ‘o’ to the stations A, B, C, D and the distances oa, ob, oc and od are cut to the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

Intersection Method:

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

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

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



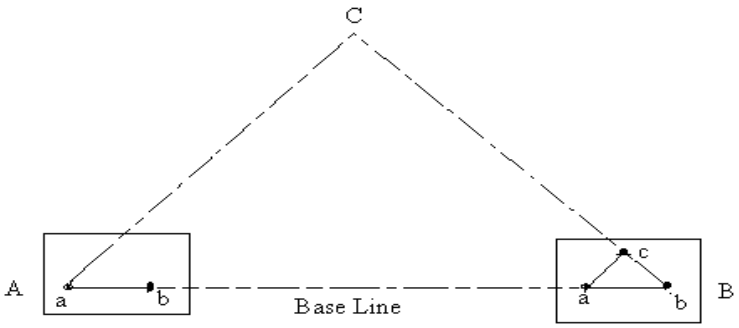


Fig 3

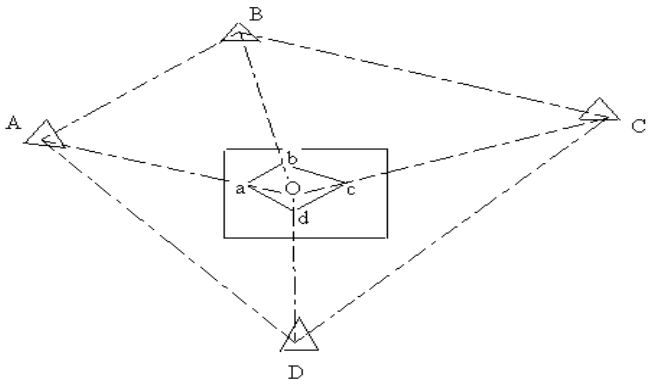


Fig 2

CALCULATIONS:

RESULT:

PRE-LAB VIVA QUESTIONS:

1. What is the advantage of plane table survey?
2. What is Alidade?
3. What is plane table orientation?
4. What are the limitations of plane table survey?

LAB ASSIGNMENT:

You are required to plot a given area by Radiation and Intersection methods of Plane Table Survey by adopting above procedure.

POST-LAB VIVA QUESTIONS:

1. How the Radiation method is different from Intersection method?
2. When Intersection method is suitable?
3. What are inaccessible points?
4. What is orientation by back sighting?

WEEK – 6

AN EXERCISE OF LONGITUDINAL SECTION AND CROSS SECTION PLOTTING

OBJECTIVES:

Determining the elevation at various points on ground at regular interval

RESOURCE:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Dumpy level			1
2	Ranging Rods		3m or 2m height	3
3	Arrows			5
4	leveling staff	Folding staff	4m	1
5	Tripod		Dumpy level Tripod	1

PRECAUTIONS:

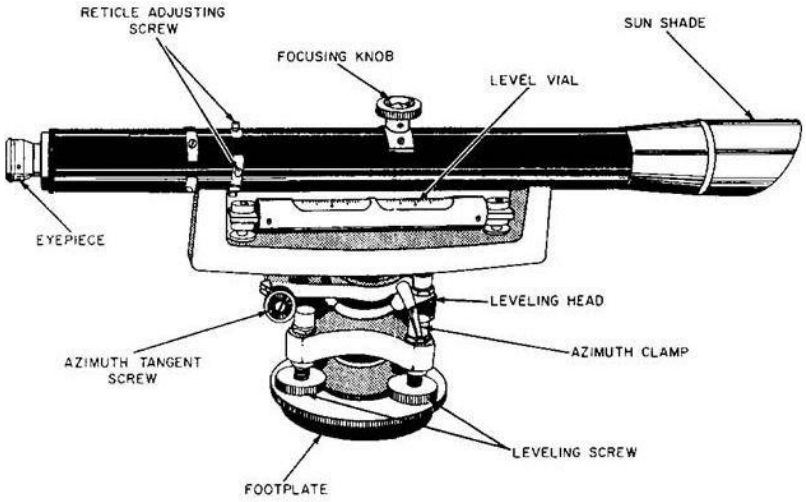
1. Staff must be vertical while taking reading.
2. Leveling must be done carefully.
3. Readings must be taken with full accuracy
4. Temporary adjustments must be done carefully..

