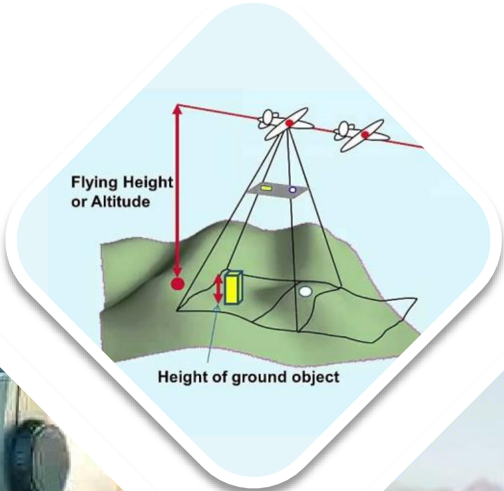
SCHEME : K

Name : ______________________________
Roll No. : ________________ Year : 20___ 20___
Exam Seat No. : ______________________

LABORATORY MANUAL FOR
ADVANCED SURVEYING
(313321)



CIVIL ENGINEERING GROUP

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001: 2015) (ISO/IEC 27001:2013)

VISION:

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION:

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

QUALITY POLICY:

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programs.

CORE VALUES:

MSBTE believes in the following:

- Skill development in line with industry requirements
- Industry readiness and improved employability of Diploma holders
- Synergistic relationship with industry
- Collective and Cooperative development of all stake holders
- Technological interventions in societal development
- Access to uniform quality technical education.

A Laboratory Manual

For

ADVANCED SURVEYING

(313321)

SEMESER-III

"K-SCHEME"

(CE/ CR/ CS/ LE)

Maharashtra State

Board of Technical Education, Mumbai.

(Autonomous) (ISO: 9001: 2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education, Mumbai
(Autonomous) (ISO: 9001: 2015) (ISO/IEC 27001:2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai – 400051,
(Printed On July 2024)

Maharashtra State
Board of Technical Education, Mumbai.

Certificate

This is to certify that Mr. / Ms. …………………………………………………….

Roll No……………………….of Second semester of Diploma in …………………………………………………………………………….............of Institute,……………………………………………………………………..………. …………………………………………….(Code:………………)has completed the term work satisfactorily in course **Advanced Surveying (313321)** for the academic year 20…… to 20…… as prescribed in the curriculum.

Place: …………… Enrollment No: ………………..

Date: ……………. Exam. Seat No: …………………

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

PREFACE

The development of the critically important industry-relevant abilities and skills is the main goal of any engineering laboratory or field work in the technical education system. In light of this, MSBTE developed the most recent "K" Scheme curricula for engineering diploma programs, emphasizing outcome-based learning. As a result, a sizable portion of the program is dedicated to practical work. This demonstrates how crucial laboratory work is in helping teachers, instructors, and students understand that every minute of lab time must be used efficiently to create these outcomes rather than wasting it on unnecessary activities. Every practical has thus been created to operate as a "vehicle" to help each student acquire this industry-identified capability in order to ensure the effective implementation of this outcome-based curriculum. The "chalk and duster" practice in the classroom is a challenging way to build practical skills. As a result, the development team of the "K" scheme laboratory manual focused on the intended results when creating the practical, as opposed to the customary approach of performing practical's to "verify the theory".

This lab manual is intended to support all parties involved, particularly the students, instructors, and teachers, in helping the students achieve the pre-established goals. It is required of every student to read through the relevant practical process in its entirety and comprehend the bare minimum of theoretical background related to the practical at least one day in advance of the practical. As a crucial starting point for carrying out the practical, each exercise in this handbook starts with establishing the competency, industry-relevant skills, course outcomes, and practical results. After that, the students will learn about the abilities they will acquire through the process outlined there and the safety measures that must be followed, which will enable them to use in addressing real-world situations in their professional life.

This manual also offers guidance to educators on how to manage resources so that students follow protocols and safety measures methodically and meet learning objectives. This allows teachers and instructors to effectively support student-centered lab activities through each practical exercise.

Today's globalized world has witnessed tremendous technological breakthroughs in surveying equipment and technology. Currently available accurate digital surveying tools are employed because of their speed, precision, and ease of use. The disciplines of civil engineering, mining engineering, environmental engineering, transportation engineering, and marine engineering heavily rely on these tools and applications. Given the importance of remote sensing and Geographic Information Systems (GIS) and their widespread usage in mapping and storing spatial data, it is expected that students will have a basic understanding of these subjects in order to use them in the field. Students who complete this course will have the necessary abilities and competences to perform tasks linked to surveys.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Program outcome (POs)

PO 1. Basic & Discipline specific knowledge: Apply knowledge of basic mathematics, sciences and engineering fundamentals and engineering specialization to solve the engineering problems.

PO 2. Problem Analysis: Identify and analyze well defined engineering problems using codified standard methods.

PO 3. Design /Development Solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

PO 4. Engineering tools experimentation and testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO 5. Engineering practices for society sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO 6. Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

PO 7. Lifelong learning: Ability to analyze individual needs and engage in updating in context of technological changes.

List of Relevant Skills

On the successful completion of the course the students will acquire the required industry relevant skills and they will be able to:

1. Study and use advance surveying instruments.
2. Determine the Tachometric constants.
3. Compute areas and Draw Plans based on the field data.
4. Design the simple circular curves using different methods.
5. Study different components and use of GIS and Remote sensing.
6. Study the relevant applications of Arial Surveying and Photogrammetry

Guidelines to teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each practical.
3. Involve students in performance of each practical.
4. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.

Instructions to Students

1. Organize the work in the group and make record all programs.
2. Students shall develop maintenance skill as expected by industries.
3. Student shall attempt to develop related hand-on skills and gain confidence.
4. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual.
5. Student shall refer technical magazines.
6. Student should develop habit to submit the practical on date and time.
7. Student should well prepare while submitting write-up of exercise.
8. Attach /paste separate papers wherever necessary.

Practical Course outcome matrix:

- CO1 - Use the Tacheometer to obtain relevant details of the terrain in given situation.
- CO2 - Set out a Simple Circular curve to finalize the alignment of the given element.
- CO3 - Prepare layout plans using relevant surveying instruments.
- CO4 - Locate the co-ordinates of a given stations using the relevant technology.
- CO5 - Interpret the images of given terrain using Photogrammetry Techniques.

