SURVEYING LAB MANUAL

DEPARTMENT OF CIVIL ENGINEERING

MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NBA and NAAC with 'A' Grade & Recognized Under Section2(f) & 12(B)of the UGC act,1956

2022-2023

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CERTIFICATE

This is to certify that this manual is a bonafide record of practical work in the **Surveying Lab** in **First Semester of Second year B.Tech (Civil) programme** during the academic year **2022-23**. The book is prepared by **Dr. M. Harihanandh, Associate Professor, Department of Civil Engineering, Mr. T.Jaya Krishna, Assistant Professor, Department of Civil Engineering, Mr. N. Krishnarao, Assistant Professor, Department of Civil Engineering.**

Signature of HOD Signature of Dean Academics Signature of Principal

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PREFACE

This book entitled "SURVEYING LAB MANUAL" is intended for the use of third semester (i.e, II Year –I Semester) B.Tech (Civil) students of Marri Laxman Reddy Institute of Technology and Management, Dundigal, Hyderabad. The main objective of the SURVEYING LAB Manual is to teach the student to impart the practical knowledge in the field to set out any Civil Engineering work, especially in advanced surveying. This book lays foundation of certain basic concepts and skills that can be repeatedly employed by the students in their future endeavours. The main aim of this book is to develop the habit of scientific reasoning and providing answers to all the doubts that arise during the course of conducting experiments. The book was written as per the new syllabus framed for MLRITM (Autonomous Institution) recommended by the BOS Committee members in a simple language. These experiments will help the students to expertise in the advanced surveying. Hence, we hope this book serve for better understanding by the student community with all details of experiments

By,

Dr. M.Harihanandh

Associate Professor,

Department of Civil Engineering

ACKNOWLEDGEMENT

It was really a good experience, working at SURVEYING Lab. First, I would like to thank Mr. T. Jayakrishna, Assistant Professor and Mr. N. Krishnarao, Assistant Professor, Department of Civil Engineering, Marri Laxman Reddy Institute of Technology and Management for giving the technical support in preparing the document.

I express my sincere thanks to Mr.K.Murali, Head of the Department, Civil Engineering, Marri Laxman Reddy Institute of Technology and Management, for his concern towards me and gave the opportunity to prepare Surveying laboratory manual.

I express my hearty thanks to Dr.K.Venkateswara Reddy, Principal, Marri Laxman Reddy Institute of Technology and Management, for giving me this wonderful opportunity for preparing the Surveying laboratory manual.

At last, but not the least I would like to thanks the entire Civil Department faculties those who had inspired and helped me to achieve my goal.

By,

Dr. M.Harihanandh

Associate Professor,

Department of Civil Engineering

GENERAL INSTRUCTIONS

1. Students are instructed to come to SURVEYING laboratory on time. Late comers are not entertained in the lab.

2. Students should be punctual to the lab. If not, conducted experiments will not be repeated.

3. Students are expected to come prepared at home with the experiments which are going to performed.

4. Students are instructed to display their identity cards and apron before entering into the lab.

5. Students are instructed not to bring mobile phones to the lab.

6. The surveying equipment's used in SURVEYING lab should be handled with care and responsibility.

7. Any damage to the equipment's during the lab session is student's responsibility and penalty or fine will be collected from the student.

8. Students should update the records and lab observation books session wise. Before leaving the lab, the student should get his lab observation book signed by the faculty.

9. Students should submit the lab records 2/3 days in advance to the concerned faculty members in the staffroom for their correction and return.

10. Students should not move around the lab during the lab session.

11. If any emergency arises, the student should take the permission from faculty member concerned in written format.

12. The faculty members may suspend any student from the lab session on disciplinary grounds.

SAFETY PRECAUTIONS

1. While working in the laboratory suitable precautions should be observed to prevent accidents.

2. Always follow the experimental instructions strictly.

3. Use the first aid box in case of any accident/mishap.

4. Never work in the laboratory unless a demonstrator or teaching assistant in present.

5. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.

INSTITUTION VISION AND MISSION

VISION

To establish as an ideal academic institutions in the service of the nation, the world and the humanity by graduating talented engineers to be ethically strong, globally competent by conducting high quality research, developing breakthrough technologies, and disseminating and preserving technical knowledge.

MISSION

To fulfil the promised vision through the following strategic characteristics and aspirations:

- ❖ Utilize rigorous educational experience to produce talented engineers
- ❖ Create an atmosphere that facilitates the success of the students
- ❖ Prudent and accountable resource management.
- ❖ Programs that integrate global awareness, communication skills and leadership abilities.
- ❖ Education and Research partnerships with institutions and industries for preparing the students for interdisciplinary research
- ❖ Successful alumni in their profession at global level.

DEPARTMENT VISION, MISSION , PROGRAMME EDUCATIONAL OBJECTIVES AND SPECIFIC OUTCOMES

VISION

The Civil Engineering department strives to impart quality education by extracting the innovative skills of students and to face the challenges in latest technological advancements and to serve the society.

MISSION

Provide quality education and to motivate students towards

professionalism.M-II Address the advanced technologies in research and

industrial issues.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS) PEO's

The Programme Educational Objectives (PEOs) that are formulated for the civil engineering programme are listed below:

PEO-I Solving civil engineering problems in different circumstances

PEO-II Pursue higher education and research for professional development.

PEO-III Inculcate qualities of leadership for technology innovation and entrepreneurship

PROGRAM SPECIFIC OUUTCOMES

PSO 1 - UNDERSTANDING: Graduates will have ability to describe, analyse and solve problems using mathematical, scientific, and engineering knowledge.

PSO 2 - ANALYTICAL SKILLS: Graduates will have an ability to plan, execute, maintain, manage, and rehabilitate civil engineering systems and processes.

PSO 3 - EXECUTIVE SKILLS: Graduates will have an ability to interact and work effectively in multi disciplinary teams.

PROGRAMME OUT COMES

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **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.
12. **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.

COURSE STRUCTURE, OBJECTIVES & OUTCOMES

COURSE STRUCTURE

SURVEYING lab will have a continuous evaluation during 2nd year 1st semester for 30 sessiosnal marks and 70 end semester examination marks.

Out of the 30 marks for internal evaluation, day-to-day work in the laboratory shall be evaluated for 20 marks and internal practical examination shall be evaluated for 10 marks conducted by the laboratory teacher concerned.

The end semester examination shall be conducted with an external examiner and internal examiner. The external examiner shall be appointed by the principal / Chief Controller of examinations

COURSE OBJECTIVE

The objective of this lab is to teach the student the practical knowledge in the field to set out any Civil Engineering work to,

- Know the principles and methods of surveying using different equipments & methods
- Determination of distance, area using chain, compass and plane table surveying
- Recording of observation accurately and Perform calculations based on the observation
- Identification of source of errors and rectification methods
- Apply surveying principles to determine areas and volumes and setting out curves
- Understand the concept of advanced techniques and operation of modern equipment and perform various experiments by using that.

COURSE OUTCOME

At the end of the course, the student will be able to:

- Measure the distance, area of the field using the instruments chain, compass, plane table and plot the same.
- Know the concepts of leveling, and perform & plot the cross & longitudinal sectioning.
- Measurement of angles using theodolite, and calculate the distance and elevation of the given point using trigonometric leveling and tacheometric leveling.
- Understand the concepts of EDM, and calculate the distance, area of the field
- Perform the traverse and plot the contour map for the obtained data.
- Locate the position of points using stake out method, perform the curve using modern equipment.

COURSE ARTICULATION MATRIX (CO - PO / PSO MAPPING):

Program outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	PSO 3
CE216.1	3	3	3	3	3	0	0	0	3	0	0	3	3	3	3
CE216.2	3	3	3	3	3	0	0	0	3	0	0	3	3	3	3
CE216.3	3	3	3	3	3	0	0	0	3	0	0	3	3	3	3
CE216.4	3	3	3	3	3	0	0	0	3	0	0	3	3	3	3
CE216.5	3	3	3	3	3	0	0	0	3	0	0	3	3	3	3
CE216.6	3	3	3	3	3	0	0	0	3	0	0	3	3	3	3
Total	18	18	18	18	18	0	0	0	18	0	0	18	18	18	18
Average	3	3	3	3	3	0	0	0	3	0	0	3	3	3	3

LIST OF EXPERIMENTS

1. Surveying of an area by chain and compass survey (closed traverse) & plotting.
2. Determine of distance between two inaccessible points with compass
3. Radiation method, intersection methods by plane table survey.
4. Levelling – Longitudinal and cross-section and plotting
5. Measurement of Horizontal and vertical angle by theodolite
6. Trigonometric leveling using theodolite
7. Height and distances using principles of tachometric surveying
8. Determination of height, remote elevation, distance between inaccessible points using total station
9. Determination of Area using total station and drawing map
10. Traversing using total station for drawing contour map
11. Stake out using total station
12. Setting out Curve using total station

Ex. No: 1

Date:

SURVEYING OF AN AREA BY CHAIN AND COMPASS SURVEY (CLOSED TRAVERSE) & PLOTTING

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

Instruments: Chain, Tape, Ranging Rods, Arrows, cross Staff.

Chain Chains of 20 m and 30 m are used to lay and measure main survey lines and long distant offsets. These chains are divided into 100 links. The length of each link is 20 cm and 30 cm for 20 m and 30mchains respectively.

Tape: Tape of 30 m length is used. The tape is used to take perpendicular offsets for smaller lengths.

Ranging rods: Steel tubular ranging rods 2 m or 3 m long are used. These are used for marking a point in such a way that the position of the point can be clearly and exactly seen from some distance away.

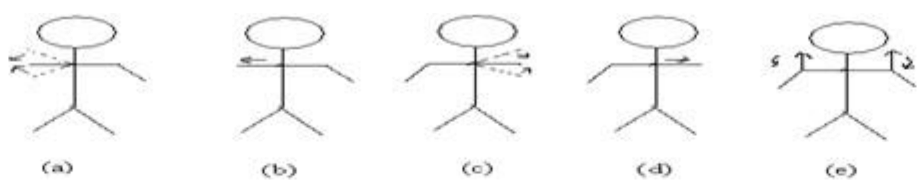
Arrows: 40 cm long steel arrows are used to mark the end of each chain during the chaining process.

Cross-staff: This instrument is used for setting right angles or perpendicular offsets of objects from main chain line.

Code of Signals: The code of signals shown in Table 1 should be followed by the surveyors while ranging a survey line using chain, to direct or convey message to the other surveyors or assistants in order to bring all the intermediate points in alignment with the end points in a chain line.

Table 1: Code of Signal

Signal given by the Surveyor	Meaning of the signal to the Assistant
1. Rapid sweep with right hand (Fig.a) 2. Slow sweep with right hand. 3. Right arm extended (Fig.). 4. Right arm up and moved to the right.	Move considerably in that direction (to your left). Move slowly to your left. Continue to move to your left. Plumb the rod to your left.
5. Rapid sweep with left hand (Fig.) 6. Slow sweep with left hand. 7. Left arm extended (Fig.). 8. Left arm up and moved to the left.	Move considerably in that direction (to your right). Move slowly to your right. Continue to move your right. Plumb the rod to your right.
9. Both hands above head and brought down (Fig.). 10. Both arms extended forward horizontally and the hands brought down quickly.	Ranging is correct. Fix the ranging rod.



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.

Procedure:

- 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):

Note: This procedure is general procedure only. This procedure varies with the experiment given to students. Therefore students are required to write the procedure according to the experiment given to them.

- 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 lying 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.

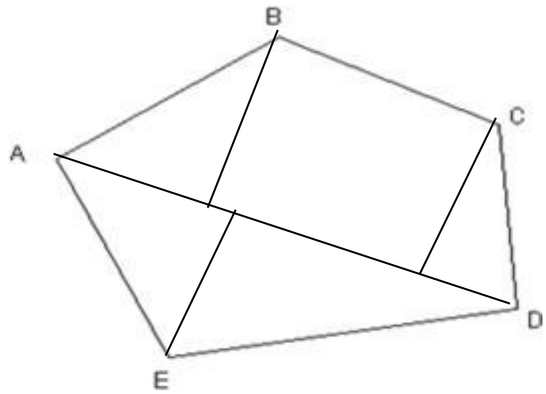


Fig 1: Survey of an Open Field (Closed Traverse)

Area Calculations:

Note: Areas of all triangles and trapeziums are calculated and added together to calculate the total area of open field (Closed Traverse) as described in class.

Calculations:

S.No	Description of sketch	Formula	Substitution	Area (m^2)

Formula:

For Triangle Shape, Area = $\sqrt{(s*(s-a)*(s-b)*(s-c))}$

Where, $s = (a+b+c) / 2$

Result:

The total Area of the given Open Field by Chain Survey =...........................Sqm.

Aim: To survey an area (Closed Traverse) by Compass Survey and to plot the area.

Instruments: Chain, Tape, Ranging Rods, Arrows, Prismatic Compass, Tripod.

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. Q1, Q2, Q3, etc in Fig 1 represent WCBs.

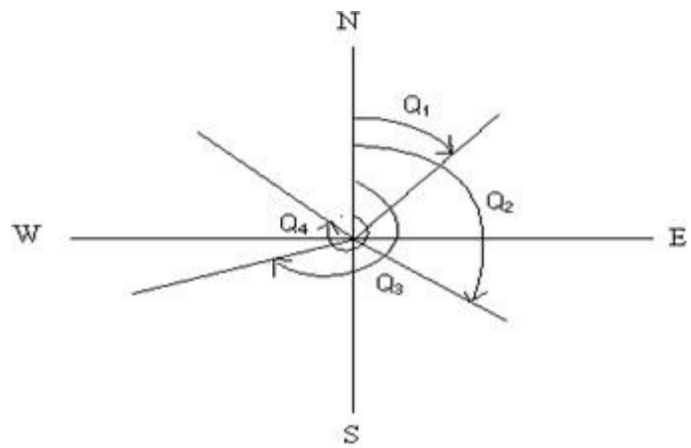


Fig 1

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.

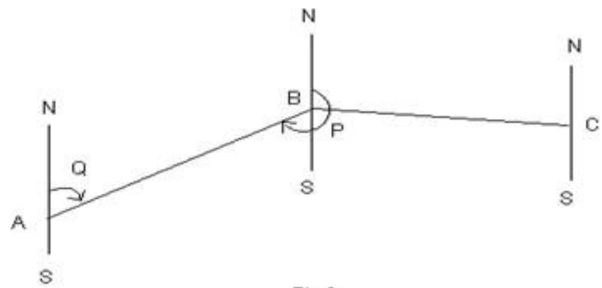


Fig 2

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.

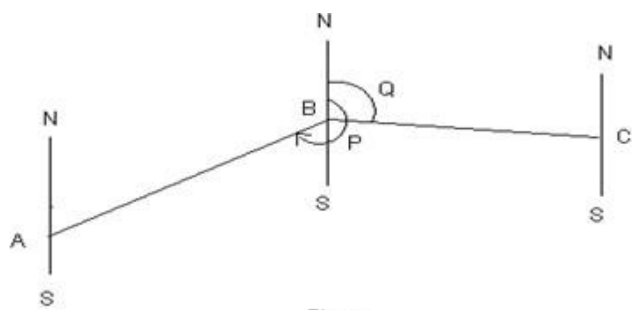


Fig 3

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.

Procedure:

Note: This procedure is general procedure only. This procedure, figures and table vary with the experiment given to students. Therefore students are required to write the procedure and draw figures and table according to the experiment given to them.

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.

Observations and Tabulations:

Line	**Observed**		**Corrected (If any local attraction)**		**Included Angle (BB of previous Line - FB of next line)**	**Distance (m)**	**Remarks**
	FB	**BB**	**FB**	**BB**			
AB							
BC							
CD							
DE							
EA							

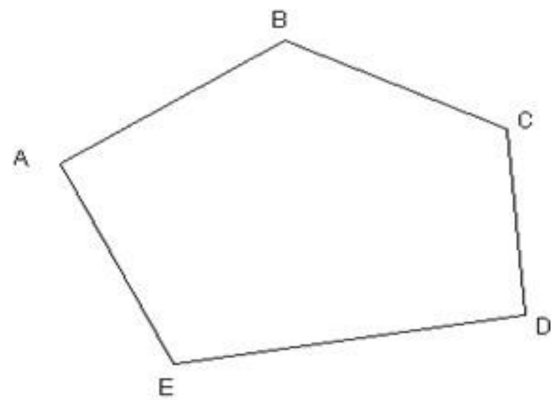


Fig 4

If the traverse running in anti clockwise direction,

Sum of included angle = $(2n + 4) \times 90^0$

Also the included angle = Exterior angle

If the traverse running in clockwise direction,

Sum of included angle = $(2n - 4) \times 90^0$

Also the included angle = Interior angle

Where, n=Number of sides of closed traverse.