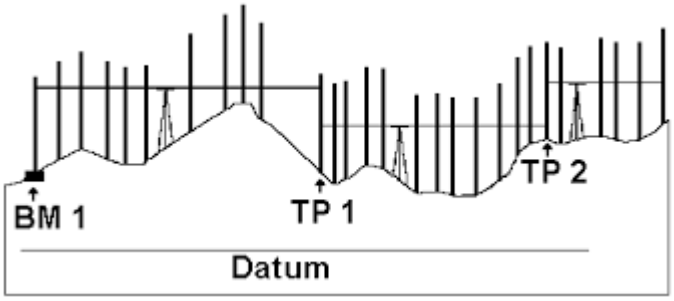
PROCEDURE:

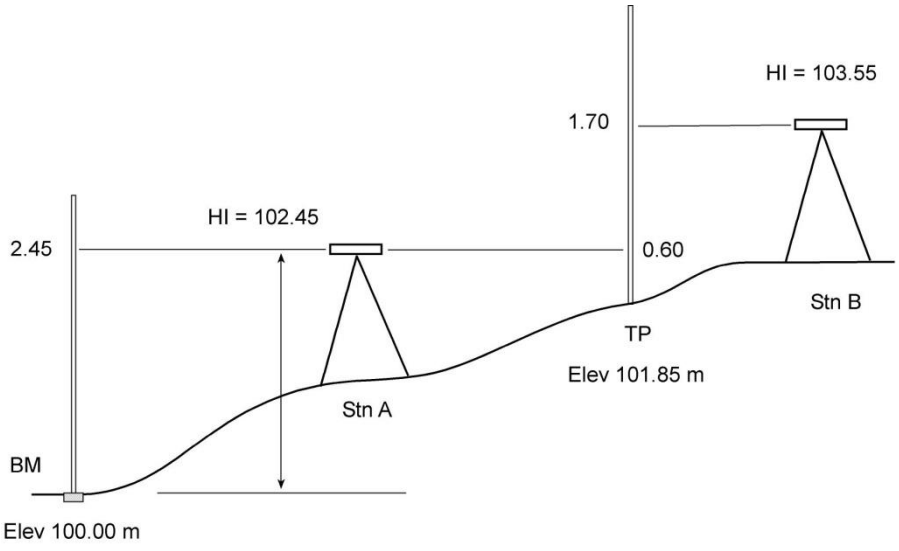
1. Profile leveling is a method of surveying that has been carried out along the central line of a track of land on which a linear engineering work is to be constructed/ laid. The operations involved in determining the elevation of ground surface at small spatial interval along a line is called profile leveling.
2. Divide the proposed center line of a given work at regular intervals.
3. Fix the level and do station adjustments.
4. Take Back Sight on Bench Mark.
5. Take Intermediate Sight on intermediate points.
6. Take Fore Sight on Change points and End point.
7. Record the values in field book in respective columns

FIGURE:

A dumpy level, builder's auto level, leveling instrument, or automatic level is an optical instrument used to establish or check points in the same horizontal plane. It is used in surveying and building with a vertical staff to measure height differences and so transfer, measure and set heights. A Dumpy level is shown in figure below.







CALCULATIONS:

St. No.	Left	Centre	Right	BS	IS	FS	HI	RL	Remarks

ARITHMETIC CHECK:-

Σ B.S – ΣF.S = Last R.L – First R.L.

RESULT:

PRE-LAB VIVA QUESTIONS:

1. What is GTS Bench-mark?
2. What is Temporary Bench-marks?
3. What is Change Point?
4. What is Arithmetical Check?

LAB ASSIGNMENT:

You are required to plot the longitudinal and cross sectional profile of a given area on graph by adopting above procedure.

POST-LAB VIVAQUESTIONS:

1. What is Height of Instrumentation method?
2. What is Fly Leveling?
3. What are Instruments used in Leveling?
4. What is Permanent Bench-marks?

WEEK – 7

MEASUREMENT OF HORIZONTAL ANGLE BY THE METHOD OF REPETITION

OBJECTIVE:
Measurement of horizontal angle by the method of repetition

RESOURCE:

S.No	Name of the equipment	Rage	Type	Quantity
1	Thedolite			1
2	Taps			1
3	Arrows			4
4	Ranging rods			4
5	Tripod			1

PERCAUTIONS:

Temporary adjustment for Thedolite

Leveling and centering

Focusing adjustment

PROCEDURE:

1) Set up the instrument over 'O' and level it accurately.