Pr. No.	Title of the Practical	Mapped Course Outcome				
		CO 01	CO 02	CO 03	CO 04	CO 05
01	*Determine the Tacheometric Constant	√	--	--	--	--
02	*Determine reduced levels of given stations and horizontal distances by Tacheometric Method (Part I)	√	--	--	--	--
03	*Determine reduced levels of given stations and horizontal distances by Tacheometric Method (Part II)	√	--	--	--	--
04	*Setting out of a circular curve by offsets from Long Chord Method.	--	√	--	--	--
05	*Setting out a circular curve by Rankine's Method of Deflection Angles. (Project) (Part I). Plot the curve details on A1 size imperial drawing sheet.	--	√	--	--	--
06	*Setting out a circular curve by Rankine's Method of Deflection Angles. (Project) (Part II). Plot the curve details on A1 size imperial drawing sheet.	--	√	--	--	--
07	*Determine horizontal and vertical distance by using EDM	--	--	√	--	--
08	*Determine Horizontal and vertical angles using Electronic Digital Theodolite	--	--	√	--	--
09	Setting up the Total Station instrument on site for surveying.	--	--	√	--	--
10	*Determine horizontal, vertical and slope distances using Total station equipment (Part I	--	--	√	--	--
11	*Determine horizontal, vertical and slope distances using Total station equipment. (Part II.	--	--	√	--	--
12	*Determine horizontal and vertical angles using Total Station. (Part I	--	--	√	--	--
13	*Determine horizontal and vertical angles using Total Station. (Part II	--	--	√	--	--
14	*Determine the Reduced Levels of given stations (Minimum 10 station) (Part I)	--	--	√	--	--
15	*Determine the Reduced Levels of given stations (Minimum 10 station) (Part II)	--	--	√	--	--
16	Stack out (transferring the data on ground) using Total Station (Part I)	--	--	√	--	--

17	Stack out (transferring the data on ground) using Total Station (Part II	--	--	√	--	--
18	Road profile of 100m length using Total Station instrument (Part I)	--	--	√	--	--
19	Road profile of 100m length using Total Station instrument (Part II)	--	--	√	--	--
20	Contouring using Total Station instruments for the area of size 50 X 50 m	--	--	√	--	--
21	*Prepare Building site layout by using Total Station (Project) (Part I). Plot the project details on A1 size imperial drawing sheet.	--	--	√	--	--
22	*Prepare Building site layout by using Total Station (Project) (Part II). Plot the project details on A1 size imperial drawing sheet.	--	--	√	--	--
23	*Carry out 5-Sided closed traverse Surveying project by using Total Station.(Project) Part I). Plot the traverse details on A1 size imperial drawing sheet.	--	--	√	--	--
24	*Carry out 5-Sided closed traverse Surveying project by using Total Station. (Project) Part II). Plot the traverse details on A1 size imperial drawing sheet.	--	--	√	--	--
25	*Locate the coordinates of a station with the help of GPS.	--	--	--	√	--
26	Create the images of contouring map with given data (Photogrammetry images, etc.) using the freeware/open source software (Part I)	--	--	--	--	√
27	Create the images of contouring map with given data (Photogrammetry images, etc.) using the freeware/open source software (Part II)	--	--	--	--	√
28	Create the images of Road Profile plan with given data (Photogrammetry images, etc.) using the freeware/open source software (Part I)	--	--	--	--	√
29	Create the images of Road Profile plan with given data (Photogrammetry images, etc.) using the freeware/open source software (Part II)	--	--	--	--	√
30	*Write a brief report on the visit to nearby surveying software laboratory for visualization of image creation of contouring map of given area using given data OR Arrange Expert Lecture OR Show study videos of Photogrammetry surveying.	--	--	--	--	√

CONTENT PAGE

List of Practical's and Formative Assessment sheet.

Pr. No	Title of the Practical	Page No.	Date of Performance	Date of Submission	Assessment marks	Dated sign of teacher	Remarks (if any)
14	*Determine the Reduced Levels of given stations (Minimum 10 station) (Part I)	48					
15	*Determine the Reduced Levels of given stations (Minimum 10 station) (Part II)	48					
16	Stack out (transferring the data on ground) using Total Station (Part I)	52					
17	Stack out (transferring the data on ground) using Total Station (Part II)	52					
18	Road profile of 100m length using Total Station instrument (Part I)	56					
19	Road profile of 100m length using Total Station instrument (Part II)	56					
20	Contouring using Total Station instruments for the area of size 50 X 50 m	61					
21	*Prepare Building site layout by using Total Station (Project) (Part I). Plot the project details on A1 size imperial drawing sheet.	65					
22	*Prepare Building site layout by using Total Station (Project) (Part II). Plot the project details on A1 size imperial drawing sheet.	65					
23	*Carry out 5-Sided closed traverse Surveying project by using Total Station.(Project) Part I). Plot the traverse details on A1 size imperial drawing sheet.	70					
24	*Carry out 5-Sided closed traverse Surveying project by using Total Station. (Project) Part II). Plot the traverse details on A1 size imperial drawing sheet.	70					
25	*Locate the coordinates of a station with the help of GPS.	74					
26	Create the images of contouring map with given data (Photogrammetry images, etc) using the freeware/open source software (Part I)	80					
27	Create the images of contouring map with given data (Photogrammetry images, etc) using the freeware/open source software (Part II)	80					

Pr. No	Title of the Practical	Page No.	Date of performance	Date of Submission	Assessment marks	Dated sign of teacher	Remarks (if any)
28	Create the images of Road Profile plan with given data (Photogrammetry images, etc) using the freeware/open source software (Part I)	84					
29	Create the images of Road Profile plan with given data (Photogrammetry images, etc) using the freeware/open source software (Part II)	84					
30	*Write a brief report on the visit to nearby surveying software laboratory for visualization of image creation of contouring map of given area using given data OR Arrange Expert Lecture OR Show study videos of Photogrammetry surveying.	88					
Total marks:							

These marks are to be transferred in pro-forma published by MSBTE.

- '*' Marked Practical (LLOs) are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

Practical No: 01 **Determine the Tachometric Constants.**

I. Practical Significance:

Tachometry is used for preparation of topographic map where both horizontal and vertical distances are required to be measured; survey work in difficult terrain where direct methods of measurements are inconvenient; reconnaissance survey for highways and railways etc. Establishment of secondary control points.

II. Industry/Employer expected outcome(s):

Determine both the horizontal and vertical distance between two points.

III. Course Level Learning Outcome (COs):

CO1 - Use the Tachometer to obtain relevant details of the terrain in given situation.

IV. Laboratory Learning Outcome (LLO):

LLO 1.1 - Use theodolite as a Tachometer to determine the Tachometric Constant

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment’s and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Tachometric surveying is one of the methods of angular surveying in which a tachometer is used to determine both the horizontal and vertical distance between two points. Tachometric Surveying eliminates chain surveying as it becomes tedious to work with chain or tape in rough grounds, deep ravines, swampy areas, stretches of water bodies etc. It is also a less time-consuming method as compared to chain surveying.

VII. Required resources/equipment:

Sr. No.	Resource required	Particulars	Quantity
01	Tachometer with tripod	20” Theodolite with tripod ,one for each batch	2 nos.
02	Pegs	Wooden/Steel	4 nos
03	Arrows	GI wired	4 nos
04	Levelling Staff	As per IS specification	4 nos.
05	Metallic or PVC tape	15m/20m/30m	1 nos.