Result:

Distances,

AB =

BC =

CD =

DE =

EA =

Included Angles:

Angle A=

Angle B=

Angle C=

Angle D=

Angle E=

The area of the given field = ... Sqm.

Viva Questions:

1. Define surveying.
2. How you can classify the surveying based on field?
3. What the common accessories used for surveying?
4. How you can erect perpendiculars using chain/tape from main chain line/
5. How you make parallel line for the chain line using chain/tape?
6. At what interval the tags and tallies are fixed in the chain?
7. What is the fundamental difference between surveying and leveling?
8. What is the fundamental difference between plane surveying and geodetic surveying?
9. What do you mean by terms "topographical map" and cadastral map?
10. What are the main principles of surveying?
11. How is a chain folded and unfolded?
12. In a chaining operation, who is the leader and who is the follower?
13. While chaining a line, if you have to measure through a steep sloping ground, what method should you apply?
14. Two stations are not intervisible due to intervening high ground. How will you range the line?
15. How many ranging rods are required to range a line?
16. What is the length of one link in a 20m chain?
17. What do you mean by triangulation?
18. Why is the triangle preferred to the quadrilateral?
19. What is reconnaissance survey?
20. What is base line of survey?
21. How is the north line of the chain survey map fixed?
22. Suppose you are asked to conduct a chain survey in a crowded town what would you say?
23. What should be the maximum length of the offset?
24. How will you set up a perpendicular with the help of only a chain and tape?
25. Who are the leader and follower when a line is being chained?
26. Why does the field book open lengthwise?
27. What is chaining?
28. Instruments used in Chain Surveying?

29. How many links are in 30m Metric Chain? Length of each link?
30. Reciprocal Ranging?
31. What is the height of pegs?
32. The rapid sway of right hand by the surveyor indicates?
33. The rapid sway of left hand by the surveyor indicates?
34. If the both arms are extended, and suddenly dropped down by the surveyor means, what should that indicates?
35. Principle of Chain Surveying?
36. What is well-conditioned triangle?
37. What is Reconnaissance Survey?
38. What is Field Book?
39. What is it necessary to provide tallies in a chain?
40. What do you mean by the term ideal triangle?
41. Objective and Uses of Surveying?
42. Methods of Surveying?
    a. Triangulation
    b. Traversing

Ex.No: 2

Date:

DETERMINE THE DISTANCE BETWEEN TWO INACCESSIBLE POINTS WITH COMPASS

Aim: To determine distance between two inaccessible points using Prismatic Compass.

Instruments: Chain, Tape, Ranging Rods, Arrows, Prismatic Compass, Tripod.

Prismatic Compass: It is a compass where the graduated ring is attached with the needle and does not rotate with line of sight. As the name implies a prism is provided at the Eye Vane end so that the readings on graduated ring are read through the prism. Graduations are engraved inverted since the graduated ring is read through the prism.

The minimum angle between two adjacent graduations is 30^0.

The advantage of this compass is that both sighting and reading can be done simultaneously.

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 centre 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.

Leveling: 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 ABCD be a traverse of which the angle at A and B to be measured. The compass is set up at point A and focus the point C, note down the value of angle in the graduated ring, then the point D is sighted and the reading on graduated ring is noted down. The difference of those two reading gives the angle at A which is an angle between line AC and line AD. Similarly the angle from point B, towards point C and D has been noted.

Procedure for measuring inaccessible distance between two points:

Let C and D be the two inaccessible points whose distance to be measured. A point A and B is established for the known distance (d), and that line AB is parallel to line CD approximately.

Let, find the distance of side AD(P) and AC (Q) using sine rule from the triangles ABD and ACD.

After finding the distance, P and Q, from the triangle ACD and using cosine rule, calculate the inaccessible distance between the points C&D.

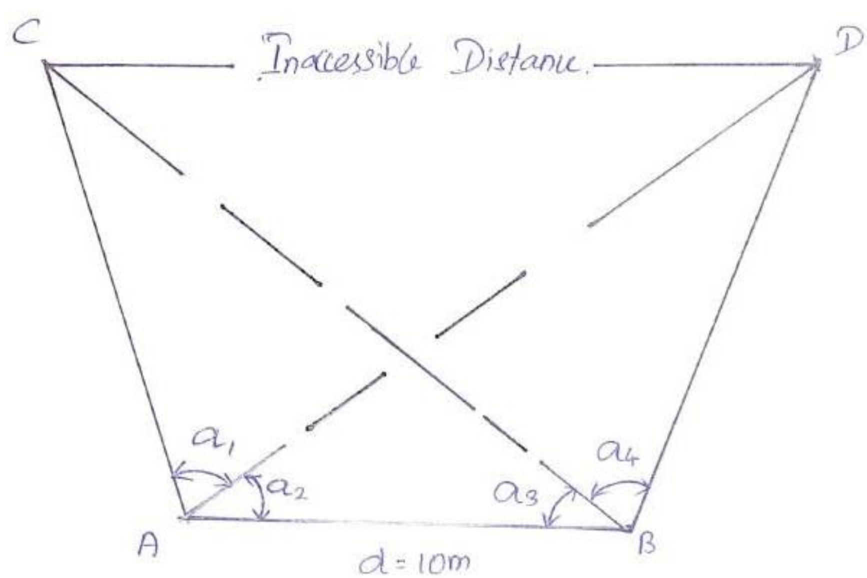
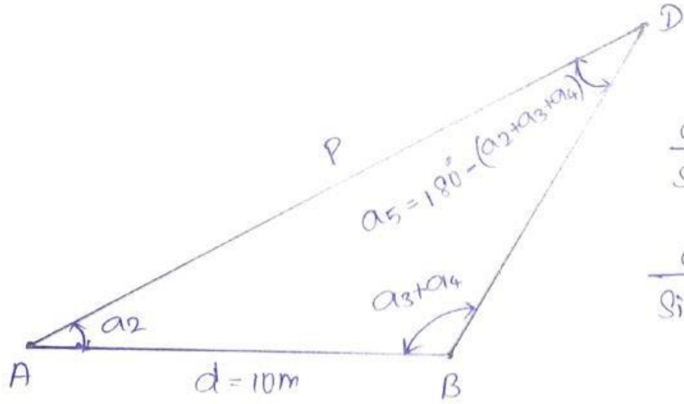


Fig. 1

$\triangle ABD$



$$\frac{d}{\sin a_5} = \frac{AD}{\sin(a_3 + a_4)}$$

$$\frac{d}{\sin a_5} = \frac{P}{\sin(a_3 + a_4)}$$

$P =$ ________ m

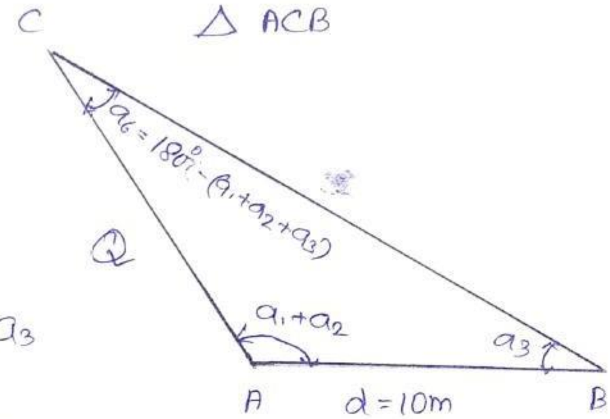
$$\frac{d}{\sin a_6} = \frac{AC}{\sin a_3}$$

$$\frac{d}{\sin a_6} = \frac{Q}{\sin a_3}$$

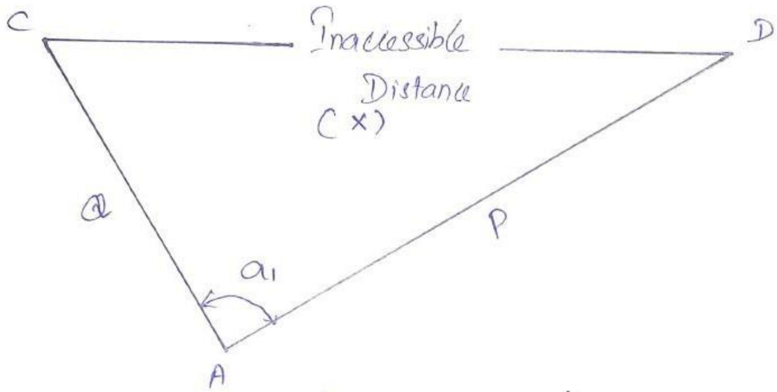
$$\therefore Q = \frac{d}{\sin a_6} * \sin a_3$$

$\therefore Q =$ ________ m.

$\triangle ACB$



Δ ACD



Using Cosine rule,

$$CD^2 = AC^2 + AD^2 - 2AC.AD. \cos a_1$$

$$x^2 = P^2 + Q^2 - 2.P.Q. \cos a_1$$

$$\therefore \text{Distance}, \ x = \sqrt{P^2 + Q^2 - 2.P.Q. \cos a_1}$$

$$\therefore x = \_\_\_\_\_\_\_\_ m$$

Calculations:

Note: All calculations should be shown here. Result:

The distance between the two inaccessible points A & B,= m

Instructions to students:

Your are required draw a rough sketch of Fig 1, with all measurements and angles should be drawn to a ***suitable scale****.*

Result:

The distance between the two inaccessible points =.....................................m

Viva Questions:

1. There are two stations A and B. Which of the following statements is correct :
    i. the fore bearing of AB is AB
    ii. the back bearing of AB is BA
    iii. the fore and back bearings of AB differ by 180°
    iv. all the above.

2. Back bearing of a line is equal to
    i. Fore bearing ± 90°
    ii. Fore bearing ± 180°
    iii. Fore bearing ± 360°
    iv. Fore bearing ± 270°

3. If whole circle bearing of a line is 120°, its reduced bearing is
    i. S 20° E ii. S 60° E iii. N 120° E iv. N 60° E

4. Reduced bearing of a line is an angle between
    i. north line and given line measured clockwise
    ii. north line and given line measured anticlockwise
    iii. east or west and the given line
    iv. given line and the part of the meridian whether N end or S end, lying adjacent to it.

5. The magnetic meridian at any point, is the direction indicated by a freely suspended
    i. magnetic needle
    ii. and properly balanced magnetic needle
    iii. properly balanced and uninfluenced by local attractive force
    iv. magnetic needle over an iron pivot

6. The zero of the graduated circle of a prismatic compass is located at
    i. north end ii. east end iii. south end iv. west end

7. The bearing of AB is 190° and that of CB is 260° 30'. The included angle ABC, is
    i. 80° 30' ii. 99° 30' iii. 70° 30' iv. none of these

8. The horizontal angle between true meridian and magnetic meridian, is known
    i. bearing
    ii. magnetic declination

iii. dip

iv. convergence.

9. Magnetic bearing of a survey line at any place

i. remains constant

ii. changes systematically

iii. varies differently in different months of the year

iv. is always greater than true bearing

10. Grid lines are parallel to

i. magnetic meridian of the central point of the grid

ii. line representing the central true meridian of the grid

iii. geographical equator

iv. none of these.

11. Magnetic declination at any place

i. remains constant

ii. does not remain constant

iii. fluctuates

iv. changes abruptly.

12. The reduced bearing of a line is N 87° W. Its whole circle bearing is

i. 87° ii. 273° iii. 93° iv. 3°

13. The vertical angle between longitudinal axis of a freely suspended magnetic needle and a horizontal line at its pivot, is known

i. Declination ii. Azimuth iii. Dip iv. Bearing.

14. True meridian of different places

i. converge from the south pole to the north pole

ii. converge from the north pole to the south pole

iii. converge from the equator to the poles

iv. run parallel to each other.

15. The main principle of surveying is to work

i. from part to the whole

ii. from whole to the part

iii. from higher level to the lower level

iv. from lower level to higher level.

16. A bearing of a line is also known as
    i. magnetic bearing
    ii. true bearing
    iii. azimuth
    iv. reduced bearing
17. True meridians are generally preferred to magnetic meridians because
    i. these converge to a point
    ii. these change due to change in time
    iii. these remain constant.
    iv. None of these.
18. The bearings of the lines AB and BC are 146° 30' and 68° 30'. The included angle ABC is
    i. 102° ii. 78° iii. 45° iv. none of these.
19. In quadrantal bearing system, back bearing of a line may be obtained from its forward bearing, by
    i. adding 180°, if the given bearing is less than 180°
    ii. subtracting 180°, if the given bearing, is more than 180°
    iii. changing the cardinal points, i.e. substituting N for S and E for W and vice-versa
    iv. none of these.
20. What is Magnetic Meridian?
21. Define true bearing.
22. Define true meridian.
23. What is Magnetic Bearing?
24. What is magnetic meridian?
25. What is Whole Circle Bearing (WCB)?
26. What is Quadrantal Bearing (QB)?
27. What is Fore Bearing?
28. What is Back Bearing?
29. What is Magnetic Declination?

30. What is Dip of the magnetic needle?
31. What is Local Attraction?
32. How locally attractions are found?
33. What are the methods available to remove the local attraction?
34. What is compass traversing?
35. What is Close Traverse?
36. What is Open Traverse?
37. What is closing error?
38. Write down the check on Closed Traverse

    Clockwise traverse =

    Anti-clock wise traverse =
39. How to adjust the closing error?
40. Write down the methods available to adjust closing error? And write which method is easiest?

Ex.No: 3

Date:

RADIATION METHOD, INTERSECTION METHODS BY PLANE TABLE SURVEY.

Aim:

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

Instruments:

Chain, Tape, Ranging Rods, Arrows, Plane Table with Tripod and its accessories, Two Drawing Sheets, Drawing Clips, Pencil, Eraser and Pins.

Plane Table Surveying:

It is the branch of surveying in which both field work and plotting are done simultaneously. The advantage of Plane Table Surveying is that as the field is in our view, omitting of any measurement is not possible and exact shapes of the areas can be drawn.

Drawing Board:

The Drawing Board is made of well-seasoned wood. The Drawing Board is mounted on a tripod by means of a screw and wing nut.

Alidade:

It is a brass ruler of about 50 – 60 cm in length. Two vanes, 'object vane' and 'sight vane' are hinged at its two ends. A scale is attached to the fudicial edge of alidade. This is used for sighting the object through object and sight vanes and to draw lines to a suitable scale along the judicial or ruling edge.

Trough Compass:

Usually it is 15 cm long and is provided to plot the magnetic meridian (N – S direction) to facilitate orientation of the plane table in the magnetic meridian.

Spirit Level:

The essential condition in plane table surveying is that the board should be level. This is usually accomplished with a circular spirit level.

Plumbing Fork:

It is a hairpin-shaped brass frame having two arms of equal length. One end of the frame is pointed and is kept over the drawing sheet touching the plotted position of the instrument station. The other end of the frame carries a plumb bob. The position of the plane table is adjusted until the plumb bob hangs over the station occupied by the instrument.

Indian Clinometer:

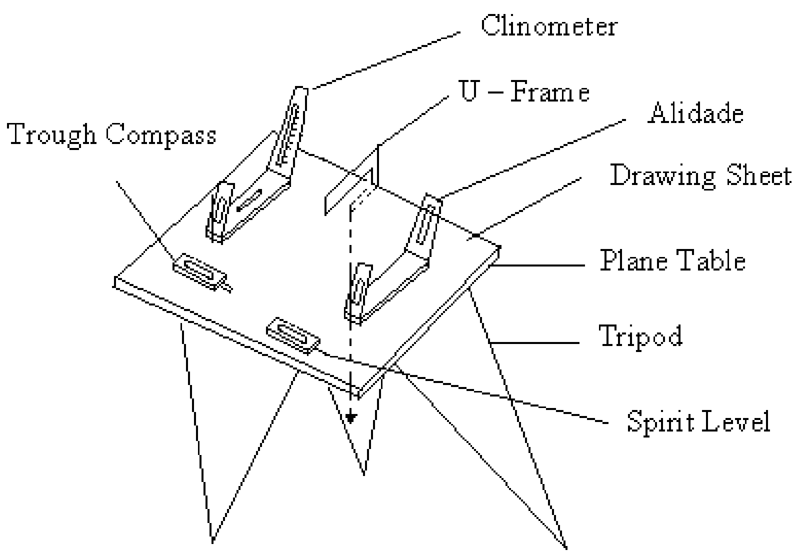
Since a large number of points of observation are required to plot contours in plane table survey, the direct or spirit levelling proves to be very slow and thus an Indian pattern Clinometer is employed to measure the levels of the ground.