2) With the instrument on the left face, set verniers A to 3600 and with the aid of the lower champ and tangent screw, bisect signal A.

3) Check the reading on verniers A&B and note it.

4) Release the upper plate, swing the telescope to the right and bisect the right hand signal B with the upper clamp and tangent screw bisect single A.

5) Release the lower clamp, swing instrument to the right and turn to signal A. Clamp the lower motion and with lower tangent screw bisect signal A.

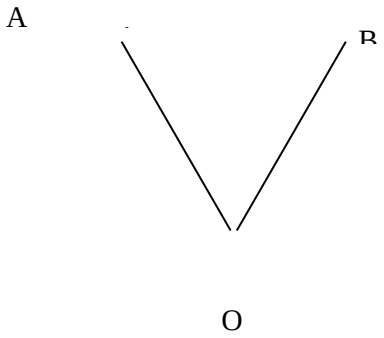
6) Release upper clamp, swing instrument to the right and again bisect signal B accurately with the upper clamp and tangent screw. The vernier reading will be twice the angle AOB.

7) Repeat the procedure until the angle is repeated the required number of times.

8) Change face to right and repeat the above procedure.

9) The average horizontal angle AOB will be the mean of the value of the angle as determined on both the faces.

DIAGRAM:



TABULATION:

Inst at	Sight to	Face Right		Right Swing		Face Left		Left Swing	
		A Vernier	B Vernier	Mean	Included Horizontal angle	A Vernier	B Vernier	Mean	Included Horizontal angle
		° ‘ “	° ‘ “	° ‘ “	° ‘ “	° ‘ “	° ‘ “	° ‘ “	° ‘ “

RESULTS:

PRE-LAB VIVA QUESTIONS:

1. What are the measures carried out for instrument set up?
2. What is centering?
3. How are cross hairs placed in the telescope?

LAB ASSIGNMENT:

Measurement of horizontal angle taking 2 points.

POST-LAB VIVA QUESTIONS:

1. What is transit Thedolite?
2. What is face left?
3. What is face right

WEEK – 8

TRIGNOMETRIC LEVELING – HEIGHTS AND DISTANCES PROBLEM

(Two exercises).

ELEVATION OF AN INACCESSIBLE POINT WHOSE BASE IS ACCESSIBLE

In order to determine the elevation of the point of a chimney or church spire etc. whose base is inaccessible proceed as follows:

OBJECTIVE:

To determine the Elevation of an inaccessible point whose base is accessible.

RESOURCE:

S.No	Name of the equipment	Rage	type	quantity
1	Thedolite			1
2	Taps			1
3	Arrows			4
4	Ranging rods			4
5	Tripod			1

PERCAUTIONS:

a) **Temporary adjustment for Theodolite**
b) **Leveling and centering**
c) **Focusing adjustment**

PROCEDURE:

Let A be the inaccessible point whose elevation is required.

Let B be its projection on the ground which is accessible,

1) Set up the Theodolite at c at a distance of say D meters from B and level it accurately by the altitude level.

2) Sight to point A and observe the vertical angle α subtended at the line of collimation, both on face left and face right and take the average of the two values.

3) Measure the horizontal distance BC accurately by tape.

4) With the line of sight horizontal, take a staff reading h on the bench mark established nearby the instrument.

DIAGRAM:

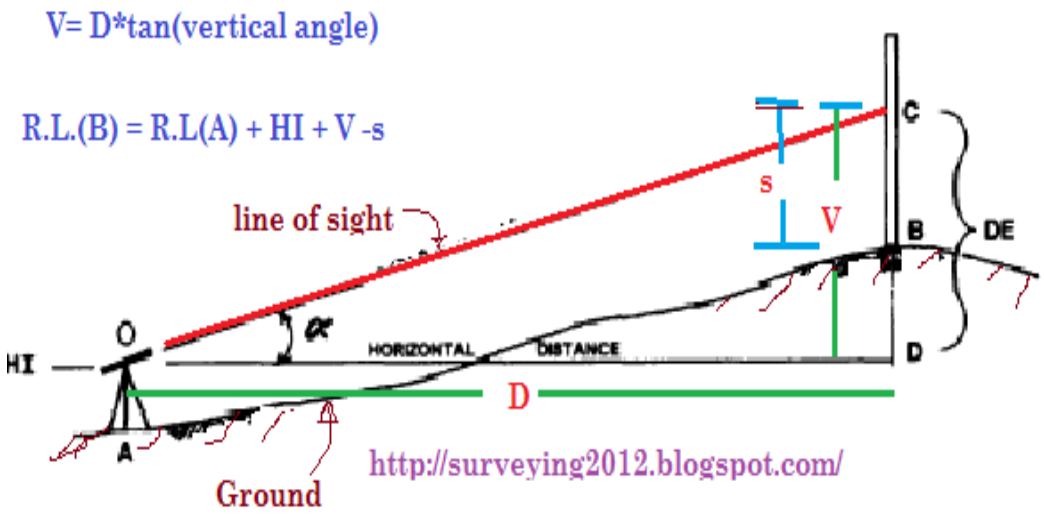


Figure. Trigonometric leveling

OBSERVATIONS AND CALCULATIONS:

AE=D tan α

R.L of A =R.L of BM+ h + D tan α

If the distance D is large, combined correction for curvature and refraction has to be applied.

Then, R.L of A= R.L of B.M + h +D tan α-0.0673(D/1000)2

RESULTS:

EXERCISE -2

ELEVATION OF AN POINT WHEN BASE IS NOT ACCESSIBLE

OBJECTIVE:

To determine the Elevation of an inaccessible point when base is not accessible**.**

RESOURCES:

S.No	Name of the equipment	Rage	type	quantity
1	Theodolite			1
2	Taps			1
3	Arrows			4
4	Ranging rods			4
5	Tripod			1

PERCAUTIONS:

a) Temporary adjustment for Theodolite

b) Leveling and centering

c) Focusing adjustment

PROCEDURE:

Let A be the inaccessible point A whose elevation is to be determined

1) Set up the theodolite at station B at a convenient position so that the object A can be sighted and level the instrument accurately by the altitude level.

2) Sight the object and read the vertical angle EB'A=α1.

3) With both motions of plates clamped, plunge the telescope and mark a station C in the line of sight at a suitable distance d from B so that points, A, B, C lie in the same vertical plane.

4) With line of sight horizontal, take the staff readings s1 on a nearby B.M. to establish the R.L. of the plane of collimation.

5) Shift the instrument and set it up exactly over C and level it accurately.

6) With line of sight horizontal, take the staff reading s2 on the B.M. to establish the level of plane of collimation at C.

7) Sight object A, bisect it accurately and read the vertical angle α2 to A form C,

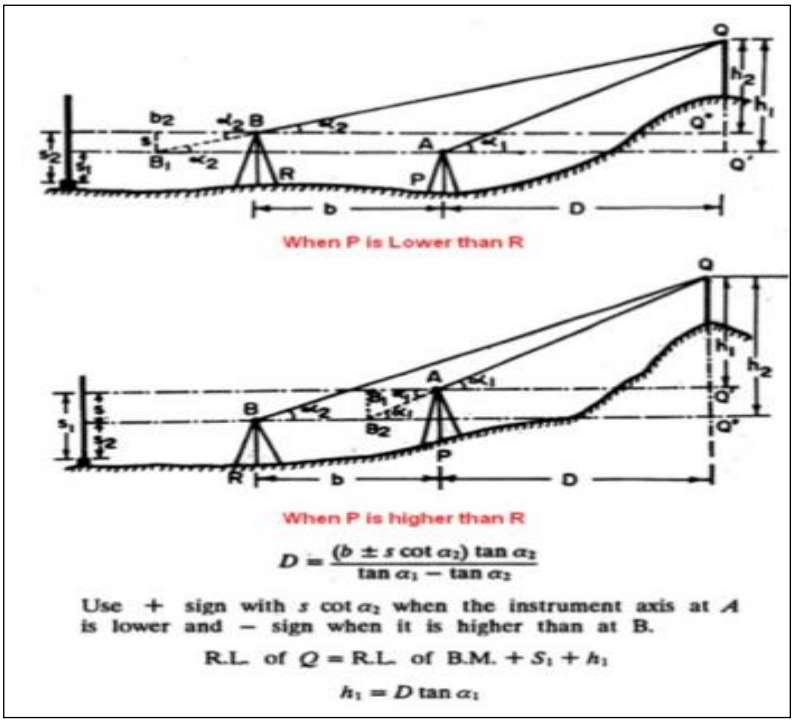
h=AE.tanα1

h= (h1+d tan α2) tan α1/tanα1-tan α2

R.L of A =R.L of B.M + staff reading s1+h

Note: if line of collimation is higher at B than at C, value of d must be taken as negative.