Figure 1.1 Levelling Staff

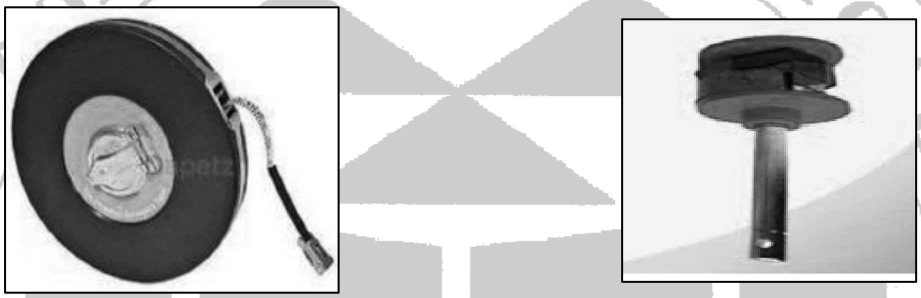


Figure 1.2 Metallic tape and line ranger

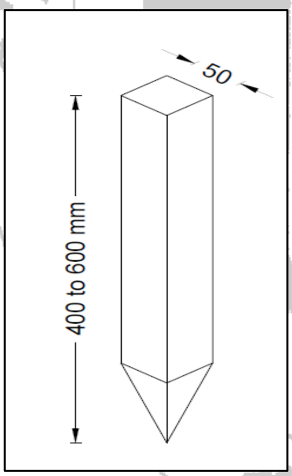


Figure 1.3 Wooden Peg

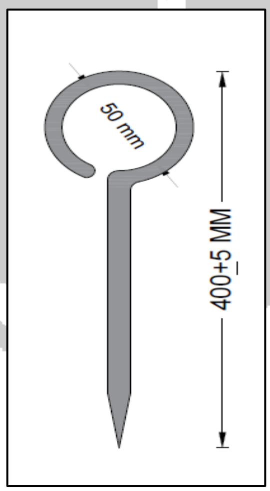


Figure 1.4 Arrow

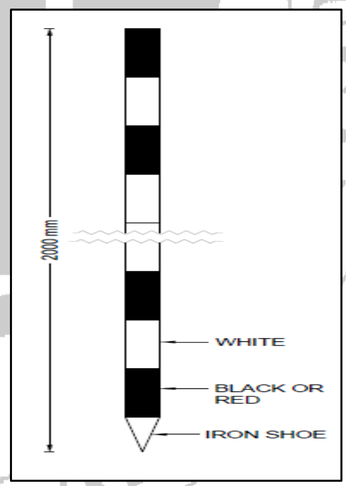


Figure 1.5 Ranging Rods

VIII. Precautions to be followed:

1. Calibrate the theodolite before starting the survey work.
2. Leveling and centering must be done perfectly.
3. Clamps and screws should especially be carefully operated. Unnecessary pressure should not be used in tightening them. If the screws do not turn easily, they should be cleaned with a good solvent such as alcohol or gasoline
4. Relation of fundamental lines at Theodolite must be maintained while taking readings.

IX. Procedure:

1. A line of fixed length is fixed on the ground and pegs are driven at some specified interval.
2. The instrument is set up at a convenient point from which all the pegs can be seen.
3. Temporary adjustments are made and the line of sight is kept horizontal.
4. Levelling staff is kept at peg fronts and staff intercept is noted down.
5. Knowing the staff intercept and distance, the Tacheometric constants can be found by solving the Tacheometric equations.
6. Tacheometric equation

   $D = KS+C$

   Where, K = Multiplying constant C = Additive constant S = staff intercept D = distance of peg points.

X. Observations:

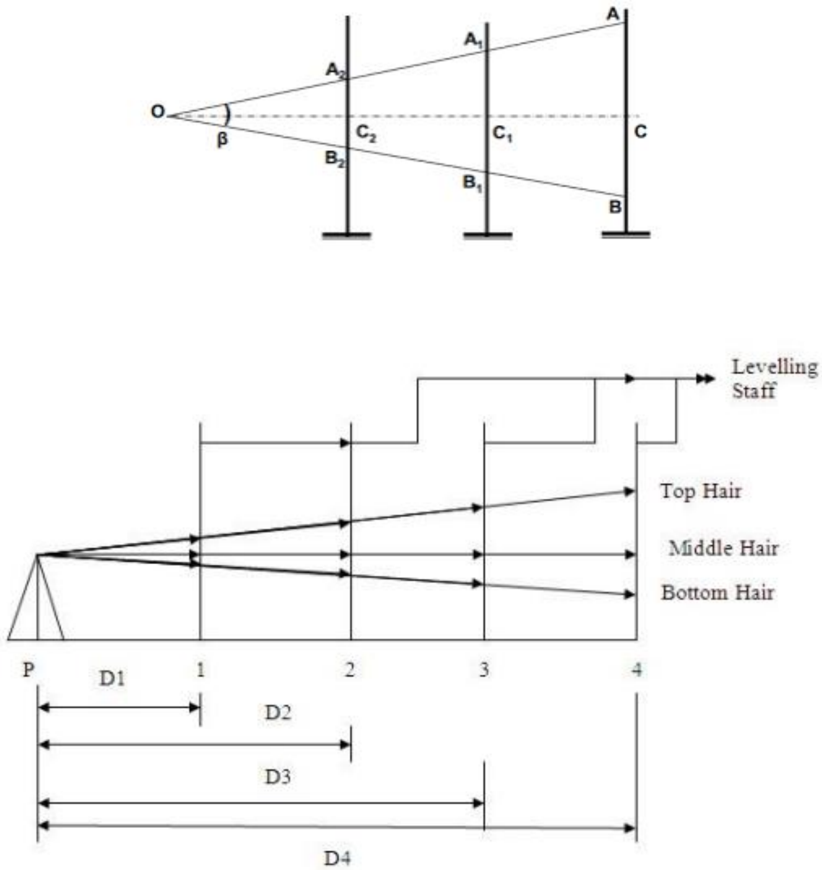


Figure 1.6 Tachometry Setup

XI. Observation Table

Instrument station	Staff Station	Staff reading		Staff Intercept	Distance (m)
		Top	Bottom		

XII. Result:

XIII. Interpretation of results:

XIV. Conclusions:

1) The constants of tachometer are
2) Multiplying constant K =
3) Additive Constant C =

XV. Practical Related Questions:

1. Explain the principle of Tacheometry?
2. Give the characteristics of Tacheometer.

Space for Answer

XV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Observation of staff readings on stadia Diaphragm.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 02 & 03 **Determine reduced levels of given stations and horizontal distances by Tacheometric Method (Part I & II).**

I. Practical Significance:

Tacheometric surveying is defined as a method of angular surveying in which a tachometer is used to determine the horizontal and vertical distance between two points. Thus, eliminating the tedious process of chain surveying to measure horizontal distance.

II. Industry/Employer expected outcome(s):

- Calculating the Horizontal distance and angles using Theodolite.

III. Course Level Learning Outcome (COs):

- CO1 - Use the Tachometer to obtain relevant details of the terrain in given situation.

IV. Laboratory Learning Outcome (LLO):

- LLO 2.1 Use theodolite as a Tacheometer to compute reduced levels and horizontal distances

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Tachometric surveying is one of the methods of angular surveying in which a tachometer is used to determine both the horizontal and vertical distance between two points. Tachometric Surveying eliminates chain surveying as it becomes tedious to work with chain or tape in rough grounds, deep ravines, swampy areas, stretches of water bodies etc. It is also a less time-consuming method as compared to chain surveying.