Drawing Sheet:

The drawing sheet used should be of the best quality to withstand rubbing and scrubbing. Because of humidity, unequal expansion and contraction of the sheet may alter the scale and distort the map. It should never be rolled or folded and should be carried flat. The sheet should be well stretched and held firmly on the board to prevent any displacement of the sheet by the friction of the alidade.

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

Note: Students are required to draw this figure.



Temporary Adjustments:

SurfaceoftheboardshouldbeperpendiculartotheverticalaxisoftheInstrument:

This can be achieved by placing a spirit level over the plane table and moving the legs to make the bubble central. The table is then turned through 1800. The spirit level is now placed at 900 to its previous position and the bubble is again made central. The procedure is repeated and if the bubble remains central, the adjustment is correct.

To check this, draw a line along the ruling or fudicial edge, reverse the alidade and place it against the ends of the line. Again draw a line which should coincide with the previous line. If the two lines do not coincide, the edge is rubbed with sand paper and is corrected.

ThetwoVanesshouldbeperpendiculartotheBaseofAlidade:

Set the alidade on the corner edge of a building or on a suspended plumb bob. Set the alidade vanes along any of the above two. The plumb line and vane should coincide. If they do not coincide adjust from the hinges till the vane coincides with the plumb line.

Setting up the Plane Table:

Centering: It is the operation of bringing the plotted station point exactly over the ground station. To achieve this pointed leg of the plumbing fork is placed against the plotted point and the plumb bob is suspended from its other leg.

Levelling: It is the operation of bringing the plane table in a horizontal plane. The plane table is set at a convenient height, which is elbow level, by spreading the legs. The board is levelled with the help of spirit level.

Orientation: It is the operation of keeping the plane table parallel to the position it occupied at the first station. The plane table is set on a new station and the alidade is placed against the line joining the new station with the preceding station. The table is rotated until the line of sight bisects the previous station. This entire procedure is known as Orientation by Back Sighting.

Sighting Through Alidade and Taking Measurement:

Let A and B be the two points on the ground whose length is to be plotted on the plane table (Fig

1). The plane table is kept at station A and is set up as described before. Now the alidade is kept along the point ‘a’ which is the transferred point of A from ground to drawing sheet by plumbing fork.

Now the alidade is rotated along point ‘a’ until the ranging rod at ground station B is sighted through object vane and eye vane. The distance AB on the ground is measured and converted to a suitable scale. A point ‘b’ is marked along the alidade with the distance that is equal to the converted distance of AB. Now ‘ab’ is the required distance of line AB on the drawing sheet.

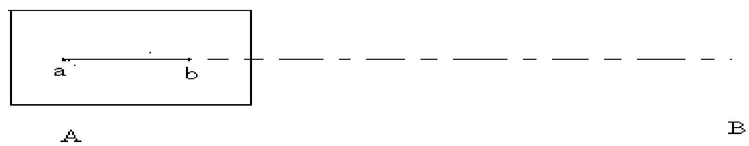


Fig 1

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.

Procedure:

Note: This procedure is general procedure only and varies with the given experiment. Students are required to write the procedure and draw figures according to the experiment given to them.

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.

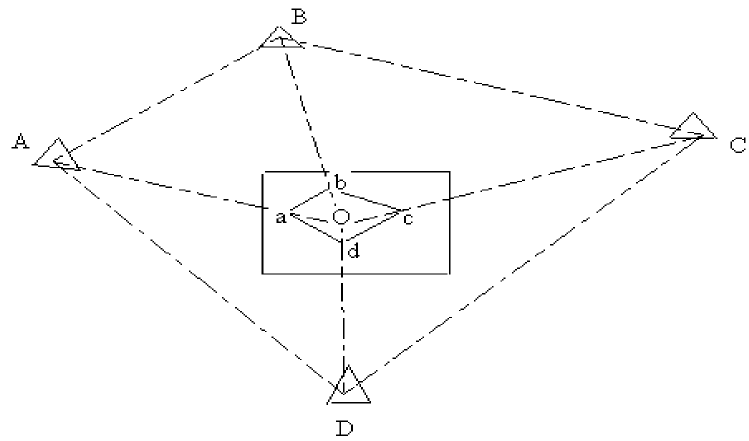


Fig 2

Result:

The area of the given field using radiation method =...Sqm

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.

Procedure:

Note: This procedure is general procedure only and varies with the given experiment. Students are required to write the procedure and draw figures according to the experiment given to them.

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

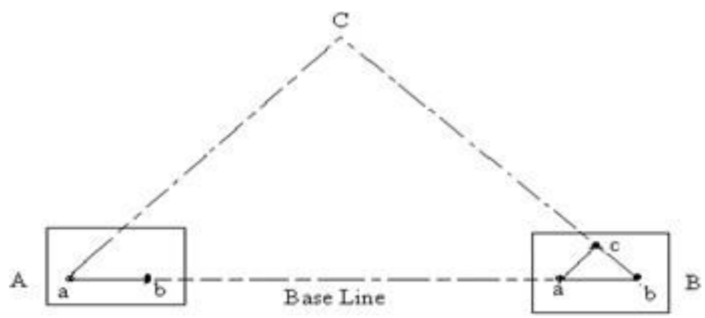


Fig 3

Instructions to Students:

There are no calculations and result in this experiment, but you are required to ***attach the two drawing sheets (the ones you have drawn on the field)*** *to the lab record after the last page of this experiment.*

Result:

The distance between the inaccessible point from station A & B are,

Distance AC =.. m

Distance BC =.. m

Viva Questions:

1. The distance between steps for measuring down hill to obtain better accuracy

   A) decreases with decrease of slope B) increases with increase of slope

   C) decreases with increase of slope D) decreases with decrease of weight of the chain

2. An ideal transition curve is

   A) cubic parabola B) cubic spiral

   C) clothoid spiral D) true spiral

3. The branch of surveying in which both horizontal and vertical positions of a point, are determined by making instrumental observations, is known

   A) tacheometry B) tachemetry

   C) telemetry D) all the above

4. For setting out a simple curve, using two theodolites.

   i. offsets from tangents are required
   ii. offsets from chord produced are required
   iii. offsets from long chord are required
   iv. deflection angles from Rankine's formula are required
   v. none of these

5. If a tacheometer is fitted with an anal-latic lens

   i. additive constant is 100, multiplying constant is zero
   ii. multiplying constant is 100, additive constant is zero
   iii. both multiplying and additive constants are 100
   iv. both multiplying and additive constants are 50

6. The branch of surveying in which both horizontal and vertical positions of a point, are determined by making instrumental observations, is known

   A) tacheometry B) tachemetry

   C) telemetry D) all the above

7. Designation of a curve is made by :

   A) angle subtended by a chord of any length B) angle subtended by an arc of specified length

   C) radius of the curve D) curvature of the curve

8. If a linear traverse follows a sharp curve round a large lake where it is difficult to have

long legs, the accuracy of the traverse may be improved by

i. taking short legs
ii. making repeated observations of angular and linear measurements
iii. making a subsidiary traverse to determine the length of a long leg
iv. all the above

9. Rankine's deflection angle in minutes is obtained by multiplying the length of the chord by

A) degree of the curve B) square of the degree of the curve
C) inverse of the degree of the curve D) none of these.

10. The chord of a curve less than peg interval, is known as

A) small chord B) sub-chord C) normal chord D) short chord

11. Mistakes which may produce a very serious effect upon the final results arise due to

A) in attention B) in experience C) carelessness D) all of these

12. Subtense tacheometry is generally preferred to if ground is

A) flat B) undulating C) mountaineous D) deserts

13. The area of any irregular figure of the plotted map is measured with

A) pentagraph B) sextant C) clinometers D) planimeter

14. The imaginary line passing through the intersection of cross hairs and the optical centre of the objective, is known as

A) line of sight B) line of collimation C) axis of the telescope D) none of these

15. In tangential tacheometry, an ordinary level staff is used

i. leaning towards the instrument for inclined sights upward
ii. leaning away from the instrument for inclined sights downwards
iii. vertical in all cases
iv. none of these

16. Horizontal distances obtained tacheometerically are corrected for

A) slope correction B) temperature correction
C) refraction and curvature correction D) all the above

17. If the long chord and tangent length of a circular curve of radius R are equal the angle of

deflection, is

A) 30°   B) 60°   C) 90°   D) 120°

18. In a theodolite

    i. the telescope axis is perpendicular to transit axis
    ii. the axis of rotation is perpendicular to transit axis
    iii. the telescope axis, the transit axis and the rotation axis pass through the centre of theodolite
    iv. all the above

19. The method generally preferred to for contouring an undulating area, is

A) chain surveying   B) Plane table surveying

C) tacheometrical surveying   D) compass surveying

20. Stadia tachometry was discovered by James Watt in the year

A) 1670   B) 1770   C) 1870   D) 1900

21. The angle of intersection of a curve is the angle between

    i. back tangent and forward tangent
    ii. prolongation of back tangent and forward tangent
    iii. forward tangent and long chord
    iv. back tangent and long chord.

22. State the circumstance where plane table is suitable?
23. Name the accessories of plane table?
24. What is orientation; State the two methods of orientation?
25. State four demerits of plane table survey?
26. What is closed traversing
27. What are the types of traversing?
28. What is prism
29. What is centering
30. What is meant by compass
31. What is leveling
32. How to find inaccessible distance.
33. List out the methods of plane table surveying.
34. Why we have to use plane table surveying?

35. List the accessories used in pane table surveying.

36. What are the advantages of three point problem of plane table surveying?

37. List out the methods available in three point problem.

38. List the advantages and disadvantages of two point problem.

39. Compare the radiation and intersection methods.

40. Define traversing method in plane table surveying.

41. Compare the methods of two point and three point problem.

Ex.No:4

Date:

LEVELLING – LONGITUDINAL AND CROSS-SECTION AND PLOTTING

Aim: To find the difference in elevation between two points.

Instruments: Dumpy level, Levelling staff.

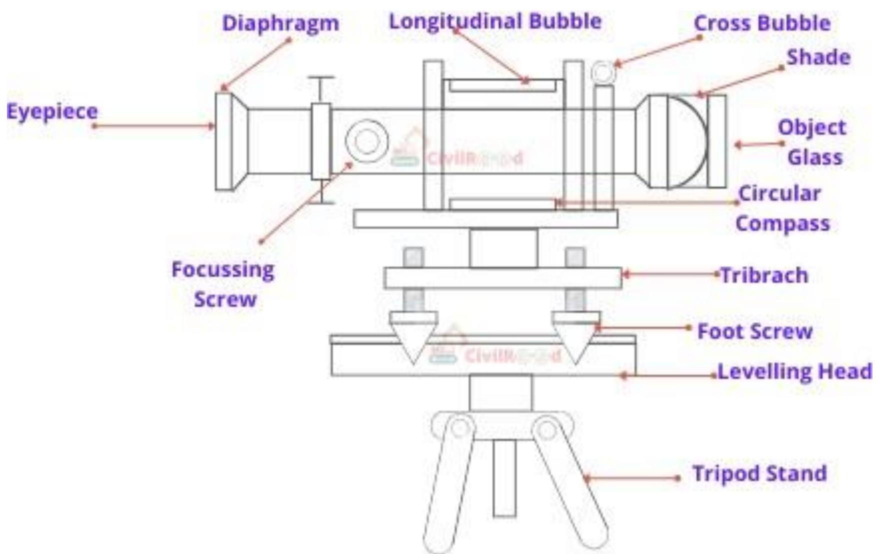


Fig.1 Components of Dumpy Level

The Major Components of a Dumpy Level

Telescope: It contains of two metal tubes, one of which slides within the other one tube carries the object glass and the second one carries eyepiece and diaphragm.

Focussing Screw: The telescope is focused by turning the focusing screw either forward or backward.

Bubble Tubes: The telescope is attached with two bubble tubes. One is longitudinal and the other is cross bubble tube. These two are placed at right angles to each other.

Diaphragm: It carries cross hairs.

Tribrach & Trivet: The telescope with vertical spindle is supported by two parallel triangular plates. The upper plate is called tribrach and the lower plate is called trivet

Foot Screws: By turning the foot screws, the tribrach can be raised or lowered to bring the bubble to the center of its run. Temporary adjustments are to be made at each setup of the instrument.

Temporary Adjustments of Dumpy Level:

Temporary adjustments are to be made at each setup of the instrument. The following are the temporary adjustments to be made.

1. Setting up of the level
2. Leveling up
3. Elimination of parallax.

Setting Up of the Level

a) Release the clamp screw of the instrument

b) Hold the instrument in the right hand and fix it on the tripod by turning round only the lower part with the left hand.

c) Screw the instrument firmly.

d) Bring all the foot screws to the center of its run.

e) Spread the tripod legs well apart.

f) Fix any two legs firmly into the ground by pressing them with the hand.

g) Move the third leg to the right or left until the main bubble is approximately in the center.

h) Then move the third leg in or out until the bubbles of the cross-level is approximately in the center.

i) Fix the third leg firmly when the bubbles are approximately in the centers of their run.

Levelling Up:

a) Place the telescope parallel to a pair of foot screws.

b) Bring the bubble to the center of its run by turning the foot screws equally either both inwards and both outwards.

c) Turn the telescope through 90º so that it lies over the third foot screw.

d) Turn this third foot screw so that the bubble corners to the center of its run.

e) Bring the telescope back to the original position without reversing the eye-piece and object glass.

f) Repeat the above operations until the bubble remains in the center of its run in both the positions.

g) Turn the telescope through 180º and check whether the bubble remains central.

Elimination of Parallax:

a) Remove the lid from the object glass.

b) Hold a sheet of white paper in front of the object glass.

c) Move the eyepiece in or out until the cross hairs are distinctly visible.

d) Direct the telescope towards the staff.

e) Turn the focusing screw until a clear and sharp image in formed in the plane of the cross hairs.

Procedure:

Longitudinal Sectioning:

1. Establish Benchmark near the starting points.
2. Fix the profile line AB and BC on the ground by fixing ranging rods at A,B,C, etc..
3. Measure the magnetic bearings of h the lines AB and BC using a compass.
4. Align the line and mark number of points at equal intervals on the proposed intervals. (Points are 20m or 30m intervals).
5. Set up the leveling instrument on the side of the alignment on firm ground at some suitable place P, so as to cover a large number of points in the lines.
6. Take back sight on benchmark, to determine the height of instrument.
7. Hold the leveling staff at successive station A, 1,2,3,4,etc..
8. Other procedure followed by differential leveling.
9. Finally close the work by taking a Fore sight on the Benchmark-2 from the last instrument setup.
10. Enter the staff readings in the field book, reduced the levels and check in each page as usual.

Cross Sectioning:

1. Mark the cross section points on the proposed centerline alignment.
2. Set out perpendicular at three points on both sides on the center line using a chain or tape or cross staff or optical square.
3. Mark the cross representative points along the erected perpendicular lines depending

upon the nature of the ground, fix the arrows on these points. (Usually at interval of 2m, 3m, or 5m).

4. Left side marking L1, L2, L3, etc.. To the right side markings R1, R2, R3 etc to the center line.

5. Take staff readings on each cross-section on marked points from the instrument station.

6. Enter the staff reading at records.

7. Write full description of each cross section regarding the chain ages, number of the cross section, distance of points on the cross section from the center line.