DIAGRAM:



TABULATION:

Inst. Station	Height of axis	Staff Stations	Vertical Angle	Hair readings	Remarks

h=AE.tanα1

h= (h1+d tan α2) tan α1/tanα1-tan α2

R.L of A =R.L of B.M + staff reading s1+h

RESULTS:

PRE-LAB VIVA QUESTIONS:

What is indirect leveling?
What is trigonometric leveling?

LAB ASSIGNMENT:

Determine the Elevation of an inaccessible point whose base is accessible tv tower

POST-LAB VIVA QUESTIONS:

a. What are stadia reading?

b. Explain the procedure?

c. What is stadia intercept?

WEEK – 9

HEIGHTS AND DISTANCE USING PRINCIPLES OF TACHEOMETRIC SURVEYING

OBJECTIVE:

To find the heights and distance using principles of Tachometric surveying

RESOURCE:

S.no	Name of the equipment	Rage	type	quantity
1	Theodolite			1
2	Taps			1
3	Arrows			4
4	Ranging rods			4
5	Tripod			1

PERCAUTIONS:

a) Temporary adjustment for Theodolite

b) Leveling and centering

c) Focusing adjustment

PROCEDURE:

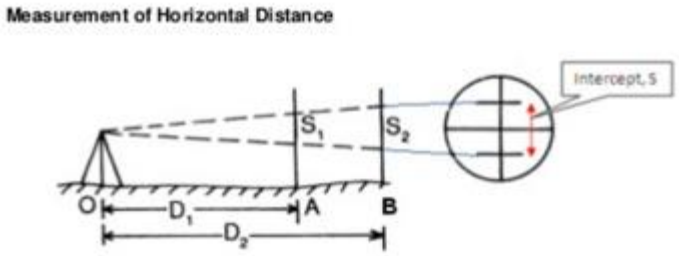
This method is used when the Theodolite is not equipped with a stadia diaphragm. In this method, angular observations are made for two vanes at a fixed vertical distance between them usually 3 m and the horizontal and the vertical distances are computed.

1. Setup the instrument at one end of a straight line say 50m
2. Drive pegs at 10m, 20m, 25m and at 50m lengths...
3. Keep the staff on the pegs and observe the corresponding staff intercepts with horizontal sight.
4. Knowing the values of ‘S’ and corresponding ‘D’ values for different peg intervals a number of similar equations can be formed by substituting the values of ‘S’ and ‘D’ in equation

D = KS + C

5. The simultaneous equations are taken two at a time to find the values of ‘K’ and ‘C’.
6. The average values of ‘K’ and ‘C’ are found.

DIAGRAM:



RESULTS:

PRE-LAB VIVA QUESTIONS:

1. What is tachometric leveling?
2. How are the cross hairs in the tachometric?

LAB ASSIGNMENT:

Determine the Heights and Distance of a tower Using Principles of Tachometric Surveying.

POST-LAB VIVA QUESTIONS:

1. What are stadia reading?
2. Explain the procedure?
3. What is stadia intercept?

WEEK – 10
CURVE SETTING –DIFFERENT METHODS

OBJECTIVE:
Setting the curve by Rankine's method of deflection angle

RESOURCE:

S.No	Name of the equipment	Rage	type	quantity
1	Theodolite			1
2	Taps			1
3	Arrows			4
4	Ranging rods			4
5	Tripod			1

PERCAUTIONS:

a) Temporary adjustment for Thedolite

b) Leveling and centering

c) Focusing adjustment

PROCEDURE:

1) Locate P.C. (T1), P.T (T2) and P.I. (I).

2) Set up the theodolite exactly at T1 and make its temporary adjustments.

3) Set up vernier A to zero and bisect the P.I Clamp the lower plate.