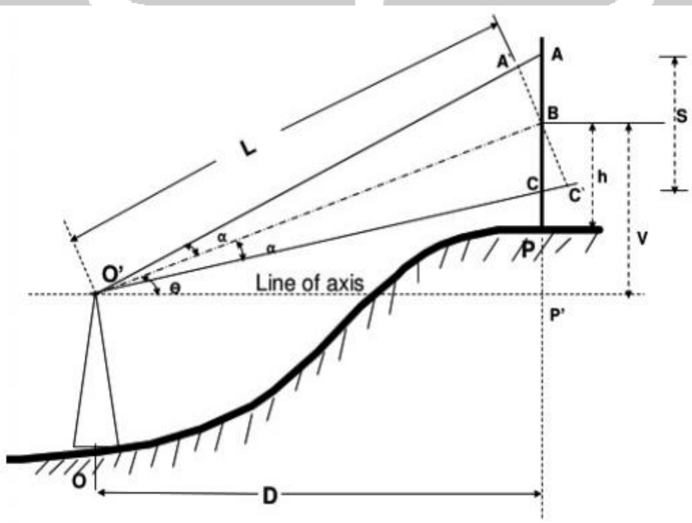
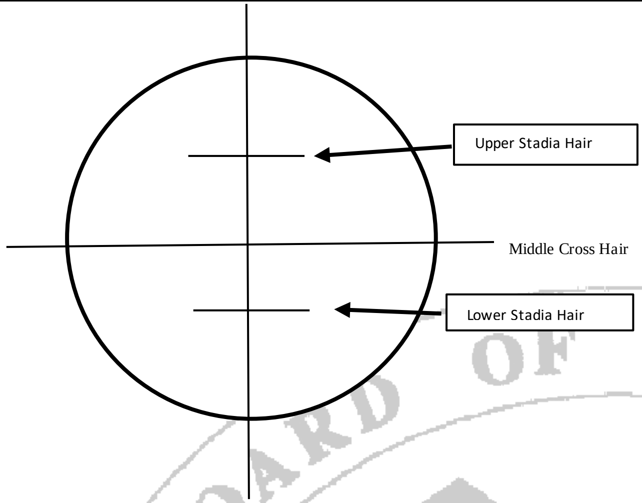
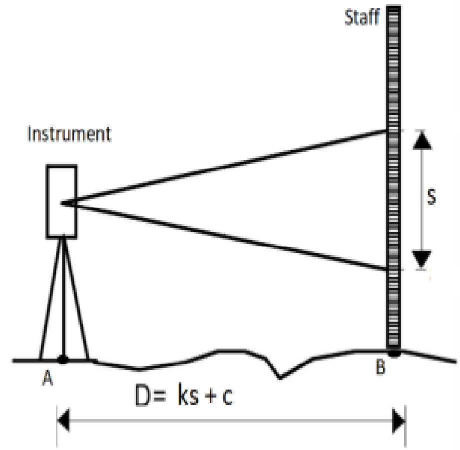


Figure 2.1: Tacheometry





Calculating staff intercept

VII. Required resources/equipment:

Sr. No.	Resource required	Particulars	Quantity
01	Tachometer with tripod	20" Theodolite with tripod ,one for each batch	2 nos.
02	Pegs	Wooden/Steel	4 nos
03	Arrows	GI wired	4 nos
04	Levelling Staff	As per IS specification	4 nos.
05	Metallic or PVC tape	15m/20m/30m	1 nos.

VIII. Precautions to be followed:

1. Calibrate the theodolite before starting the survey work.
2. Leveling and centering must be done perfectly.
3. Clamps and screws should especially be carefully operated. Unnecessary pressure should not be used in tightening them. If the screws do not turn easily, they should be cleaned with a good solvent such as alcohol or gasoline
4. Relation of fundamental lines at Theodolite must be maintained while taking readings.

IX. Procedure:

1. Collect the required instruments as per Table IX from the store.
2. Set up the tripod over the given station and fix theodolite over it. Perform approximate levelling by tripod stand
3. Perform Centering by using plumbob.
4. Perform accurate Levelling by using foot screws.
5. Focus the eye piece and make cross hairs clear and distinct.
6. For removal of parallax do focusing the object glass.
7. Set the vertical circle Vernier C to 0° 00' 00" and D at 0° 00' 00" accurately using vertical clamp and vertical tangent screw.
8. Unclamp the Vertical clamp and bisect staff held at A approximately, Clamp Vertical clamp. Using vertical tangent screw bisect the staff at A precisely and take upper, central and bottom hair readings

9. Take readings at the Vernier C and D and get the vertical angle
10. Find the RL and the horizontal distance using formulae.
11. The horizontal distance is determined using the mathematical formula

$$\mathbf{D=k\times S\times \cos^2\theta+C\times \cos\theta}$$

Where,
S = Staff intercept = difference between top and bottom reading
k = Multiplying constant
C = Additive constant
$\boldsymbol{\theta}$ = Vertical angle measured by Tacheometer

And, the vertical distance is calculated as:

$$\mathbf{V=k\times S\times \sin\theta\times \cos\theta+C\times \sin\theta}$$

It should be noted that if an Anallytic lens is used, then k=100 and C=0.

X. Observations & Calculations:

1. Multiplying Constant of Instrument =
2. Additive constant of Instrument =
3. Horizontal Distance =

4. Vertical Distance =

XI. Calculation table:

Instrument station	Staff Station	Staff reading		Staff Intercept
		Top	Bottom	

XII. Results:

Horizontal Distance D = ______ m

Vertical Distance V = ______ m

XIII. Interpretation of results:

XIV. Conclusions:

XV. Practical Related Questions:

1. State the use of Analytic Lens.
2. Explain the procedure to find additive and multiplying constant when staff is held vertical and line of sight horizontal.

Space for Answer

XV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Fixing of TBM and Alignment of the Profile	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 04 ***Setting out of a circular curve by offsets from Long Chord Method.**

I. Practical Significance:

The linear method, also known as the chord method or the tangent-offset method, is one of the techniques used in surveying and engineering to determine and mark points along a curved path, such as a circular curve or an arc.

II. Industry/Employer expected outcome(s):

- To Design the curves on highways, railways and other transportation routes.

III. Course Level Learning Outcome (COs):

- CO 2 - Set out a Simple Circular curve to finalize the alignment of the given element.

IV. Laboratory Learning Outcome (LLO):

- LLO 4.1 Use the offsets from Long Chord Method to Set out a circular curve

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Curve setting is a crucial aspect of designing highways, railroads, and other transportation routes. Two primary methods are used: linear and angular. Linear methods determine the coordinates of points along the curve, while angular methods use deflection angles and tangent offsets. Each method has its advantages and is selected based on project requirements and terrain characteristics. The setting out of a circular curve involves the process of determining and marking the physical positions of points along the curve on the ground. It is a critical step in highway or railway design to ensure accurate construction of curves with specific radii and degrees. Curve setting can be achieved by two methods:

Linear Method: This method involves the determination of linear distances for curve setting.

Angular Method: This method involves angular measurements, which may or may not include linear measurements.