8. Calculate the reduced levels and with usual check.

Tabulation:

Reduced level of first point =.................... m

Staff Station	Back Sight	Inter Sight	Fore Sight	Height of Instrument	Reduced Level	Remarks	Angle (Using Compass)
						BM	
						L1	
						L2	
						L3	
						C - 0m	
						R1	
						R2	
						R3	
						L1	
						L2	
						L3	
						C - 20m	
						R1	
						R2	
						R3	

							L1	
							L2	
							L3	
							C - 40m	
							R1	
							R2	
							R3	
							L1	
							L2	
							L3	
							C - 60m	
							R1	
							R2	
							R3	
							L1	
							L2	
							L3	
							C - 80m	
							R1	
							R2	
							R3	
							L1	
							L2	
							L3	
							C - 100m	
							R1	
							R2	
							R3	

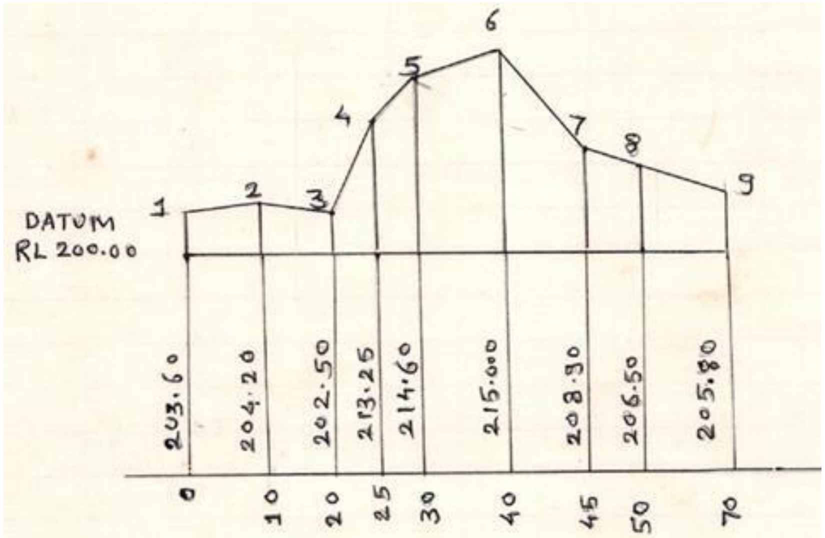


Fig.2 Example Diagram For L.S/C.S Plotting

Result:

The longitudinal and cross sectional levels are calculated and plotted.

Viva Questions:

1. How many chief types of levels are used in levelling?
2. A levelling staff is used to establish:
3. Dumpy level was originally designed by:
4. How many categories of levelling staff are there?
5. Which of the below is used to make line of sight horizontally in a level?
6. A digital level reads a
7. Which of the below cannot be used to measure vertical heights?
8. How many types of self-reading staff are available?
9. Which of the below is not common in all levelling equipments?
10. Level vials can be of______________types.
11. Abney level is a type of hand level.
12. For accurate leveling____________is attached inside telescope in an automatic level.
13. How many methods are used in levelling?
14. How many types of levelling are there?
15. In___________levelling, the first and last point are at a far distance.
16. Stadia levelling is a modified form of:
17. Contours can be found in a____________map.
18. Contour Maps are mandatory in civil engineering projects like
19. How many methods of contouring are present?
20. Indirect methods uses how many methods?
21. The commonly used squares in method of square is:
22. Which of the below methods is used for interpolating contour points between 2 points?
23. The contour interval is the same for all purposes.
24. The curves used for drawing lines between points in a contour line is:
25. Which shaped lines indicate presence of a ridge?
26. The line which separates the catchment basin from the rest of the area is:
27. How many types of EDM instruments are there based on wavelength?
28. Which of the below is used up to a range of 100km?
29. Plane table (PT) surveying is a____________method.

30. What is used for levelling a plane table?
31. List the components of vernier theodolite.
32. Define transit.
33. What is swinging the telescope?
34. Define telescope normal.
35. Define telescope inverted.
36. Define the term line of sight.
37. What is centering.
38. What is face left observation?
39. Define face right observation?
40. The other name of plunging is

Ex.No:5

Date:

MEASUREMENT OF HORIZONTAL AND VERTICAL ANGLE BY THEODOLITE

Aim: To determine a horizontal angle by the method of repetition.

Equipment: Transit Theodolite, Tripod, Plumb Bob, Ranging Rods and Pegs.

Principle:

In the method of repetition, the angle is measured and added to itself several times and divided by the number of times it is added. It is then possible to obtain the value of angle to a greater degree of accuracy than the least count of the vernier. The error due to imperfect graduations is also minimized.

Procedure:

The method of repetition is used to measure a horizontal angle to a finer degree of accuracy than that obtainable with the least count of the vernier. By this method an angle is measured two (or) more times by allowing the vernier to remain clamped each time at the end of each measurement instead of setting it back at zero when sighting at the previous station. Thus an angle reading is mechanically added several times depending upon the number of repetitions. The average horizontal angle is then obtained by dividing the final reading by number of repetitions. Generally six repetitions are done three with the telescope normal and three with the telescope inverted. To measure the horizontal angle, say angle PQR (Fig.1) the following procedure is followed.

1. Setup the instrument at 'Q' and level it.
2. Loosen the upper clamp and turn the upper plate until the index of vernier 'A' nearly coincide with the horizontal circle. Now tight the upper clamp.
3. Turn the upper tangent screw so as to make the two zeros exactly coincide. So that 'A' vernier reads 0^0 and 'B' vernier reads 180^0.
4. Sight station 'P', tighten the lower clamp and bisect station 'P' exactly by using the lower tangent screw.
5. Unclamp the upper clamp and swing the telescope, bisect station 'R' by using the upper clamp and upper tangent screw.
6. Read both the verniers take average to get $\angle PQR$.

7. Unclamp the lower clamp and swing the telescope and bisect station ‘P’ accurately by using the lower clamp and lower tangent screw.
8. Read both the verniers check the vernier reading it should be the same (unchanged) as that obtained in step 6.
9. Release the upper plate by using upper clamp and bisect station ‘R’ accurately by using upper tangent screw. The vernier will read twice the $\angle PQR$
10. Repeat the procedures for required number of times say three times and find out the value of $\angle PQR$.
11. Change face and make three more repetitions as described above. Find the average angle with face right by dividing the final reading by three or whatever the number of repetitions.
12. The average Horizontal angle is then obtained by taking the average of the two angles obtained with face left and face right.

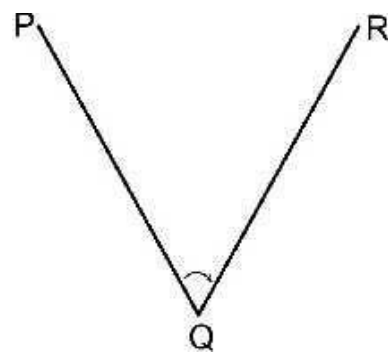


Fig.1 Measurement of Horizontal Angle (Repetition Method)

Observations and Calculations:

Observations are entered in the field book and the angles are calculated.

Inst. At	Sight to	Face: Right - Swing: Right				Face: Left - Swing: Right				Mean Included angle
		A	B	Mean	Included angle	A	B	Mean	Included angle	
		0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “
The average included angle =										

Result:

The angle is measured by the method of repetition and the obtained Horizontal angle is □*PQR* = ...

MEASUREMENT OF VERTICAL ANGLE

Aim: To measure the vertical angle subtended by the line of sight of a given rod with reference to the horizontal axis at a selected station.

Equipment: Transit Theodolite, Tripod Stand, Plumb Bob, Ranging Rod and Pegs.

Principle:

The vertical angle is the angle made by an inclined line of sight with horizontal line of sight. Vertical angles are measured by using telescope clamping and telescope tangent screws.

Procedure:

1) Let □AOB is to be measured (Fig.2):

1. Setup the instrument doing the exact adjustments (centering, leveling and focusing the eyepiece)
2. The centering is done with reference to altitude bubble.
3. Keep the instrument in the left position make the vernier 'C' read zero with the help of vertical circle clamp & tangent screws.
4. Bring the altitude bubble to zero when the telescope is horizontal.
5. Direct the telescope to the object and bisect it accurately by means of the vertical circle clamp and tangent screw.
6. Read both the vernier 'C' and 'D' and take the average, this gives the value of vertical angle.
7. Change the face and repeat the procedure.
8. The required vertical angle is the average of face left and face right.

2) Let □AOC is to be measured (Fig.2):

1. The instrument is already setup on the station at 'O'.
2. Direct the telescope to the top of the rod and bisect it accurately by means of the vertical.

3. Read the both verniers ‘C’ and ‘D’ and take the average which gives the value of vertical angle ‘α’.
4. Then the telescope is bisected to the bottom of the rod. Then read the both verniers ‘C’ and ‘D’ readings the average gives the value of vertical angle ‘β’.
5. The summation of α & β gives the ∠AOC.
6. The face is changed and same procedure should be repeated then find ∠AOC.
7. The average of this two gives the ∠AOC.

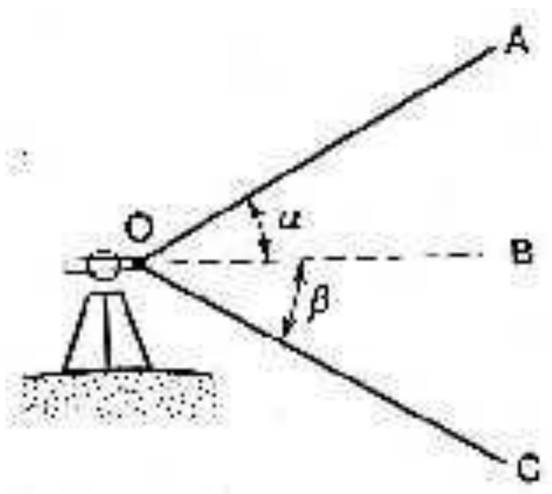


Fig.2 Measurement of Vertical Angle

Tabulations:

Inst. At	Sight to	Face: Right				Face: Left				Mean Included angle
		C	D	Mean	Included angle	C	D	Mean	Included angle	
		0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “	0 ‘ “
The average included angle =										

Observations and Calculations:

α =

β =

Total Vertical angle =

Result:

The vertical angle to the given object AOC =………………………..

Viva Questions:

1. Define: Theodolite surveying. What are the uses of a theodolite?
2. Why a type of theodolite is called a transit theodolite?
3. List the essential parts of a theodolite.
4. Differentiate between the Vernier theodolite and Micrometer theodolite.
5. List the essential qualities of a theodolite telescope. The essential parts of the telescope:
6. What are the temporary adjustments of the theodolite?
7. List out the permanent adjustments of Theodolite.
8. List out the fundamental lines of Theodolite
9. What is an anallatic lens? What is the use of an anallatic lens?
10. Name the two methods of measuring horizontal angles using a thedolite. When each method is advantageously used?
11. State what errors are eliminated by repetition method.
12. What are the methods used to plot the traverse?
13. Define closing error.
14. Define: Balancing. What are the methods used to balancing the traverse?
15. Explain the Bowditch's rule in balancing the traverse.
16. What is Gale's table? What is its use?
17. Define: Omitted measurements.
18. What is closed traverse? What are the two checks applicable in this case?
19. Define: Trigonometrical leveling or Heights and Distances.
20. What are the methods used to find the elevations of the points in the case of inaccessible points?
21. What is Single plane method?
22. What is Double plane method?
23. The error due to eccentricity of inner and outer axes can be eliminated by
24. In the double application of principle of reversion, the apparent error is?
25. Which of the following errors can be eliminated by taking mean of both face observations?
26. Which of the following errors cannot be eliminated by taking both face observations?

27. If altitude bubble is provided both on index frame as well as on telescope of a theodolite, then the instrument is levelled with reference to
28. The following sights are taken on a "turning point"
29. The rise and fall method of levelling provides a complete check on ……………….
30. In an internal focussing type of telescope, the lens provided is?
31. For measuring horizontal angle, which vernier scale we have to look up?
32. For measuring vertical angle, which vernier scale we have to look up?
33. What is the least count of our vernier theodolite?
34. What is the least count of our leveling staff?
35. What is the necessasity of measuring horizontal and vertical angle using theodolite?
36. List the components of vernier theodolite.
37. Define transit.
38. What is swinging the telescope?
39. Define telescope normal.
40. Define telescope inverted.
41. Define the term line of sight.
42. What is centering.
43. What is face left observation?
44. Define face right observation?
45. The other name of plunging ……………….

Ex.No:6

Date:

TRIGONOMETRIC LEVELING USING THEODOLITE

(A) BASE ACCESSIBLE

Aim:

To find the elevation of the top of a spire / tower / building using the principle of trigonometric leveling.

Equipment:

Transit Vernier Theodolite, Tripod stand, Plumb bob, Tape, Leveling Staff and Pegs.

Procedure:

It is required to find the elevation (R.L.) of the top of a tower 'Q' from the instrument station 'P' as shown in Fig.1

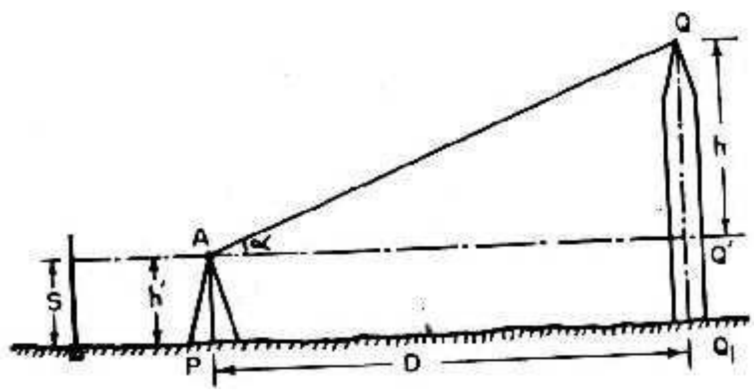


Fig.1 Base Accessible

Let,

P= instrument station

Q= Point to be observed

A= Center of the instrument

D= Horizontal distance between P and Q

h' = Height of the instrument at P

Q'= Projection of Q on horizontal plane

S= Reading on staff kept on B.M, with line of sight on horizontal

α = Angle of elevation from A to Q

1. Setup the Theodolite at P and level if accurately w.r.t. the altitude bubble. See that the vertical circle reads $0^0 0' 0''$ when the line of sight is horizontal.

2. Direct the telescope towards Q and bisect it accurately clamp both the plates. Read the vertical angle ‘α’.

3. Plunge the telescope and sight to the same point ‘Q’ and take the vertical angle ‘α’ calculate the avg. of the vertical angles measured in both faces.

4. With the vertical vernier set to zero reading and the altitude bubble in the center of its run take the reading on the leveling staff kept at A.B.M. Let it be ‘S’.

Observations and Calculations:

Vertical Angle, α =

Staff Reading, S (m) =

Horizontal Distance, D (m) =

From Triangle AQQ’: $h = D \tan \alpha$

Reduced Level of Point Q (m) = R.L of B.M + S + h =

Result:

Reduced Level of the given Point w.r.to BM =

(B) BASE INACCESSIBLE (SINGLE PLANE METHOD)

Aim: To find the elevation of the top of a building using the principle of trigonometrical leveling with the instrument stations having their vertical axes in the same plane as the object.

Equipment: Transit Vernier Theodolite, Tripod Stand, Plumb Bob, Tape, Leveling Staff and Pegs.