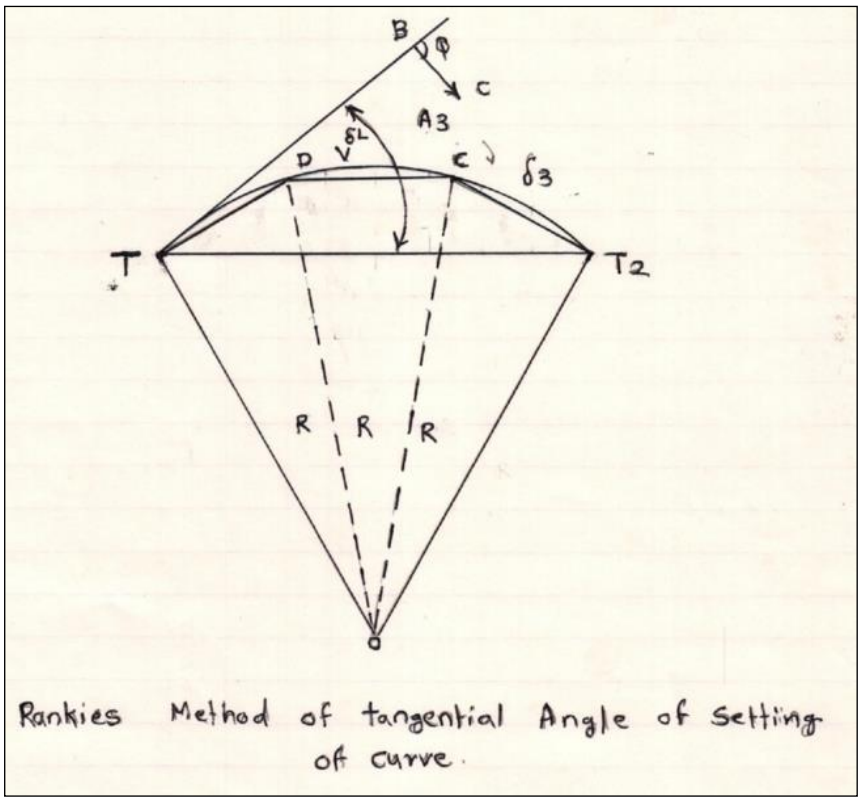
4) Release the upper plate and set the vernier A to read Δ1. The line of sight is thus directed along T1a.

5) Hold the zero tape at t1, take a distance C1 (T1a) and swing the tape with an arrow till it is bisected by the theodolite. This establishes the first point in the curve.

6) Set the second deflection angle Δ2. On the scale so that lime of sight is set along T1b. 7) With zero of the of the tape held at a and an arrow at the other end (chord distance=ab), swing the tape about a, till the arrow is bisected by the theodolite at b, this establishes the second point b on the curve.

8) The same steps are repeated till the last point T2 is reached.

DIAGRAM:



CALCULATION:

Now, for the first tangential angle δ_1, from the property of a circle

$$\text{Arc } T_1 a = R \times 2\delta_1 \text{ radians}$$

Assuming the length of the arc is same as that of its chord, if C_1 is the length of the first chord i.e., chord $T_1 a$, then

$$\delta_1 = \frac{C_1}{2R} \text{ radians}$$

$$= \frac{180^\circ C_1}{2\pi R} \text{ degrees}$$

$$= \frac{180 \times 60 C_1}{2\pi R} \text{ minutes}$$

$$= 1718.9 \frac{C_1}{R} \text{ minutes}$$

(Note: the units of measurement of chord and that of the radius of the curve should be same).

Similarly, tangential angles for chords of nominal length, say C,

$$\delta = 1718.9 \frac{C}{R} \text{ minutes}$$

And for last chord of length, say C_n

$$\delta_n = 1718.9 \frac{C_n}{R} \text{ minutes}$$

The deflection angles for the different points a, b, c, etc. can be obtained from the tangential angles. For the first point a, the deflection angle Δ_a is equal to the tangential angle of the chord to this point i.e., δ_1. Thus,

$$\Delta_a = \delta_1.$$

The deflection angle to the next point i.e., b is Δ_b for which the chord length is T_1 b. Thus, the deflection angle

$$\Delta_b = \frac{1}{2} \angle T_1 O b$$

$$= \frac{1}{2}(2\delta_1 + 2\delta)$$

$$= \Delta_a + \delta$$

Similarly, $\Delta_C = \frac{1}{2} \angle T_1 O c$

$$= \frac{1}{2}(2\delta_1 + 2\delta + 2\delta).$$

$$= \Delta_b + \delta$$

Like wise, $\Delta_n = \Delta_{n-1} + \delta_n$

Thus, the deflection angle for any point on the curve is the deflection angle upto previous point plus the tangential angle at the previous point.

RESULTS:

PRE-LAB VIVA QUESTIONS:

1. Define curve.
2. What I s a chord, how it is formed?
3. What does the Rankins method say?

LAB ASSIGNMENT:

a. Setting the curve by given two points T1 and T2

POST-LAB VIVA QUESTIONS:

Procedure for curve settings
What are the deflection angles in the curve?