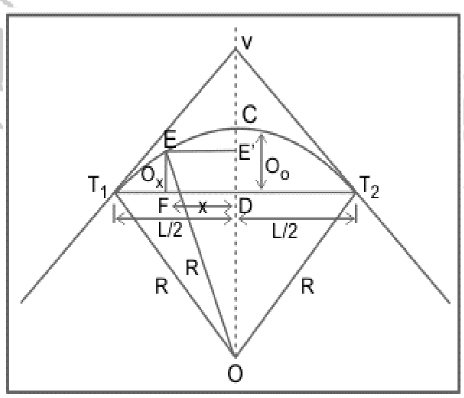


Figure 4.1:Offsets from Long chord

Ordinate at a distance x from the midpoint of the long chord is given by:

$$O_x=\sqrt{(R^2-x^2)}-\sqrt{R^2-(L/2)^2}$$

Where,

Ox = length of offset at a distance ‘x’ from the mid of long chord.

X = specified distance between offsets.

L = length of the long chord. R = Radius of the curve

$$O_o = R-\sqrt{R^2-(L/2)^2} \text{ (Mid-Ordinate)}$$

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Chain and tape.	As per IS standards.	01 nos
02	Ranging Rods.	As per requirement	01 nos
03	Pegs	As per requirement	10 nos
04	Hammer	----	01 nos

VIII. Precautions to be followed:

1. Read the operating manual of instrument before use.
2. Tracing point is moved precisely over the boundary of figure or plan.
3. Set the scale as per the given drawing to the Planimeter.

IX. Procedure:

1. The obtained length of long chord is first set out on the field by proper ranging and mid-point is established.
2. The length of offsets at mid length is to be set out. For this, a person holds the cross-staff at required point and aligns the slit with the end station ranging rods. At this instant another person looks through the normal slit and guides a person with a ranging rod to come into its view thus along this line normal to long chord, the calculated offset is setout..
3. The cross staff is shifted to next point distance ‘x’ as specified and above step is repeated the offset corresponding to that distance is set out from that point.
4. Pegs are marked at the end of the offsets, the joining of which completes the setting of curve.

X Results:

- Length of long Chord = ______ m
- Length of offset – Mid Ordinate(O_0) =

XI. Interpretation of results:

XII. Conclusions:

XIII. Practical Related Questions:

1. State the purpose of horizontal curve?
2. Explain Linear and angular method of setting of curve?
3. Explain the importance of curve setting.

<u>Space for Answer</u>

XIV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Accuracy in length measurement of the offsets from long chord	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 05 & 06 Setting out a circular curve by Rankine's Method of Deflection Angles. **(Project).** Plot the curve details on A1 size imperial drawing sheet. **(Part I&II)**

I. Practical Significance:

Rankine method is based on the principle that the deflection angle to any point on a circular curve is measured by one half the angle subtended by the arc from Point of curve to that point. The method is most accurate since each point is fixed independently.

II. Industry/Employer expected outcome(s):

- To Design the curves on highways, railways and other transportation routes..

III. Course Level Learning Outcome (COs):

- CO 2 - Set out a Simple Circular curve to finalize the alignment of the given element.

IV. Laboratory Learning Outcome (LLO):

- LLO 5.1 & 6.1 Apply the technique of Rankine's Method of Deflection Angles to Set out a circular curve

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

- In this method, curves are staked out by use of deflection angles turned at the point of curvature from the tangent to points along the curve. The curve is set out by driving pegs at regular interval equal to the length of the normal chord. Usually, the sub-chords are provided at the beginning and end of the curve to adjust the actual length of the curve
- A substance of this method of setting out a simple curve is the location of various points on the curve from their total deflection angles. Total deflection of a point is the angle made by a chord joining that point to the point of curvature with the rare tangent. It is indicated by 'Δ'. A deflection angle of a chord is the angle made by the chord with the tangent drawn at the straight starting point of the chord. It is denoted by 'δ'.
- 'δ' for given chord lengths are determined by

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

Where C = Length of chord, R = Radius of curve

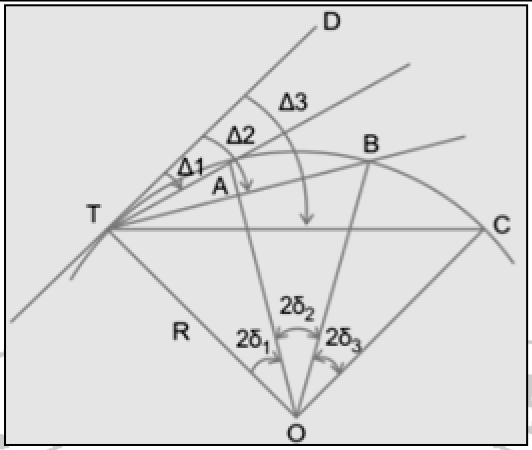


Figure 5.1:Rankines Method of Deflection angles

VII. Required resources/equipment.

Sr. No.	Resource required	Particulars	Quantity
01	Chain and tape.	As per IS standards.	01 nos
02	Theodolite	As per IS standards-20” Least count	01 nos
03	Ranging Rods.	As per requirement	10 nos
04	Pegs	As per requirement	01 nos
05	Hammer	----	01 nos

VIII. Precautions to be followed:

1. Fix the Theodolite exactly over the station.
2. Temporary adjustment of the theodolite should be done precisely.
3. Calculate the deflection angles to transfer it on ground.
4. Observe and record carefully.

IX. Procedure:

1. First collect the all instruments as per mentioned in point no VIII from the survey lab.
2. Locate the tangent points, the points where there is change in direction. Set up the theodolite over first tangent pointT1and make its temporary adjustments.
3. Set the ‘A’ – Vernier to zero degrees and bisect the point V, clamp the lower plate.
4. Release the upper plate and set the ‘A’-Vernier to read Δ1 the line of sight is thus directed along T1 A.
5. Hold the zero of the tape at T1 & take a distance C1 (T1A) and swing the tape with an arrow till it is bisected by the Theodolite. This establishes the first point A on the curve.
6. Set the second deflection angle Δ2 on the Vernier so that the line of sight is set along T1B.
7. Hold the zero of the tape at point A and an arrow at the other end (AB), swing the tape about point A till the arrow is bisected at point B. This establishes the second point B on the curve.
8. The same steps are repeated till the last point T2 is reached.

X. Observation & Calculations:

Let ABCD ….. be the points on the curve the total deflection angles of which are $\Delta 1$ $\Delta 2$ $\Delta 3$ … then,

$\Delta 1 = \delta 1$ $\Delta 2 = \Delta 1 + \delta 2$

And $\Delta n = \Delta n\text{-}1 + \delta n$

XI. Results:

The required simple circular curve is set out in the field by Rankine's Method (Prepare A1 Size sheet of the Curve).

XII. Interpretation of results:

XIII. Conclusions:

XIV. Practical Related Questions:

1. Define Deflection angle?
2. Draw neat sketch showing important points in the circular curves.
3. Explain the important terms related to Circular curves.

<u>Space for Answer</u>

XV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Accuracy in measurement of deflection angles	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

<table>
<tr><th colspan="3">Marks Obtained</th><th rowspan="2">Dated sign of Teacher</th></tr>
<tr><th>Process Related (15)</th><th>Product Related (10)</th><th>Total (25)</th></tr>
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Practical No: 07 **Determine horizontal and vertical distance by using EDM.**

I. Practical Significance:

Electronic Distance Measurement (EDM) is a remarkable technology used in surveying to measure distances with extraordinary accuracy. At its core, EDM measures the time it takes for a signal to travel from the instrument to a target and back. This innovative approach to distance measurement has replaced traditional methods such as chain and tape, providing surveyors with a more precise and efficient way to obtain distance measurements.