Procedure: It is required to find the elevation (R.L.) of the top of a building 'Q' from the instrument stations P & R as shown in Fig.2 (a)

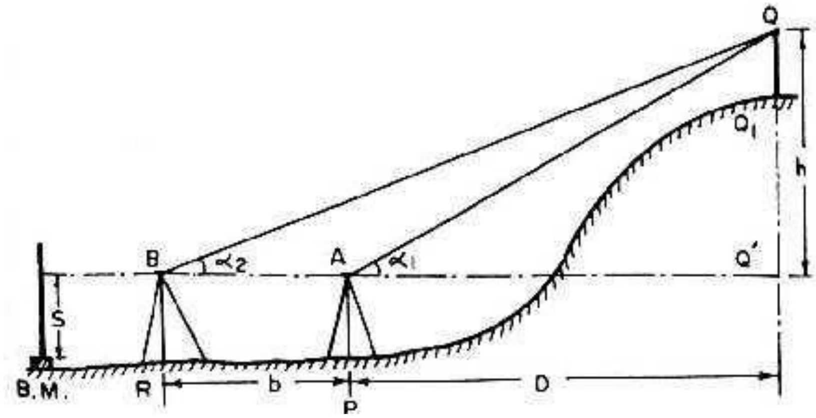


Fig.2 (a) Instrument Axis at Same Levels

h = QQ'

D = Horizontal dist. b/w P & Q

b = Horizontal dist. b/w P & R

α1 = angle of elevation from A to Q

α 2 = angle of elevation from B to Q

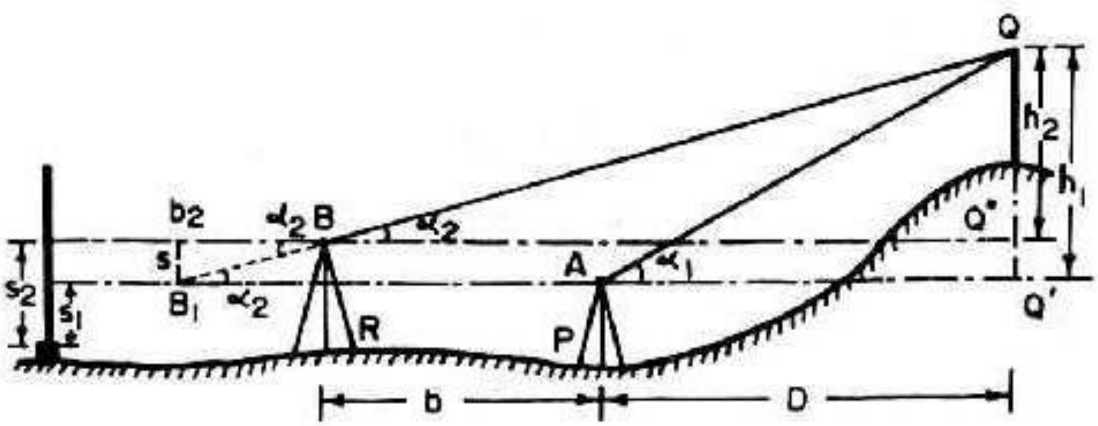


Fig.2 (b) Instrument Axes at Different Levels

1. Setup the Theodolite at P and level it accurately with respect to the altitude bubble. See that the vertical circle reads $0^0 0' 0''$ when the line of sight is horizontal.

2. Direct the telescope towards Q and bisect it accurately clamp both the plates. Read the vertical angle α1.

3. Transit the telescope so that the line of sight is reversed. Mark the instrument station R on the ground along the line of sight. Measure the dist. b/w P&R accurately. Let it be 'b' repeat the steps (2) & (3) for both face observations. The mean values should be adopted in the calculations.

4. With the vertical vernier set to zero reading and the altitude bubble in the center of its run take the reading on the leveling staff kept at A.B.M. Let it be 'S' if both the instrument axis are at same level and 'S1' if they are at different levels.

5. Shift the instrument to R and set up the Theodolite there. Measure the vertical angle 'α 2' to Q with both face observations.

6. In case of instrument axis at different levels repeat the step (4) and let the reading at R be 'S2'.

Observations and Calculations:

Vertical Angles,

α 1 = α 2 =

Staff Readings

S (m) =

S1 (m) =

S2 (m) =

Horizontal dist. b/w P & R = b =

In case of instrument axis at same level:

From triangle AQQ'

$h = D \tan \alpha 1$

From triangle BQQ'

$h = (b + D) \tan \alpha 2$

$D = (b \tan \alpha 2) / (\tan \alpha 1 - \tan \alpha 2)$

Reduced Level of point Q (m) = R.L. of B.M. + S + h

In case of instrument axis at different levels:

$h1-h2 = S2 \sim S1 = S$

$D = (S + b \tan \alpha 2) / (\tan \alpha 1 - \tan \alpha 2)$

$h1 = D \tan \alpha 1$

$h2 = (b + D) \tan \alpha 2$

Reduced Level of point Q = R.L. of B.M. + S1 + h1

Reduced Level of point Q = RL of B.M. + S2 + h2

Result:

Reduced Level of given point Q (m) =

Viva Questions:

1. How many methods are used in levelling?
2. How many types of levelling are there?
3. Trigonometric levelling is also called
4. In___________levelling, the first and last point are at a far distance.
5. Stadia levelling is a modified form of:
6. The last reading taken from the instrument is called:
7. Reciprocal levelling is used when,
8. In a hilly terrain, staff reading is more at:
9. Which is the arithmetic check for height of instrument method?
10. Which instrument is used in trigonometric levelling?
11. In levelling, error due to earth's curvature is to be corrected using:
12. Level vials can be of______________types.
13. How many types of bench mark are there?
14. A stone that marks boundary is called:
15. __________errors are small unavoidable fluctuation.
16. Plan is a small-scale representation of a large area.
17. Which of the below is not a means of linear surveying methods?
18. The term Gore is used to indicate:
19. An acre is equal to how many square feet.
20. In triangulation method, the whole area is divided into:
21. A stone that marks boundary is called:
22. The commonly used squares in method of square is:
23. Which of the below methods is used for interpolating contour points between 2 points?
24. The contour interval is the same for all purposes.
25. The curves used for drawing lines between points in a contour line is:
26. Which shaped lines indicate presence of a ridge?
27. Plan is a small-scale representation of a large area.
28. How many meridians are used in surveying?
29. Which of the below is not an instrument used to set right angles?

30. In how many ways can ranging be carried out?
31. How many types of cross staff are available?
32. List the components of vernier theodolite.
33. Define transit.
34. What is swinging the telescope?
35. Define telescope normal.
36. Define telescope inverted.
37. Define the term line of sight.
38. What is centering.
39. What is face left observation?
40. Define face right observation?

Ex.No:7

Date:

HEIGHT AND DISTANCES USING PRINCIPLES OF TACHOMETRIC SURVEYING

Aim: Determination of elevation of points by Tacheometric surveying

Equipment:

Tachometer with tripod, Tape, Leveling staff, Ranging rods

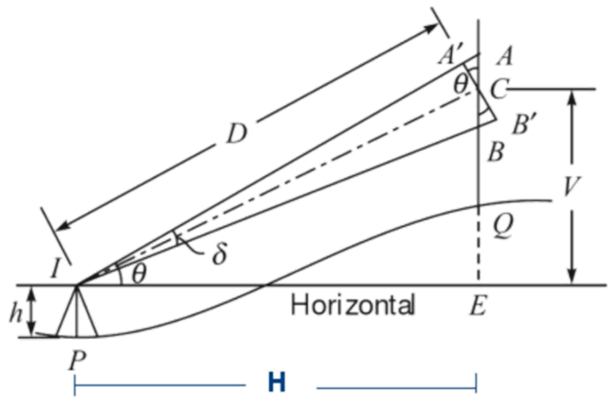
Theory:

The Tachometer is an instrument which is generally used to determine the horizontal as well as vertical distance . it can also be used to determine the elevation of various points which cannot be determine by ordinary leveling. When one of the sight is horizontal and staff held vertical then the RLs of staff station can be determined as we determine in ordinary leveling .But if the staff station is below or above the line of collimation then the elevation or depression of such point can be determined by calculating vertical distances from instrument axis to the central hair reading and taking the angle of elevation or depression made by line of sight to the instrument made by line of sight to the instrument axis.

Procedure:

1. Set up the instrument in such a way that all the point should be visible from the instrument station.
2. Carryout the temporary adjustment and set vernier zero reading making line of sight horizontal.
3. Take the first staff reading on Benchmark and determine height of instrument.
4. Then sight the telescope towards the staff station whose R.Ls are to be calculated. Measure the angle on vernier if line of sight is inclined upward or downward and also note the three crosshair readings.
5. Determine the R.Ls of various points by calculating the vertical distance

Where,

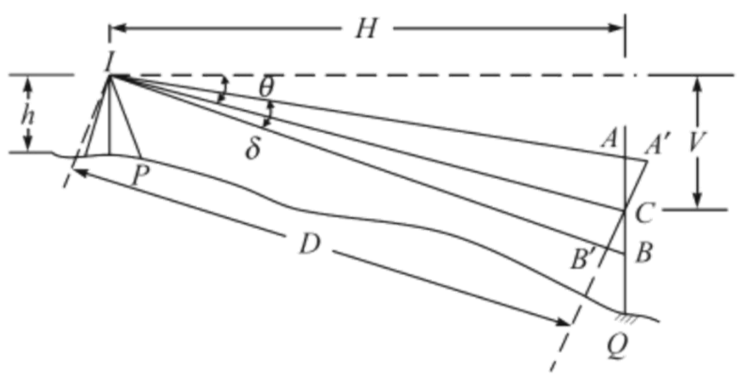


Inclined sight (elevation)

$$H = D\cos\theta = KS\cos^2\theta + C\cos\theta$$

$$V = \frac{1}{2}KS\sin 2\theta + C\sin\theta$$

$$\text{R.L. of } Q = \text{R.L. of } P + h + V - CQ$$



Inclined sight (depression).

$$D = KS\cos\theta + C$$

$$H = D\cos\theta = KS\cos^2\theta + C\cos\theta$$

$$V = D\sin\theta = KS\sin\theta\cos\theta + C\sin\theta$$

$$\text{R.L. of } Q = \text{R.L. of } P + h - V - CQ$$

Observation and Calculations:

Where,

K = Multiplying constant = 100 (Instrument fitted with anallatic lens)

C = Additive constant = 0 (Instrument fitted with anallatic lens)

S = Staff Intercept = Top hair reading – Bottom hair reading

Result:

Reduced level of the given point =............................... m.

Viva Questions:

1. Define tacheometry.
2. The other name for tacheometry are ………………………….
3. Which type of theodolite is necessary for doing the tacheometric surveying?
4. The transit theodolite is to be fitted with ....Diaphragm
5. List out the essential characteristics of tacheometer.
6. What are the types of holding available in tacheometry and name that?
7. Write the advantage and disadvantages of vertical and normal holding.
8. What is subtense bar?
9. Under which circumstances the subtense bar can be used?
10. Contours can be found in a___________map.
11. How many methods of contouring are present?
12. Indirect methods uses how many methods?
13. Contour Maps are mandatory in civil engineering projects like road works, dams, canals
14. The commonly used squares in method of square is:
15. Which of the below methods is used for interpolating contour points between 2 points?
16. The contour interval is the same for all purposes.
17. The curves used for drawing lines between points in a contour line is:
18. Which shaped lines indicate presence of a ridge?
19. The line which separates the catchment basin from the rest of the area is:
20. How many chief types of levels are used in levelling?
21. A levelling staff is used to establish:
22. Dumpy level was originally designed by:
23. How many categories of levelling staff are there?
24. Which of the below is used to make line of sight horizontally in a level?
25. A digital level reads a:
26. Which of the below cannot be used to measure vertical heights?
27. How many types of self-reading staff are available?
28. Which of the below is not common in all levelling equipments?
29. Level vials can be of_____________types.
30. Abney level is a type of hand level.

31. Which instrument is used in trigonometric levelling?
32. How many types of variations in declination are there?
33. Which of the below is not a temporary adjustment of prismatic compass?
34. _____________line is the line drawn through points of same declination.
35. How many meridians are used in surveying? List the components of vernier theodolite.
36. Define transit.
37. What is swinging the telescope?
38. Define telescope normal.
39. Define telescope inverted.
40. Define the term line of sight.
41. What is centering.
42. What is face left observation?
43. Define face right observation?

INTRODUCTION ON TOTAL STATION

Total Station:

The **total station** is an electronic theodolite (transit) integrated with an electronic distance measurement (EDM) to read slope distances from the instrument to a particular point, and an on-board computer to collect data and perform advanced coordinate based calculations.

Function:

Angle measurement

Most total station instruments measure angles by means of electro-optical scanning of extremely precise digital bar-codes etched on rotating glass cylinders or discs within the instrument. The best quality total stations are capable of measuring angles to 0.5 arc-second. Inexpensive "construction grade" total stations can generally measure angles to 5 or 10 arc-seconds.

Distance measurement

Measurement of distance is accomplished with a modulated infrared carrier signal, generated by a small solid-state emitter within the instrument's optical path, and reflected by a prism reflector or the object under survey. The modulation pattern in the returning signal is read and interpreted by the computer in the total station. The distance is determined by emitting and receiving multiple frequencies, and determining the integer number of wavelengths to the target for each frequency. Most total stations use purpose-built glass corner cube prism reflectors for the EDM signal. A typical total station can measure distances with an accuracy of about 1.5 millimetres (0.0049 feet) + 2 parts per million over a distance of up to 1,500 meters (4,900 feet).

Reflector less total stations can measure distances to any object that is reasonably light in colour, up to a few hundred meters.

Coordinate measurement:

The coordinates of an unknown point relative to a known coordinate can be determined using the total station as long as a direct line of sight can be established between the two points. Angles and distances are measured from the total station to points under survey, and the coordinates (X, Y, and Z or easting, northing and elevation) of surveyed points relative to the total station position are calculated using trigonometry and triangulation. To determine an absolute location a Total Station requires line of sight observations and can be set up over a known point or with line of sight to 2 or more points with known location, called Resection (Free Stationing).

For this reason, some total stations also have a Global Navigation Satellite System receiver and do not require a direct line of sight to determine coordinates. However, GNSS measurements may require longer occupation periods and offer relatively poor accuracy in the vertical axis.

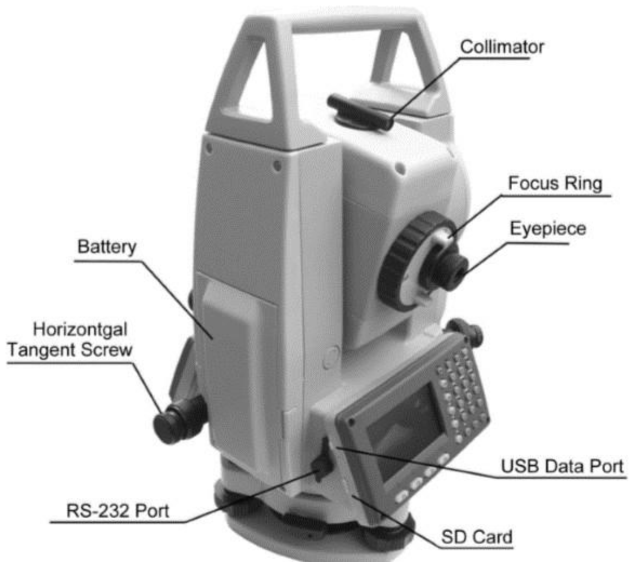
Data processing Some models include internal electronic data storage to record distance, horizontal angle, and vertical angle measured, while other models are equipped to write these measurements to an external data collector, such as a hand-held computer.

When data is downloaded from a total station onto a computer, application software can be used to compute results and generate a map of the surveyed area. The newest generation of total stations can also show the map on the touch-screen of the instrument immediately after measuring the points.

Precautions To Be Taken While Handling Total Station:

1. Never point the instrument at the sun without a filter.
2. Never store the instrument in extreme temperatures and avoid sudden changes of temperature.
3. When not using the instrument, place it in the case to avoid shock, dust, and humidity.
4. If there is a great difference in temperature between the work site and the instrument storage location leave the instrument in the case until it adjusts to the temperature of the surrounding environment.
5. Please remove the battery for separate storage if the instrument is to be in storage for an extended time. The battery should be charged once a month during storage.
6. The instrument should be placed in its carrying case during transportation. It is recommended that the original packing case be used for cushioning during extended transportation.
7. Be sure to secure the instrument with one hand when mounting or removing from the tripod.
8. Clean exposed optical parts with degreased cotton or lens tissue only.
9. Clean the instrument's surface with a woollen cloth when finished with use. Dry it immediately if it gets wet.
10. Check the battery, functions, and indications of the instrument as well as its initial setting and correction parameters before operating.
11. Unless you are a maintenance specialist do not attempt to disassemble the instrument for any reason. Unauthorized disassembly of the instrument can result in a void warranty.
12. The total stations emit a laser during operation. DO NOT stare into the beam or laser source when instrument is operation.

Nomenclature:



Unpacking and Storage of The Instrument:

Unpacking of the instrument: Place the case lightly with the cover upward, unlock the case and take out the instrument.

Storage of the instrument: Replace the cover on the telescope lens, place the instrument into the case with the vertical clamp screw and circular vial upward (objective lens toward the tribrach), tighten the vertical clamp screw, close and lock the case.

Instrument Set Up: Mount the instrument onto the tripod and secure firmly. Level and centre the instrument precisely to ensure the best performance. Use the tripod with a 5/8" tripod screw.