WEEK – 11
DETERMINATION OF AREA USING TOTAL STATION

OBJECTIVE:

To find the area of a closed traverse using total station.

RESOURCE:

S.No	Name of the equipment	Rage	Type	Quantity
1	Total station			1
2	Prism			1
3	Tripod			1
4	Pegs			

PERCAUTIONS:

a) Temporary adjustment for total station

b) Leveling and centering

c) Focusing adjustment

PROCEDURE:

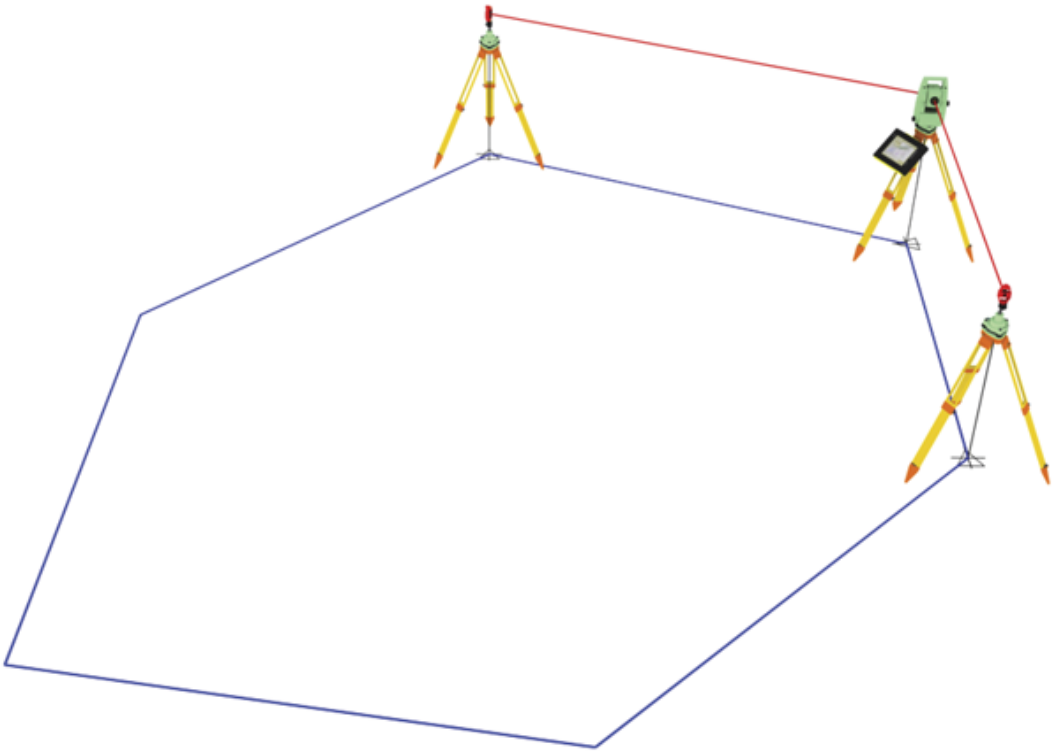
1. Fix the total station over a station and level it
2. press the power button to switch on the instrument.
3. select MODE B -------> S function------->file management------>create(enter a name)------->accept
4. then press ESC to go to the starting page
5. then set zero by double clicking on 0 set(F3)
6. Then go to S function ------> measure-----> rectangular co-ordinate---->station --- >press enter.
7. Here enter the point number or name, instrument height and prism code.

PN .....
E.....
N.....
IH.....
PC.....

8. Then press accept(Fs)
9. Keep the reflecting prism on the first point and turn the total station to the prism ,focus it and bisect it exactly using a horizontal and vertical clamps.
10. Then select MEAS and the display panel will show the point specification
11. Now select edit and re-enter the point number or name point code and enter the prism height that we have set.
12. Then press MEAS/SAVE (F3) so that the measurement to the first point will automatically be saved and the display panel will show the second point.
13. Then turn the total station to second point and do the same procedure.
14. Repeat the steps to the rest of the stations and close the traverse

15. Now go to S function----> view/edit----graphical view.
16. It will show the graphical view of the traverse.
17. Select S function---> calculation---> 2D surface----> All------> accept
18. This will give the area of the closed traverse.