II. Industry/Employer expected outcome(s):

Determining the Horizontal and vertical distances accurately without physical measurement using tape or chain.

III. Course Level Learning Outcome (COs):

CO3 - Prepare layout plans using relevant surveying instruments.

IV. Laboratory Learning Outcome (LLO):

LLO 7.1 Use EDM to measure horizontal and vertical distance

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Electronic distance measuring instrument is a surveying instrument for measuring distance electronically between two points through electromagnetic waves. DDM or Direct distance measurement – This is mainly done by chaining or taping. ODM or Optical distance measurement. This measurement is conducted by Tacheometry, horizontal subtends method or telemetric method. These are carried out with the help of optical wedge attachments. EDM or Electromagnetic distance measurement – Electronic distance measurement (EDM) is a method of determining the length between two points, using phase changes, that occur as electromagnetic energy waves travels from one end of the line to the other end. Electronic distance measurement in general is a term used as a method for distance measurement by electronic means. In this method instruments are used to measure distance that rely on propagation, reflection and reception of electromagnetic waves like radio, visible light or infrared waves.

Electronic Distance Measurement (EDM)

Types of Electronic Distance Measurement Instrument: EDM instruments are classified based on the type of carrier wave as

1. Microwave instruments
2. Infrared wave instruments
3. Light wave instruments.

1. Microwave Instruments: These instruments make use of microwaves. And named as Tellurometers. They are light and highly portable. Tellurometers can be used in day as well as in night. The range of these instruments is up to 100 km.

2. Infrared Wave Instruments: In this instrument amplitude modulated infrared waves are used. Prism reflectors are used at the end of line to be measured. These instruments are light and economical and can be mounted on theodolite. With these instruments accuracy achieved is ± 10 mm. The range of these instruments is up to 3 km. The instruments available in trade name of Distomat.

3. Visible Light Wave Instruments: These instruments rely on propagation of modulated light waves. This type of instrument was first developed in Sweden and was named as Geodimeter. During night its range is up to 2.5 km while in day its range is up to 3 km. Accuracy of these instruments varies from 0.5 mm to 5 mm/km distance.

VII. Required resources/equipment:

Sr. No.	Resource required	Particulars	Quantity
01	Electronic Distance meter	Range Depending upon type of EDM upto 3km	1 nos.
02	Metallic tape	30m	1 nos
03	Ranging rods	2m length	5 nos

VIII. Precautions to be followed:

1. Hold the EDM properly mounted on the stand.
2. Make sure that the EDM is charged and calibrated regularly.
3. Ensure that there is no obstacle between the EDM and the target.
4. Observe and record carefully.

IX. Procedure: Working of EDM

1. Emitting Signals: The first step in the EDM process involves the emission of signal pulses from the device. These signals, whether electromagnetic waves or laser pulses, are directed towards the target that needs to be measured.

2. Reflecting the Signal: Once the signal pulses reach the target, they bounce back and are reflected towards the instrument. This reflection is the basis for further calculations and distance measurement.

3. Measuring Time: The EDM device precisely measures the time it takes for the signal to travel from the instrument to the target and back. This measured time serves as a crucial component in the calculation of the distance to the target.

4. Calculating Distance: Using the recorded time and the known speed of the signal, typically the speed of light for laser pulses, the device calculates the distance to the target. This calculation is achieved by multiplying the time by the speed of the signal and dividing it by two, providing an accurate distance measurement.

X. Observation Table:

Sr. No.	Station	Line	Length (m)	Remarks

XI. Results:

XII. Interpretation of results:

XIII. Conclusions:

XIV. Practical Related Questions:

1. Explain the working principle of EDM.
2. Explain the different types of EDM.
3. Give the advantages of EDM over Chain or tape.

Space for Answer

XV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Accuracy in length measurement.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 08 ***Determine Horizontal and vertical angles using Electronic Digital Theodolite.**

I. Practical Significance:

Digital Theodolite is the instrument which is helpful to measure the angles with high precision, also it is useful in determining the relative positions of points on earth's surface.

II. Industry/Employer Expected Outcome(s):

- Determining the horizontal angle and vertical angle of points on earth surface.
- Plotting the plans/maps on the ground.

III. Course Level Learning Outcome (COs):

- CO3 - Prepare layout plans using relevant surveying instruments.

IV. Laboratory Learning Outcome (LLO):

- LLO 8.1 Use Electronic Digital Theodolite to determine Horizontal and vertical angles.

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

A theodolite is an instrument used to determine the relative position of points on the earth's surface by measuring the horizontal and vertical angles. Theodolites can be either digital or non-digital types. Digital theodolites are more convenient and accurate as they provide digital readouts instead of reading directly from the traditional graduated circle.

Figure 8.1 Digital Theodolite.

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Digital theodolite	As per IS Standard	1 nos.
02	Tripod stand	As per IS Standard	1 nos
03	Peg	Wooden	3 nos
04	Ranging rods	2m length	2 nos
05	Measuring Tape	30 m	1 nos.

VIII. Precautions to be followed:

1. Precise Temporary adjustment of the theodolite.
2. Bisect the Ranging rod of station point accurately.
3. Read the Reading displayed and save it accordingly.
4. Record the reading properly.

IX. Procedure:

1. Mark the station Point accurately on the ground.
2. Set the theodolite with tripod over the station point and do the temporary adjustment of theodolite.
3. Remove the parallax by properly focusing the object glass.
4. Check the centering using optical plumate accurately.
5. After leveling, through the telescope, aim the crosshairs at the point to be measured. The knobs on the side of the theodolite are used to lock it to keep the target on point.
6. Now the note the angle displayed on the digitals screen.
7. Note the reading for the consecutive angles marked on the ground
8. You can repeat the procedure and can take the average of the readings.
9. Repeat the same procedure.

X. Observation Table:

Sr. No	Station Point	Object Bisected	Angle			Mean Angle			Remark
			Degree	Min	Seconds	Degree	Min	Seconds	

XI. Result:

XII. Interpretation of Results:

XIII. Conclusions:

XIV. Practical Related Questions:

1. State the function of upper and lower clamp screw.
2. Explain the temporary adjustments of theodolite?
3. Give the advantage and disadvantage of Digital Theodolite over Transit Theodolite.

Space for Answer

XV. Assessment Scheme:

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Accuracy in Angular measurement.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 09 Setting up the Total Station instrument on site for surveying.

I. Practical Significance:

Total Station is three-dimensional surveying technology unit. Total station combines the follow three basic components into one integral unit.

- An electronic distance measurement instrument
- An electronic digital Theodolite
- A computer or microprocessor.

A **total station** is a type of digital theodolites that integrates the angle-measuring tool with electronic distance measurement functionality. They are almost essential to modern surveying. Understanding how to properly set up and use a **total station** can help you to get more from your purchase.

II. Industry/Employer Expected Outcome(s):

- Determining the horizontal angle with accuracy.
- Plotting the plans/maps on the ground with accuracy and store it digitally for further reference.