Operation Reference: Levelling and Centring the Instrument

1. **Setting up the tripod:** First extend the extension legs to suitable length and tighten the screws, firmly plant the tripod in the ground over the point of beginning.
2. **Attaching the instrument to the tripod:** Secure the instrument carefully on the tripod and slide the instrument by loosening the tripod mounting screw. If the optical plumb site is positioned over the centre of the point tighten the mounting screw.
3. **Roughly levelling the instrument by using the circular vial:** Turn the levelling screw A and B to move the bubble in the circular vial, in which case the bubble is located on a line perpendicular to a line running through the centres of the two levelling screw being adjusted. Turn the levelling screw C to move the bubble to the centre of the circular vial. Recheck the position of the instrument over the point and adjust if needed.
4. **Levelling by using the plate vial:** Rotate the instrument horizontally by loosening the Horizontal Clamp Screw and place the plate vial parallel with the line connecting levelling screws A and B, then bring the bubble to the centre of the plate vial by turning the levelling screws A and B. Rotate the instrument 90° (100g) around its vertical axis and turn the remaining levelling screw or levelling C to centre the bubble once more.

Repeat the procedures for each 90° (100g) rotation of the instrument and check whether the bubble is correctly centred in all directions.

5. **Centring by using the optical plummet (or plummet or laser):** Adjust the eyepiece of the optical plummet telescope to your eyesight. Slide the instrument by loosening the tripod screw; place the point on the centre mark of the optical plummet. Sliding the instrument carefully as to not rotate the axis will allow you to get 7 the least dislocation of the bubble. (Place star-key after power on, then press F4(LASER)key, press F1(ON)key to turn on the laser plummet. Slide the instrument by loosening the tripod screw; Place laser facular on the occupied pointing, Sliding the instrument carefully as to not rotate the axis will allow you to get the least dislocation of the bubble. The last, press ESC key, and laser plummet turn off automatically.)
6. **Complete levelling the instrument:** Level the instrument precisely as in Step 4. Rotate the instrument and check to see that the bubble is in the centre of the plate level regardless of the telescope direction then tighten the tripod screw firmly.

Battery Removal & Insertion - Information and Recharging:

Battery removal and insertion: Insert the battery into the battery slot and push the battery until it clicks. Press the right and left buttons of the battery compartment to remove the battery.

Battery information:-----------------Indicates that battery is fully charged

------------ Indicates that the battery can only be used for about 1 hour. Recharge the battery or prepare a recharged battery for use.

------------- Recharge the battery or prepare a recharged battery for use

Note: The working time of the battery is determined by environment conditions, recharging time, and other factors.

Battery recharging: Battery should be recharged only with the charger supplied with the instrument. Remove the on-board battery from instrument as instructed and connect to the battery charger.

Battery removal caution: Before you take the battery out of the instrument, make sure that the power is turned off. Otherwise the instrument can be damaged.

Recharging Caution:

- The charger has built-in circuitry for protection from overcharging. However, do not leave the charger plugged into the power outlet after recharging is completed.
- Be sure to recharge the battery at a temperature of 0℃～45℃, recharging may be abnormal beyond the specified temperature range.
- When the indicator lamp does not light after connecting the battery and charger the battery or the charger may be damaged.

Storage Caution:

- The rechargeable battery can be repeatedly recharged 300-500 times. Complete discharge of the battery may shorten its service life.
- In order to get the maximum service life be sure to recharge the battery at least once a month.

Function Key and Display:

Operation Key:

KEYS	NAME	FUNCTION
ANG	Angle meas. key	Angle measurement mode
	Distance meas. key	Distance measurement mode
	Coordinate meas. key	Coordinate measurement mode (▲Up)
S.0	Layout key	Layout measurement mode (▼Down)
K1	Quick key1	User-defined quick key 1(Left)
K2	Quick key 2	User-defined quick key 2(Right)
ESC	Escape key	Return to the measurement mode or previous layer mode.
ENT	Enter key	Press after confirmation of inputting values
M	Menu key	Switches menu mode and normal mode
T	Shift key	Shift distance measuring key
★	Star key	Press once to adjust contrast or twice for illumination of keypad
⏻	Power key	On / Off key press and hold key

F1 – F4	Soft key	(Function Responds to the message displayed key)
0 - 9	Number key	Input numbers
-	Minus key	Input minus sign, displays electronic bubble
.	Point key	On / Off laser pointing function

DISPLAY	CONTENT
V	Vertical angle
V%	Vertical angle as a percentage (Gradient display)
HR	Horizontal angle (right)
HL	Horizontal angle (left)
HD	Horizontal distance
VD	Elevation difference
SD	Slope distance
N	North coordinate
E	East coordinate
Z	Z or elevation coordinate
*	EDM working
m/ft	Switches units between meters and feet
m	Meter unit
S/A	Sets temperature, air pressure, prism constant
PSM	Prism constant (unit: mm)
PPM	Atmospheric correction

Ex.No:8

Date:

DETERMINATION OF HEIGHT, REMOTE ELEVATION, DISTANCE BETWEEN INACCESSIBLE POINTS USING TOTAL STATION

Aim:

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

Equipment:

Total station, Prism, Tripod, Tape, Compass, Pegs and arrows

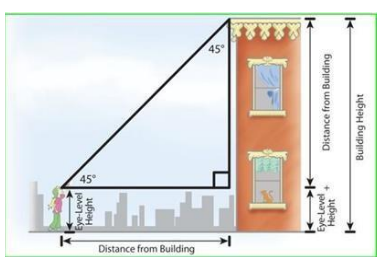
Precautions:

a) Temporary adjustment for total station
b) Levelling and centring
c) Focusing adjustment

Procedure:

1. Fix the total station over a station point and level it. Press the power button to switch on the instrument.
2. Select MODE B→ S function→ file management → Create a job (enter a name) → Accept. And press ESC to go to the starting page
3. Place the compass and orient the telescope towards magnetic north and then set zero by double clicking on 0 set (F3).
4. Go to S Func – Prog (F1) - REM comment. Focus and bisect the bottom of the given object and set starting point (i.e 0m). Then focus the top of the given object, automatically the height of the object will appear in the screen.

Diagram:



Result:

The remote elevation of the given object = ... m

Aim:

To find the Distance, gradient, difference, height between two inaccessible points using Total Station.

Equipment:

Total station, Prism, Tripod, Tape, Compass, Pegs and arrows

Precautions:

Temporary adjustment for total station

Levelling and centring

Focusing adjustment

Procedure:

1. Fix the total station over a station "O" 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.
8. Select two inaccessible points "P" and "Q" between which the distance is to be measured. Calculate the coordinates of point P and Q and save those values.
9. Go to Calc – Cogo – Inverse – SP (Starting Point – Choose the coordinate values of P from the list) - EP (End Point – Choose the coordinate values of Q from the list) – The distance and elevation difference between point P and Q should be displayed.

$$\text{Gradient of line PQ} = \frac{\text{level difference between PQ}}{\text{horizontal distance between PQ}}$$

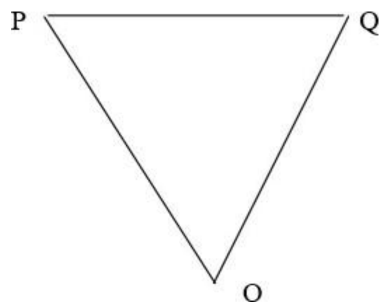
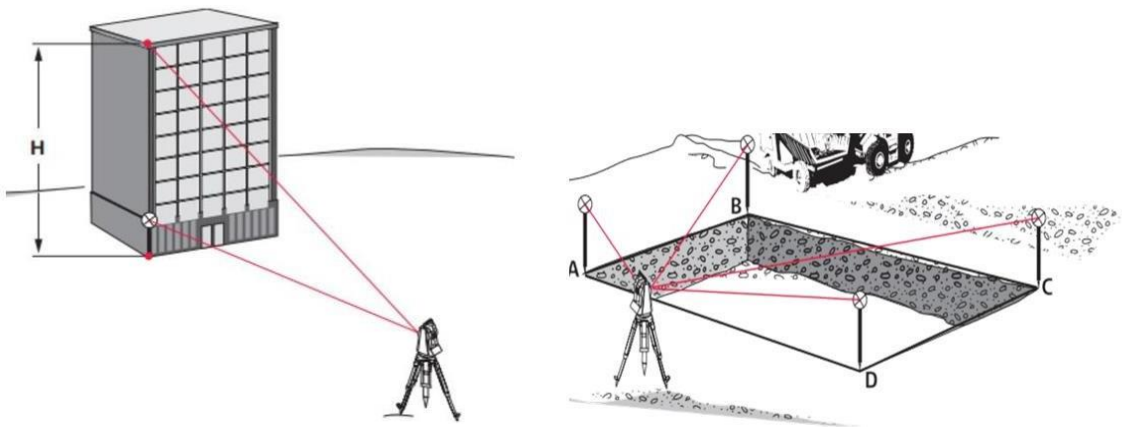


DIAGRAM:



Calculation:

Select – S functions - Calc – Cogo – Inverse – SP (Starting Point – Choose the coordinate values of P from the list) - EP (End Point – Choose the coordinate values of Q from the list) – The distance and elevation difference between point P and Q should be displayed.

Result:

The distance between two inaccessible points P and Q = ... m

The elevation difference between two inaccessible points P and Q = ... m

Gradient between two inaccessible points P and Q = 1 in .... m

Viva Questions:

1. Define remote height.
2. What is elevation?
3. What is depression?
4. How to find out the high of the tower by using total station
5. Which mode is used to measure the height of the tower?
6. What is gradient?
7. What is meant by inaccessible points?
8. Where the procedure of measuring distance between two inaccessible points will be applied practically?
9. How the gradient will be calculated?
10. Define closed traverse.
11. What is Total Station?
12. List the major components of Total Station?
13. What are the uses of Total Station?
14. What is the Least of Count of Total Station?
15. What are temporary adjustments of Total Station?
16. Nowadays targets are not necessary for doing surveying. Is it true?
17. What is resection?
18. What is the purpose of resection?
19. What is the advantage of resection?
20. How to measure of the height of instrument?
21. How the sensitiveness of a bubble tube is designated?
22. How the benchmark is established?
23. As a surveyor, what are your primary job tasks?
24. What are the methods of surveying?
25. What is the aim of this experiment?
26. What is EDM?
27. Brief the principles of EDM?
28. How do you perform change point using total station?
29. What are the functions of total station?

30. What kinds of coordinates are available in total station?
31. Where we can use polar coordinates?
32. List the comments used in total station.
33. What is the use of cogo comment?
34. What is the use of REM comment?
35. What is MLM?
36. List the capabilities of a total station.
37. What are the field procedures for a total station in topographic surveys?
38. Value of prism correction = …………………….
39. What are the modes of observation available in total station?
40. Define stakeout.

Ex.No:9

Date:

DETERMINATION OF AREA USING TOTAL STATION AND DRAWING MAP

Aim:

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

Equipment:

Total station, Prism, Tripod, Tape, Compass, Pegs and arrows

Precautions:

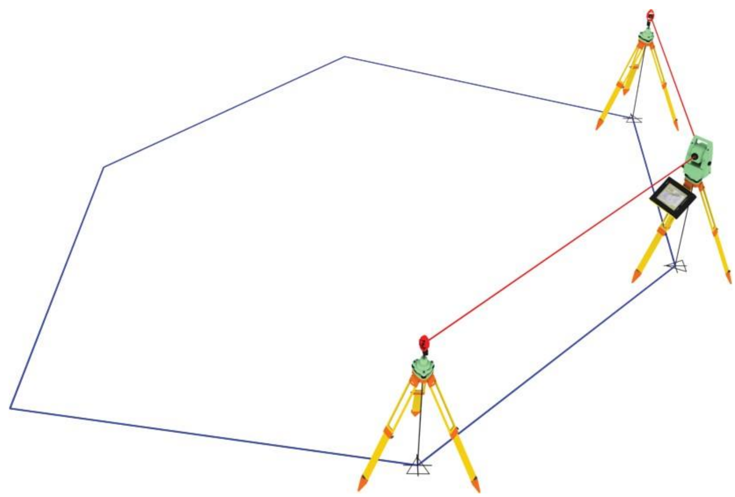
a) Temporary adjustment for total station
b) Levelling and centring
c) Focusing adjustment

Procedure:

1. Fix the total station over a station and level it. Press the power button to switch on the instrument.
2. Select MODE B→ S function→ file management → Create a job (enter a name) → Accept. And press ESC to go to the starting page.
3. Then go to S Function → Measure → Station (Enter the coordinates of station point) - Place the compass and orient the telescope towards magnetic north and then set zero by double clicking on 0 set (F3) - Rectangular co-ordinate - Here enter the point number or name, instrument height and prism code (Measure the coordinates of points of given field)
4. 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 clamp.
5. Then select MEAS and the display panel will show the point specification
6. Now select edit and re-enter the point number or name point code and enter the prism height that we have set.
7. 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.
8. Then turn the total station to second point and do the same procedure.

9. Repeat the steps to the rest of the stations and close the traverse
10. Now go to S function→ view/edit→ graphical view.
11. It will show the graphical view of the traverse.
12. Select S function→ calculation→ 2D surface→ All→ accept
13. This will give the area of the closed traverse.

Diagram:



Calculation:

Select S function → Calculation→ 2D surface →All → accept – (Will display the area of the field which we taken the readings in the screen)

Result:

The area of the given field = ...Sqm

Viva Questions:

1. What are the temporary adjustments of total station?
2. What is the instrument used for ranging?
3. What is levelling?
4. What are the precautions to be taken while determining the area?
5. What is closed traverse?
6. What is Total Station?
7. What are the major components of Total Station?
8. What are the uses of Total Station?
9. What is the Least of Count of Total Station?
10. What are temporary adjustments of Total Station?
11. Nowadays targets are not necessary for doing surveying. Is it true?
12. What are the types of Horizontal Curves?
13. What is traversing?
14. What are the types of traversing?
15. What are the advantages of traversing?
16. What are the disadvantages of traversing?
17. What is the difference between the open traverse and closed traverse?
18. What is fixed traverse?
19. What is remote height?
20. What is elevation?
21. What is depression?
22. How to find out the high of the tower by using total station?
23. Where we can use polar coordinates?
24. List the comments used in total station.
25. What is the use of cogo comment?
26. What is the use of REM comment?
27. What is MLM?
28. List the capabilities of a total station.
29. What are the field procedures for a total station in topographic surveys?
30. Value of prism correction = …………………….

31. What are the modes of observation available in total station?
32. Define stakeout.
33. What is resection?
34. What is the purpose of resection?
35. What is the advantage of resection?
36. How to measure of the height of instrument?
37. How the sensitiveness of a bubble tube is designated?
38. How the benchmark is established?
39. As a surveyor, what are your primary job tasks?
40. What are the methods of surveying?
41. What are the general principles of surveying?

Ex.No:10

Date:

TRAVERSING USING TOTAL STATION FOR DRAWING CONTOUR MAP

Aim:

Prepare the contour plan of given area (One full size drawing sheet) using total station.

Equipment:

Total station, Prism, Tripod, Tape, Compass, Pegs and arrows

Precautions:

a) Temporary adjustment for total station
b) Levelling and centring
c) Focusing adjustment

Procedure:

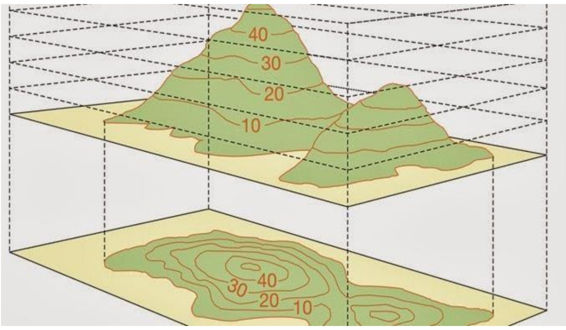
The elevation and depression and the undulations of the surface of the ground are shown as map by interaction of level surface with by means of contour line. A contour may be defined as the line of intersection of a level surface with the surface of the ground.