DIAGRAM:



CALCULATION:

Select S function---> calculation---> 2D surface----> All------> accept

RESULTS:

PRE-LAB VIVA QUESTIONS:

1. What is the temporary adjustment for total station?
2. What is the instrument used for ranging

LAB ASSIGNMENT:

To find the area of a closed traverse using stations by using total station

POST-LAB VIVA QUESTIONS:

1. What Total station operations
2. What is the command we use for horizontal station

WEEK – 12

DETERMINATION OF REMOTE HEIGHT USING TOTAL STATION

OBJECTIVE:

To find the height of a remote point using total station.

RESOURCE:

S.No	Name of the equipment	Rage	Type	Quantity
1	total station			1
2	Prism			1
3	Tripod			1
4	Pegs			

PERCAUTIONS:

a) Temporary adjustment for total station

b) Leveling and centering

c) Focusing adjustment

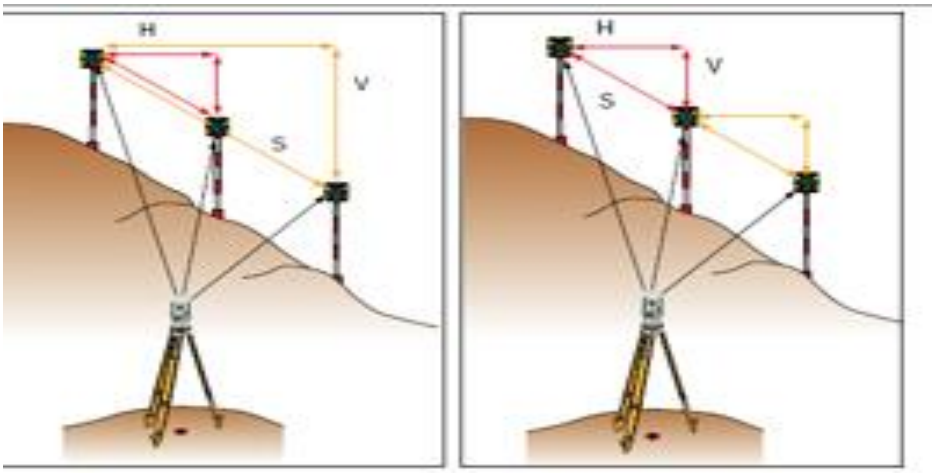
PROCEDURE:

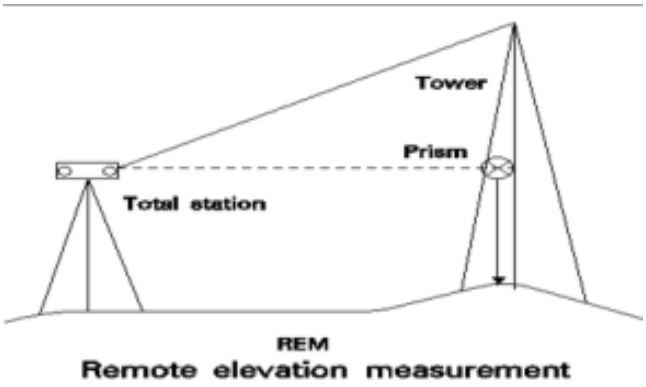
1. Fix the total station over a station and level it
2. Press the power button to switch on the instrument.
3. Select MODE B -------> S function-------->file management------>create(enter a name)------->accept
4. Press ESC to go to the starting page
5. Then set zero by double clicking on 0 set(F3)
6. Then go to S function ------> measure-----> rectangular co-ordinate---->station --- >press enter.
7. Here enter the point number or name, instrument height and prism code.

PN .....
E.....
N.....
IH.....
PC.....

8. Then press accept (Fs)
9. Setup a reflector vertically beneath the point, the height of which is to be determined.
10. Enter the reflector height, target to it, and measure the distance.
11. Target the high point.
12. The height difference H between the ground point and the high point is now calculated and displayed at the touch of a button

DIAGRAM:





CALCULATION:

Select S function---> calculation---> 2D surface---->All------> accept

RESULTS:

PRE-LAB VIVA QUESTIONS:

1. What is the temporary adjustment for total station?
2. What is the instrument used for ranging?
3. How to find out the Height of the Tower by using Total Station?

LAB ASSIGNMENT:

Counter plan of given area (One full size drawing sheet) using total station

POST-LAB VIVA QUESTIONS:

1. What Total station operations?
2. Commends for linear measurement.
3. What is the command we use for vertical station?