III. Course Level Learning Outcome (COs):

- CO-3: Prepare layout plans using relevant surveying instruments.

IV. Laboratory Learning Outcome (LLO):

- LLO 9.1 Set up the Total Station instrument.

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment’s and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Total station can automatically measure horizontal and vertical angles as well as slope distances from a single setup. From these data it can instantaneously compute,

- Horizontal and vertical distance components
- Elevations

Coordinates and display the results on an LCD. Total station can also store data either on board in internal memory or in external data collectors. Data can be uploaded and can be downloaded to a computer. It can also perform basic co-ordinate geometry functions like area and perimeter calculations.

Distance Measurement: When a distance is measured with a total station a electromagnetic pulse is used for measurement – this is propagated through the atmosphere from instrument to a prismatic reflector or target and back during measurement. Distances are obtained by measuring the time taken for a laser radiation to travel from the instrument to a prism (or target) and back. The pulses are derived from an infrared or visible laser diode and they are transmitted through the telescope towards the remote end of the distance being measured, where they are reflected from a reflector and return to the instrument.

Since the velocity v of the pulses can be accurately determined, the distance D can be obtained using **2D = vt**, where t is the time taken for a single pulse to travel from instrument-target-instrument. This is also known as the timed-pulse or time of flight measurement technique, in which the transit time t is measured using electronic signal processing technique.

When measuring distances to a reflector telescope uses a wide visible red laser beam, which emerges coaxially from the telescope's objective. When reflector less measurements are made telescope uses a narrow visible red laser beam which emerges coaxially from the telescope's objective.

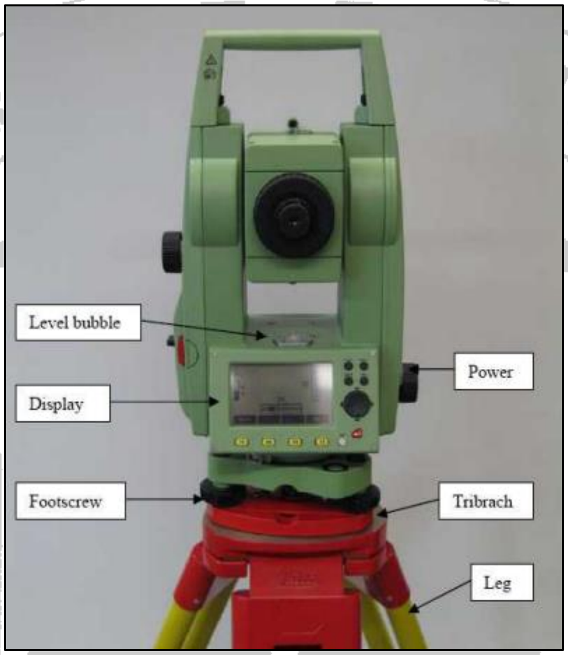

Figure 9.1:Total Station

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total Station with Tripod Stand	As per IS Standard	1 nos.
02	Peg	Wooden	3 nos
03	Prism Reflector with stand	As per specification	2 nos
04	Measuring Tape	30 m	1 nos.

VIII. Precautions to be followed:

1. Carry out temporary adjustments of Total station precisely.
2. Bisect the ranging rod of station point accurately.
3. Record the readings from the display accurately and save the readings for the further calculation and reference.
4. Handle the Total Station with care. Avoid heavy shocks or vibration.
5. Always switch the power off before removing the standard battery.

IX. Procedure:

1. First collect the all instruments and necessary attachments as per mentioned in point no VII from the survey lab.
2. Establish a temporary benchmark on the field.
3. While holding the tripod, loosen the tripod leg clamps and extend the tripod up to a height near your neck and chin. Tighten the leg clamps. Spread out the tripod legs evenly, about two to three feet for each leg, and center it over your benchmark stake. The top of your tri-pod should be mostly level and parallel with a horizontal plane.
4. Attach the Tribach to tripod and level the instrument accurately with the help of level tube and bubble.
5. Using Optical Plumate make the centering of the instrument accurately on the ground over the station point.
6. Attach the Total station instrument on the stand and check the all necessary levels again.
7. Carry out the fine levelling of the total station and check it digitally on the display.
8. Carry out the necessary checks and study the operating of Total station for various tasks such as angular and linear measurements, calculation of area etc.

X. Result:

XI. Interpretation of Results:

XII. Conclusions:

XIII. Practical Related Questions:

1. State the advantages and disadvantages of Total Station over theodolite.
2. Explain the parts of total station with their functions.
3. Collect the information of different total stations available in market with their make and specifications.

<u>Space for Answer</u>

XIV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Setting of Total Station and temporary adjustments.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 10 &11 **Determine horizontal, vertical and slope distances using Total station Equipment (Part I&II).**

I. Practical Significance:

Total Stations are commonly used by land surveyors, civil engineers, archaeologists. They are also widely used in the mining industry to record the absolute location of tunnel walls, ceilings, and floors as drifts are driven in underground mines. In the construction industry, Total Stations are used in mechanical and electrical construction for layout purposes and to lay out the locations of penetrations in structures, such as pipes, conduits, ducts, and hangers.

II. Industry/Employer Expected Outcome(s):

- Measurement of horizontal and vertical distances useful in preparing gradients and measuring the distances when it is not possible to measure it directly.

III. Course Level Learning Outcome (COs):

- CO3 - Prepare layout plans using relevant surveying instruments.

IV. Laboratory Learning Outcome (LLO):

- LLO 10.1 & 11.1: Use Total station instrument to measure horizontal, vertical and slope distances.

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment’s and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Distance measurement using Total station is done using a modulated infrared carrier signal, which is generated by the total station’s emitter and reflected back to the total station. The returning signal is interpreted by the Total Station’s computer. Distance is calculated by emitting and receiving multiple frequencies and determining the number of wavelengths to the target for each frequency. Total Station is a versatile tool that has become the standard for most forms of construction layouts. With its advanced technology and functionality, it is an essential tool for surveyors and construction professionals to get accurate and precise measurements.

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total Station with Tripod Stand	As per IS Standard	1 nos.
02	Peg	Wooden	3 nos
03	Prism Reflector with stand	As per specification	2 nos
04	Measuring Tape	30 m	1 nos.

VIII. Precautions to be followed:

1. Carry out temporary adjustments of Total station precisely.
2. Bisect the ranging rod of station point accurately.
3. Record the readings from the display accurately and save the readings for the further calculation and reference.
4. Handle the Total Station with care. Avoid heavy shocks or vibration.
5. Always switch the power off before removing the standard battery.