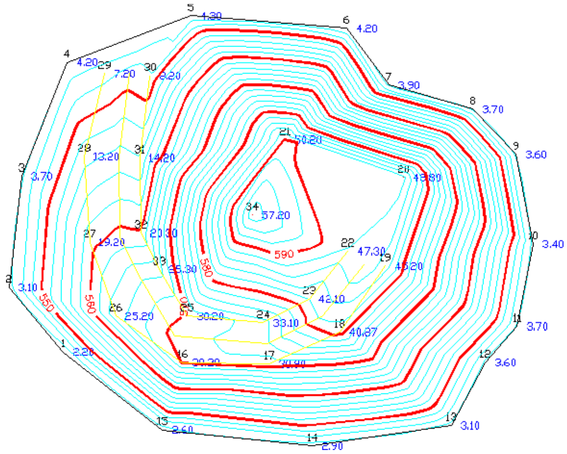
1. Fix the total station over a station and level it. Press the power button to switch on the instrument.
2. Select MODE B→ S function→ file management → Create a job (enter a name) → Accept. And press ESC to go to the starting page.
3. Then go to S Function → Measure → Station (Enter the coordinates of station point) - Place the compass and orient the telescope towards magnetic north and then set zero by double clicking on 0 set (F3) - Rectangular co-ordinate - Here enter the point number or name, instrument height and prism code (Measure the coordinates of points of given field)
4. 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 clamp.
5. Then select MEAS and the display panel will show the point specification
6. Now select edit and re-enter the point number or name point code and enter the prism

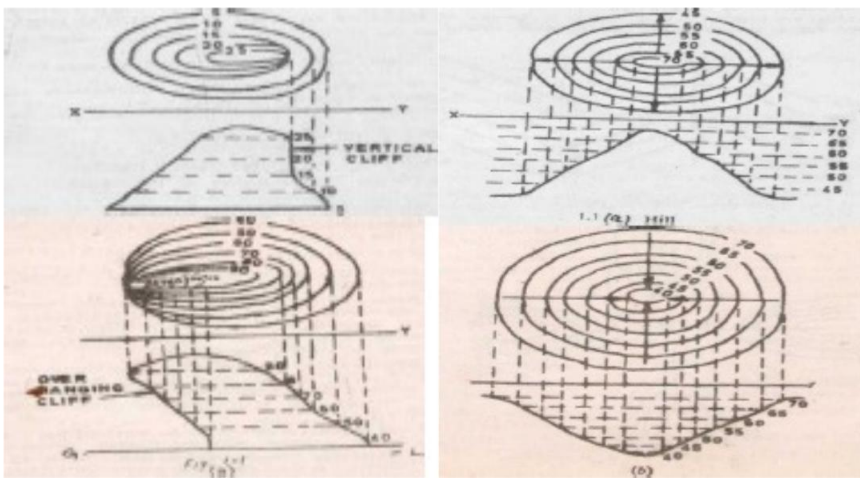
height that we have set.

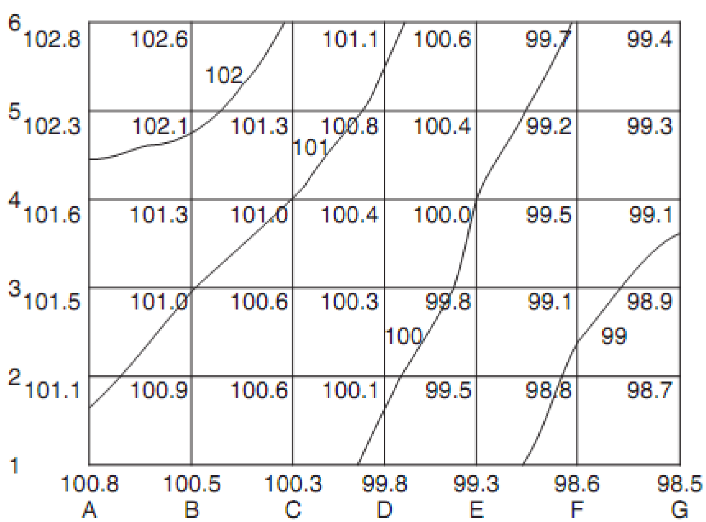
7. Then press MEAS/SAVE (F3) so that the measurement to the first point will automatically be saved and the display panel will show the second point.
8. Adopt Cross section method for establishing the major grid around the study area.
9. Project suitably spaced cross sections on either side of the centre line of the area. Choose several points at reasonable distances on either side.
10. 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 clamp.
11. Then select MEAS and the display panel will show the point specification
12. Now select edit and re-enter the point number or name point code and enter the prism height that we have set.
13. 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.
14. Then turn the total station to second point and do the same procedure. Repeat the steps to the rest of the stations and get all point details.
15. Plot cross section lines to scale and enter spot levels.
16. The points on the chosen contours are interpolated assuming uniform slope between adjacent points and join them by a smooth line.

Diagram:









Calculations:

Select S Function → calculation → 2D surface → All → accept.

Result:

The contour of a given field has been plotted.

Viva Questions:

1. What is contouring?
2. What are the advantages of contouring?
3. Represent contour for a hill with a neat sketch.
4. What are the characteristics of contour?
5. What are the uses of contouring?
6. What is traversing?
7. What are the temporary adjustments of total station?
8. What is the instrument used for ranging?
9. What is levelling?
10. What are the precautions to be taken while determining the area?
11. What is closed traverse?
12. What is Total Station?
13. What are the major components of Total Station?
14. What are the uses of Total Station?
15. What is the Least of Count of Total Station?
16. What are temporary adjustments of Total Station?
17. Nowadays targets are not necessary for doing surveying. Is it true?
18. What is remote height?
19. What is elevation?
20. What is depression?
21. How to find out the high of the tower by using total station?
22. What is resection?
23. What is the purpose of resection?
24. What is the advantage of resection?
25. How to measure of the height of instrument?
26. How the sensitiveness of a bubble tube is designated?
27. How the benchmark is established?

28. As a surveyor, what are your primary job tasks?
29. What are the methods of surveying?
30. What are the general principles of surveying?
31. Where we can use polar coordinates?
32. List the comments used in total station.
33. What is the use of cogo comment?
34. What is the use of REM comment?
35. What is MLM?
36. List the capabilities of a total station.
37. What are the field procedures for a total station in topographic surveys?
38. Value of prism correction = …………………….
39. What are the modes of observation available in total station?
40. How you can do contouring using total station?

Ex.No:11

Date:

STAKE OUT USING TOTAL STATION

Aim:

To find a specific point in the field using Total Station

Equipment:

Total station, Prism, Tripod, Tape, Compass, Pegs and arrows

Precautions:

a) Temporary adjustment for total station
b) Levelling and centring
c) Focusing adjustment

Procedure:

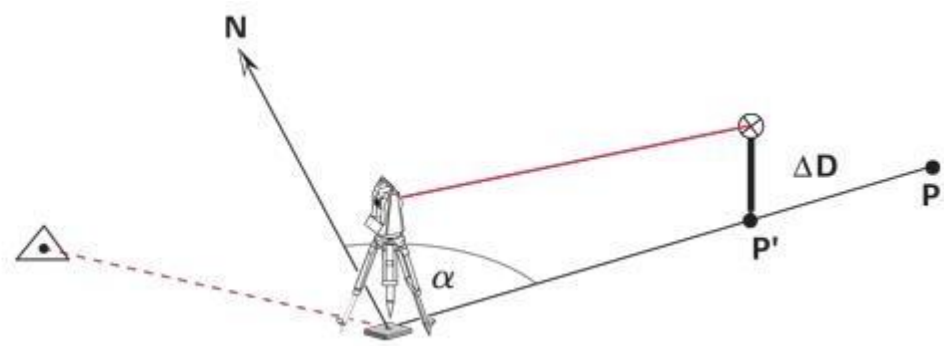
Stakeout: Construction surveying or building surveying is to stake out reference points and markers that will guide the construction of new structures such as roads or buildings. These markers are usually staked out according to a suitable coordinate system selected for the project.

Place the total station in the spot from which you want to stake out points after you have finished entering the coordinates for the area into the total station's internal memory.

1. Set up the instrument at a known point and set the horizontal circle (Consider this point as station point) using S Func – Stake – Station (After entering the station point coordinates, press Enter, and press BSP (Back Sight Point), enter the coordinates of one reference point. Since, the instrument has to be oriented with existing North of previous records)
2. Go to Stakeout and enter the coordinates of the point to be staked out. (The program automatically calculates direction and distance to the point – the two parameters needed for staking out.)
3. Turn the total station until the horizontal circle (Horizontal Angle) reads zero.

4. Position the reflector at this point (Point P).
5. Measure the distance. (The difference in the distance D to the point P will be displayed automatically.)
6. The coordinates of the points to be staked out can be transferred beforehand from your computer to the total station. Under these circumstances, you only need to select the point number. If two points are known, you can also use the resection method to set up and orient your instrument.

Diagram:



Note:

It is suitable for establishing the coordinates which already established and vanished due to natural or manual causes. Here we need station point coordinates as well as any one reference point coordinates values.

Result:

The missed out point has been re-established in the field and their Coordinates are,

N =

E =

Z =

Viva Questions:

1. Define stake out.
2. What is the purpose of staking out a point?
3. List the advantage of staking out a point.
4. What are the precautions to be taken while staking out a point?
5. Which method is preferable for making stake out

   Prismatic mode

   Non-prismatic mode

   Sticker mode
6. What is remote height?
7. What is elevation?
8. What is depression?
9. How to find out the hight of the tower by using total station
10. Which mode is used to measure the height of the tower?
11. Write down the temporary adjustments of total station?
12. Name the instrument used for ranging?
13. Define levelling? Where we can use polar coordinates?
14. List the comments used in total station.
15. What is the use of cogo comment?
16. What is the use of REM comment?
17. What is MLM?
18. List the capabilities of a total station.
19. What are the field procedures for a total station in topographic surveys?
20. Value of prism correction is equal to?
21. What are the modes of observation available in total station?
22. Define stakeout.
23. What are the precautions to be taken while determining the area?
24. What is the aim of this experiment?
25. List the major components of Total station.
26. What are the uses of Total Station?
27. What is the Least of Count of Total Station?

28. What are temporary adjustments of Total Station?
29. Nowadays targets are not necessary for doing surveying. Is it true?
30. How to measure of the height of instrument?
31. How the sensitiveness of a bubble tube is designated?
32. How the benchmark is established?
33. As a surveyor, what are your primary job tasks?
34. What are the methods of surveying?
35. What are the general principles of surveying?
36. What is the aim of this experiment?
37. What are the tools used for this experiment?
38. How does fix the total station in the field?
39. How do change point in the field using total station?
40. What is setout?

Ex.No:12

Date:

SETTING OUT CURVE USING TOTAL STATION

Aim:

To determine angle/distance measurements to known points using total station.

Equipment:

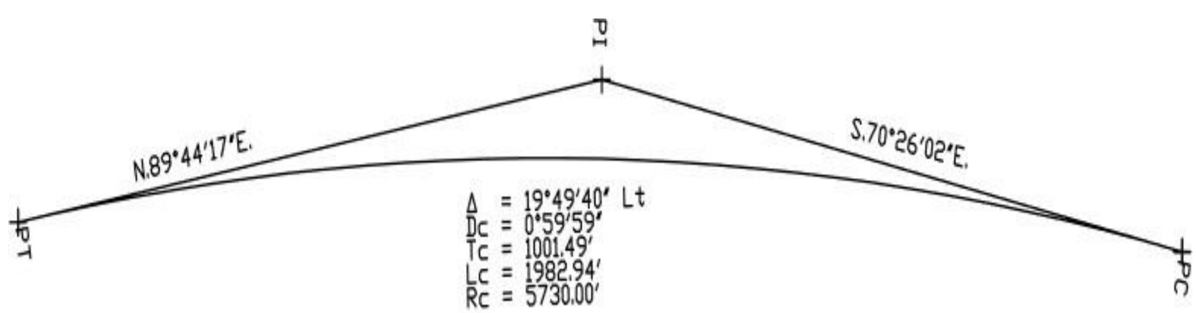
Total station, Prism, Tripod, Tape, Compass, Pegs and arrows

Precautions:

a) Temporary adjustment for total station
b) Levelling and centring
c) Focusing adjustment

Procedure:

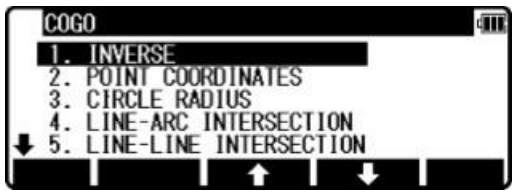
Simple Curve: A simple curve is a circular arc in the horizontal plane that has a central angle of less than 180 degrees (PI radians). A simple curve starts at the PC (Point of Curvature), has a CC (Circle Centre) and a PI (Point of Intersection for the tangents to the curve), and ends at the PT (Point of Tangency, the ending point of the curve).



Simple Curve

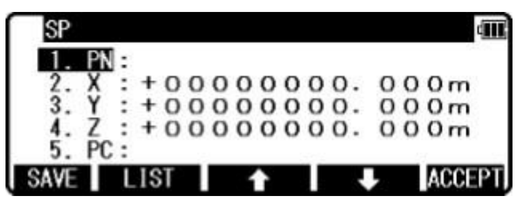
1. From the Power Topo Lite screen, press [F2] [CALC] to view CALCULATION screen.

2. Select 1. COGO and press [ENT] to view the COGO screen.

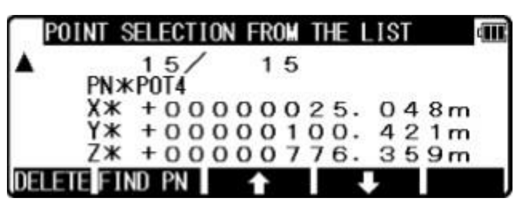


3. Select the 1. INVERSE and press [ENT] to view INVERSE screen.

4. **Start point input** (Input the PN, Coordinates and PC of the Start point.)
5. Select 1. SP and press [ENT] to view SP screen.

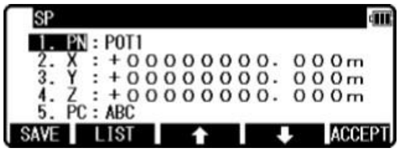


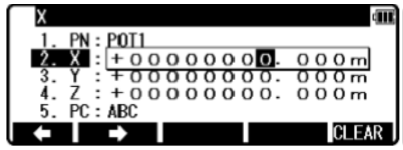
6. [LIST] key All stored points can be displayed as follows by pressing [F2] [LIST]. Press [F2] [LIST] to view POINT SELECTION FROM THE LIST screen.

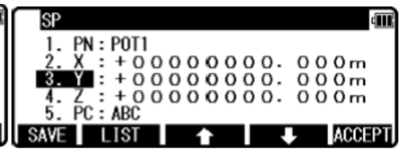


7. Press [ENT] to open the SP input screen.

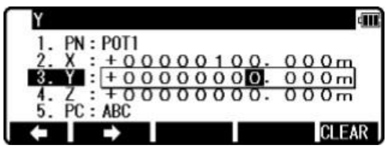
8. Input your desired Point Name by pressing keys, and press [ENT] to open the X coordinate input screen.
9. Input your desired value by pressing each keys and press [ENT] to go Y coordinate.

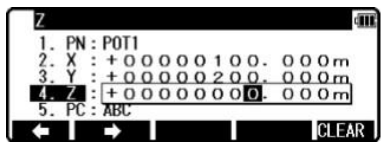


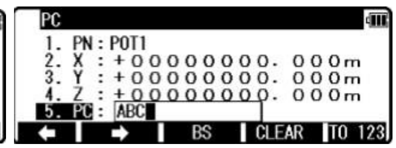




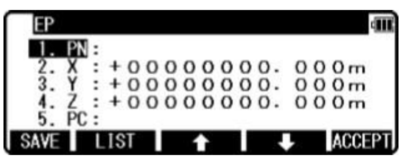
10. Press [ENT] to open the Y coordinate input screen and input.
11. Press [ENT] to open the Z coordinate input screen and input.
12. Press [ENT] to open the PC input screen and input.

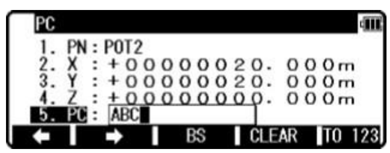


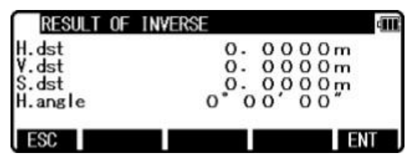




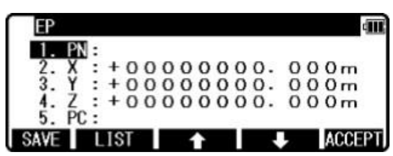
13. **End point coordinates input** (Input the PN, Coordinates and PC of the End point.)
14. After PC input, EP screen is viewed.
15. Input the PN, X, Y, Z Coordinates and PC name of the End point.
16. Press [ENT] to view the RESULT OF INVERSE screen.

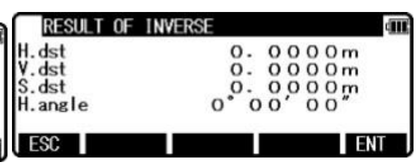


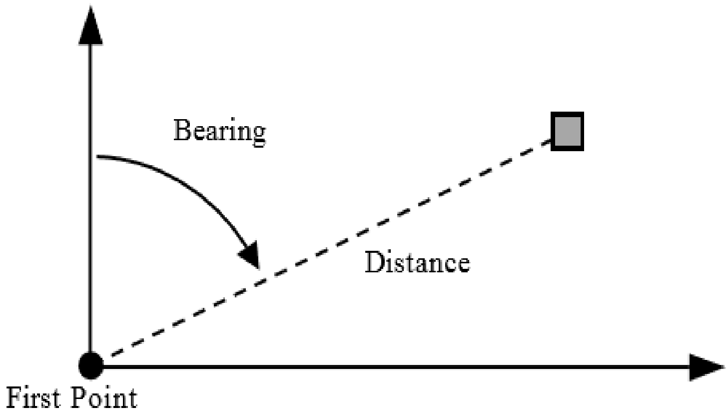




17. **Another End Point Coordinates input** the PN, X, Y, Z Coordinates and PC name of another End point, and another inverse result can be performed.







18. A point Coordinates is calculated from a known point Coordinates and the Distance and Horizontal angle of the Second point.
19. Input: Coordinates of a known point, Distance and Horizontal angle of the Second point Output: Coordinates of the Second point
20. From the Power Topo Lite screen, press [F2] [CALC] to view the CALCULATION screen.
21. Select 1.COGO and press [ENT] to view the COGO screen.

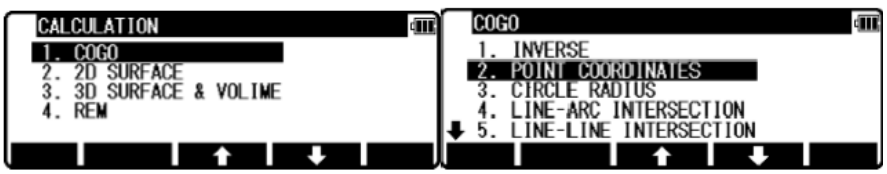
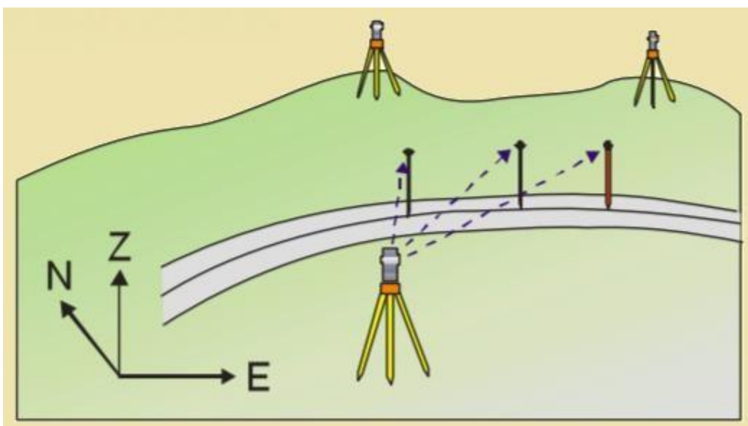


Diagram:



Calculation:

From the Power Topo Lite screen, press [F2] [CALC] to view the CALCULATION screen.

Note:

Have to calculate the N, E, Z coordinates of the curve before going to the field based on the preliminary data's.

Result:

The simple curve has been plotted using total station.

Viva Questions:

1. What is curve setting?
2. Where the curve setting method is applied in civil engineering constructions?
3. What are the programs you can find in COGO?
4. What are the various methods available for curve setting?
5. Give a list of various types of curves.
6. What is remote height?
7. What is elevation?
8. What is depression?
9. How to find out the high of the tower by using total station
10. Which mode is used to measure the height of the tower?
11. What are the temporary adjustments of total station?
12. What is levelling?
13. What are the precautions to be taken while determining the area?
14. What is Total Station?
15. What are the major components of Total Station?
16. What are the uses of Total Station?
17. What is the Least of Count of Total Station?
18. What are temporary adjustments of Total Station?
19. Nowadays targets are not necessary for doing surveying. Is it true?

20. How to measure of the height of instrument?
21. How the sensitiveness of a bubble tube is designated?
22. How the benchmark is established?
23. As a surveyor, what are your primary job tasks?
24. What are the methods of surveying?
25. What are the general principles of surveying?
26. What are the general principles of surveying?
27. What is the aim of this experiment?
28. What is EDM?
29. What is the use of polar co-ordinate?
30. How do you perform change point using total station?
31. Where we can use polar coordinates?
32. List the comments used in total station.
33. What is the use of cogo comment?
34. What is the use of REM comment?
35. What is MLM?
36. List the capabilities of a total station.
37. What are the field procedures for a total station in topographic surveys?
38. Value of prism correction is equal to
39. What are the modes of observation available in total station?
40. Define stakeout.
41. What precision have to achieve during leveling using total station?

CONTENT BEYOND THE SYLLABUS

Ex.No: 1

Date:

THREE POINT PROBLEM USING PLANE TABLE SURVEY

Aim:

To locate the station point occupied by the plane table with the reference of three known points.

Equipments:

Chain/Tape, Ranging Rods, Arrows, Plane Table with Tripod and its accessories, Drawing Sheets, Drawing Clips, Pencil, Eraser and Pins.

Procedure:

Three Point Problem - Principle:

In this method, three well defined points, having locations already being plotted on the drawing are involved. These are used to find and subsequently plot the location of the plane table station.

The method is based on the fact that, in a correctly oriented plane table, resectors through well defined points get intersected at a point which represents the location of the plane table station on the drawing. For example, as shown in Figure, if X, Y and Z are well defined objects present in the field whose plotted positions are x, y and z. Now, if the plane table is oriented correctly, the three resectors Xx, Yy and Zz get intersected at p which represents the location of the plane table station, P on the drawing sheet. Thus, through solution of three-point problem, both orientation and resection of plane table gets accomplished simultaneously.

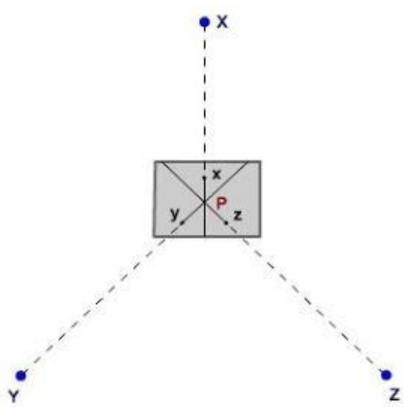


Figure: Principle of Three Point Problem

There are several methods for solution of the three point problem: (i) Trial and Error method, (ii) Mechanical method, (iii) Graphical method, (iv) Analytical method and (v) Geometrical construction method. Of these, the **trial and error** method is easy, quick and accurate. It is commonly used in practice and hence, has been discussed in detail.

Trial and Error method of Solution of Three Point Problem

In three point problem, if the orientation of the plane table is not proper, the intersection of the resectors through the three points will not meet at a point but will form a triangle, known as ***triangle of error***. The size of the triangle of error depends upon the amount of angular error in the orientation.

The trial and error method of three point problem, also known ***as Lehman's method*** minimises the triangle of error to a point iteratively. The iterative operations consist of drawing of resectors from known points through their plotted position and the adjustment of orientation of the plane table.

The estimation of location of the plane table depends on its position relative to the well defined points considered for this purpose. Depending on their relative positions, three cases may arise:

(i) The position of plane table is inside the great triangle;
(ii) The position of plane table is outside the great triangle;
(iii) The position of plane table lies on or near the circumference of the great circle.

In case of (iii), the solution of the three-point problem becomes indeterminate or unstable. But for the cases (i) and (ii), Lehmann's rules are used to estimate the location of plane table.

Lehmann's rules

1. If the position of plane table station is inside the great triangle, its plotted position should be chosen inside the triangle of error.
2. If the position of plane table station is outside the great triangle, its plotted position should be chosen outside the triangle of error.
3. The plotted position of the plane table should be so chosen that its distance from the the resectors is proportional to the distance of plane table station from the field positions of the considered objects.
4. The plotted position of the plane table should be so chosen that it is to the same side of all the three rays.
4(a). If the position of plane table station is outside the great circle, its plotted position should be so chosen that

- It lies on the same side of ray to the most distant point as the intersection k of the other two rays.
- The intersection of two rays to the nearer points, is midway between the plotted position of the station and the ray to the most distant point.

4(b). If the position of plane table station is outside the great triangle but inside the great circle, the plotted position of the station is so chosen that the ray to the middle point lies between plotted station position and the intersection of the rays to the two extreme points.

Steps for Solution of Three-Point Problem

Let X, Y, and Z represent the ground location of the well defined objects whose plotted positions are x, y, and z, respectively. Let P be the plane table station whose plotted position, say p, is to be determined.

i. Select a plane table position inside the great triangle XYZ and set up the table over P and orient it by judgment so that apparent line xy is approximately parallel to the imaginary side XY.
ii. Pivoting the alidade on x, y, and z bisect the signals placed at X, Y, and Z in turn and draw rays. If the orientation of the table is correct, the three rays will meet at one point which is the desired location of p on the sheet. If not, the rays will form a triangle of error.
iii. Choose a point p' inside the triangle of error such that its perpendicular distances from each ray is in proportion to the respective distances of P from the three ground objects. For selection of location of p', Lehmann's rules (1) and (3) need to be applied.
iv. Align the alidade along p' x (assuming X to be the farthest station) rotate the table till flag at X is bisected, and clamp the table.
v. Pivoting the alidade on x, y, and z repeat the process as in step (ii) above. If the estimation of p as p' is correct, the three rays will intersect at a point otherwise again a triangle of error will be formed but of smaller size and within the previous triangle of error. .
vi. Estimate again the location of p' in the new triangle of error applying the rules, (i) and (iii), and repeat the steps (iv) and (v).
vii. The method is repeated till all the three rays intersect at a point. The point of intersection is the required location p of the plane-table station P.

Result:

The station point of the plane table has been re-established using plane table surveying by three point problem.

Ex.No: 2

Date:

FINDING THE LOCATION OF POINTS USING GLOBAL POSITIONING SYSTEM

Aim:

To find the position (latitude, longitude and elevation) of station point using global positioning system (GPS).

Equipments:

GPS Meter, GPS software, Total Station or Garmin GPS

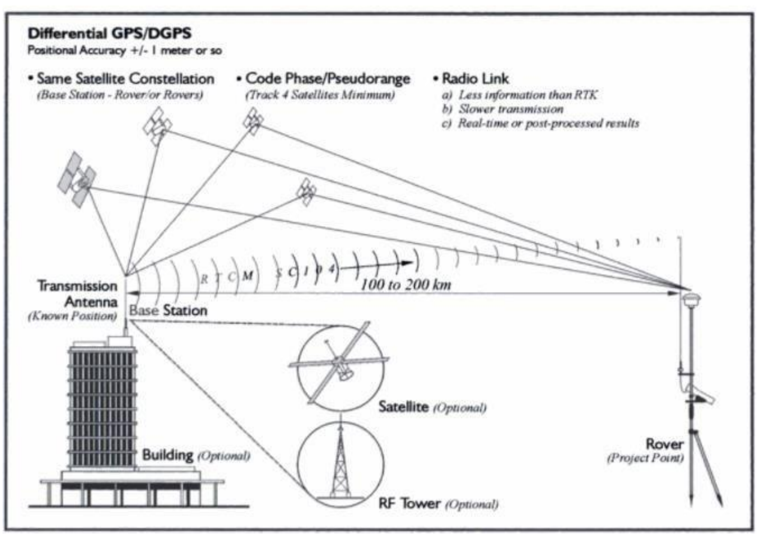
Precautions:

a) Temporary adjustment for total station
b) Levelling and centring
c) Focusing adjustment

Theory:

The Global Positioning System (GPS) employs trilateration to calculate the coordinates of positions at or near the Earth's surface. Trilateration refers to the trigonometric law by which the interior angles of a triangle can be determined if the lengths of all three triangle sides are known. GPS extends this principle to three dimensions.

A GPS receiver can fix its latitude and longitude by calculating its distance from three or more Earth-orbiting satellites, whose positions in space and time are known.



1. In the absolute positioning mode, the absolute coordinates of the antenna position (centred over the survey station) are determined using single GPS receiver, by a method similar to the resection method used in plane tabling.
2. The pseudo ranges (the satellite-antenna range, contaminated by the receiver clock bias) from minimum four satellites are observed at the given epoch, from which the four unknown parameters - the 3-D position of the antenna (x, y, z) and the receiver clock error can be determined.
3. The accuracy of the position obtained from this method depends upon the accuracy of the time and position messages received from the satellites.
4. With the selective availability operational, the accuracy of absolute positioning in real-time was limited to about 100 metres, which has now improved to a about 10 to 20 metres, since the SA is switched-off.
5. This can be further improved to few centimetres level by using post-processed satellite orbit information in the post-processing mode.
6. The accuracy of absolute positioning with GPS is limited mainly due to the high orbit of the satellites. However, very few applications require absolute position in real time.
7. A wide variety of GPS receivers are commercially available today. Depending upon the type of application, accuracy requirements and cost factor, the user can select the type of GPS receiver which best suits his demands.
8. The receivers available cover a wide range from the high-precision Rouge receivers developed by the Jet Propulsion Laboratories, (JPL), of the National Aeronautics and Space Administration (NASA), with built-in atomic clock, to the hand-held navigation receivers used by Army personnel, mountaineers, etc., which can give the position to few-metres accuracy. Even wrist-watches with built-in GPS receivers are now commercially available (e.g.: the Casio GPS watch).
9. The surveying type of receivers are single frequency, multi-channel receivers, which are useful for most surveying applications, including cadastral mapping applications, providing tertiary survey control, engineering surveys, etc.
10. These are more expensive than the navigation type of receivers, and more versatile. The data from many of these receivers can be directly imported in to most commonly used GIS software packages / formats.
11. Most of these receivers can also be used in DGPS mode. Examples of surveying receivers are the PRO-XR model of Trimble Navigation Ltd., the SR 100 model of Leica Ag., etc

Procedure:

1. Visit the Trimble website
2. Hover your mouse cursor over *Support & Training*, and click on **Support A-Z**.
3. In the list of *Support & Training, Support A-Z,* find and click on the **Planning Software** link.
4. On the *Planning Software* page that you land on, follow the **Trimble GPS Data Resources** link.

In the next step you may be prompted to install Microsoft Silverlight. If you are prompted to install Silverlight, go ahead and do so. There are Windows and Mac versions. The software will download and then you will need to install it. Use the *Run as Administrator* option to do so. If the installation process comes back with a message that Silverlight is already installed, the implication is that you have more than one browser app installed on your machine and you just need to open the one that Silverlight is associated with. Chances are that it is Internet Explorer that you need to use.

5. On the *GPS Data Resources* page, follow the **GNSS Planning Tool** link. The **GNSS Planning Online** interface will open. You will land on the *Settings* page.
6. Go ahead and enter at least longitude and latitude information for a location you are interested in.
   You can also use the **Pick** button to interactively select a location. After you pick a location from the map, click the **Apply** button.
7. Change or take note of the other setting in the *Settings* dialog window.
8. Click the *Settings* window **Apply** button. Your settings will be processed. Then you can click on any of the other buttons along the left side of the interface.

   For example, the **Satellite Library** button gives you access to the satellites in the various GPS systems that exist. You can choose the satellites you want to use. Clicking on a satellite entry from one of the system lists will bring up its almanac information.

9. Click the **DOPs** button. This allows you to see how the various sources of Dilution of Precision vary throughout the time period that was specified on the *Settings* page. Can you determine the best and worst times of day for GPS work?
10. Spend some time investigating what the other buttons allow you to investigate.
11. Trimble's GNSS Planning Online tool is not a teaching tool; you will not find a Help button that links to explanations of the functionality. The planning tool is aimed at users already versed in the terminology and technology.

Using Garmin GPS meter:

1. Switch on the power button present in the instrument. The instrument has to receive the signals from 5 satellites for getting accuracy (3m circumference) in result.
2. Go to Mark Waypoint comment – That gives the latitude, longitude and elevation of a particular point.

Result:

The latitude, longitude and the elevation of the station point have been found.

Latitude =

Longitude =

Elevation =