IX. Procedure:

1. First collect the all instruments and necessary attachments as per mentioned in point no VII from the survey lab.
2. Establish a temporary benchmark on the field.
3. While holding the tripod, loosen the tripod leg clamps and extend the tripod up to a height near your neck and chin. Tighten the leg clamps. Spread out the tripod legs evenly, about two to three feet for each leg, and center it over your benchmark stake. The top of your tri-pod should be mostly level and parallel with a horizontal plane.
4. Attach the Tribach to tripod and level the instrument accurately with the help of level tube and bubble. Using Optical Plumate make the centering of the instrument accurately on the ground over the station point.
5. Press the power button to switch on the instrument.
6. Select the mode-Function-create file-accept.
7. Set Zero using appropriate function.
8. Setup a reflector vertically beneath the point, the height of which is to be determined.
9. Target the reflector, the height difference H between the ground point and the high point is now calculated and displayed at the touch of a button

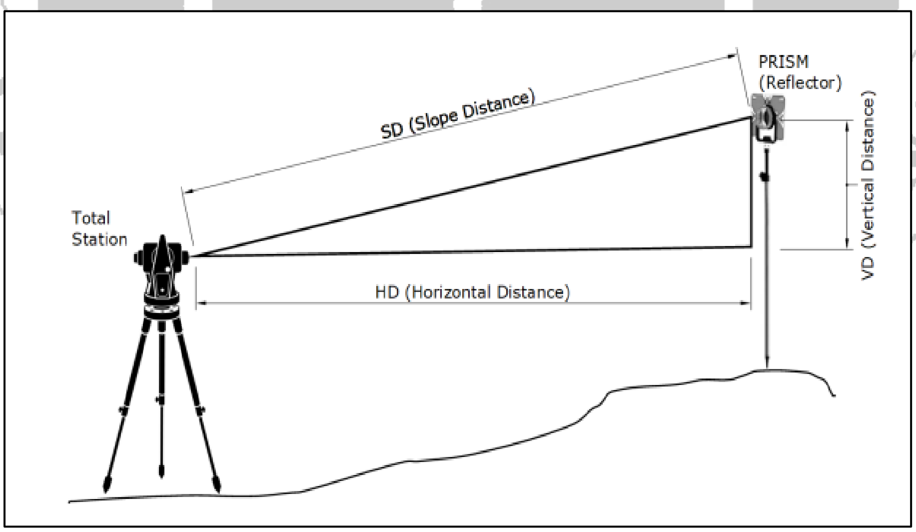

Figure 10.1: Measurement of Linear Distances and gradient

X. Observation Table:

A. Measurement of Horizontal, Vertical and Inclined distance or slope.

Sr. No	Station Point	Object Bisected	Horizontal Distance	Vertical Distance	Remark

XI. Result:

XII. Interpretation of Results:

XIII. Conclusions:

XIV. Practical Related Questions:

1. State the functions used in measurement of horizontal and vertical distances.
2. State the functions in TS for measurement of gradient?

<u>Space for Answer</u>

XV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Measurement of angle and distances.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 12 & 13 **Determine horizontal and vertical angles using Total Station (Part-I&II)**

I. Practical Significance:

The horizontal angle is used primarily to obtain direction to a survey control point, or to topographic detail points, or to points to be set out. Vertical Angle is necessary to determine the elevation of a point on earth's surface. It is useful in fixing the profile of ground for the infrastructure projects, topographic and geodetic works.

II. Industry/Employer expected outcome(s):

- Calculation of horizontal and vertical angle for Geodetic work for project developments in Infrastructure.

III. Course Level Learning Outcome (COs):

- CO3 - Prepare layout plans using relevant surveying instruments.

IV. Laboratory Learning Outcome (LLO):

- LLO 12.1 & 13.1 Use Total station instrument to measure the given horizontal and vertical angles

V. Relevant Affective Domain related Outcome(s):

- Follow safe practices.
- Practice good housekeeping.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Angle measurement is typically performed by the operator first occupying a known point, aiming the head of the instrument at a target or prism which exists at either another known point or along an azimuth, which is to be held as a backsight sighting with the reticle inside the eyepiece and then holding that line as an angle of 00°00'00". The operator then will turn the head of the instrument at a target or feature that is to be observed as a foresight and record the AR (Angle Right) from the backsight measured by the instrument in which a horizontal angle is produced.

VII. Required resources/equipment:

Sr. No.	Resource required	Particulars	Quantity
01	Total Station with Tripod Stand	As per IS Standard	1 nos.
02	Peg	Wooden	3 nos
03	Prism Reflector with stand	As per specification	2 nos
04	Measuring Tape	30 m	1 nos.

VIII. Precautions to be followed:

1. Perform temporary adjustments precisely.
2. Hold the staff truly vertical.
3. Read staff reading accurately.
4. Record the reading accurately in the level book.

IX. Procedure:

- **Measurement of Horizontal and Vertical Angle**

1. Setup and level the total station at the point assigned to your group.
2. Point the total station to the point that marks the left hand side of the angle. Lock the motion and set zero on the instrument.
3. Free the motion and aim the total station to the point that marks the right hand side of the angle.
4. Rotate the total station back to the first point. If there was no error in your measurements, the horizontal angle reading should be zero (or 360 degrees). Document the error in the measurements.
5. Turn the total station back to the left pointing again to the first point and write the measured angle in your field notes.
6. Repeat the procedure for vertical angle between the selected points of observation and calculate the average angle to get the accurate angle.
7. Record field book page.

X. Observation Table:

Inst. Station	Point Bisected	Measured Angle	Remark

XI. Result:

1. Average Horizontal Angle Between points ___________ =

2. Vertical Angle between Points ___________ =

XII. Interpretation of results:

XIII. Conclusions: --

XIV. Practical Related Questions:

1. State the Least count of the Instrument.
2. State the Function keys used in measurement of Horizontal and Vertical Angle.

Space for Answer

XV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Accuracy in length measurement.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 14 & 15 **Determine the Reduced Levels of given stations (Minimum 10 station) (Part I&II)**

I. Practical Significance:

If reduced levels of different points are known then it is very easy to know the nature or type of ground. Planning of different construction activities is possible by considering nature of ground. Economical constructions are possible from knowledge of reduced levels. Reduced levels can be calculated by using Rise & Fall method in simple levelling, differential levelling, check levelling, fly levelling, etc.

II. Industry/Employer Expected Outcome(s):

- Calculation of Reduced Levels.

III. Course Level Learning Outcome (COs):

- CO4 - Determine Reduced Level to prepare Contour maps for the given type of terrain.

IV. Laboratory Learning Outcome (LLO):

- LLO 14.1 & 15.1: Use Total station to determine Reduce Levels

V. Relevant Affective Domain related Outcome(s):

- Follow safe practices.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Reduced level refers to equating elevations of survey points with reference to a commonly assumed datum. It is a vertical distance above or below the datum plane. The most common datum used is Mean Sea Level. This reduced level is the term used in levelling

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total Station with Tripod Stand	As per IS Standard	1 nos.
02	Peg	Wooden	3 nos
03	Prism Reflector with stand	As per specification	2 nos
04	Measuring Tape	30 m	1 nos.

VIII. Precautions to be followed:

1. Perform temporary adjustments precisely.
2. Hold the staff truly vertical.
3. Read staff reading accurately.
4. Record the reading accurately in the level book.

IX. Procedure:

1. First collect the all instruments as per mentioned in point no VII from the survey lab.
2. Mark the staff stations on the ground whose elevations are to be found.
3. Set up the Total Station approximately midway between the stations and perform temporary adjustments.
4. Swing the telescope towards the Reflector and observe and record the readings in the appropriate columns of the level book.
5. Record field book page.

X. Observation Table:

Inst. Station	Chainage	Reduced Level	Remark

XI. Result:

XII. Interpretation of Results:

XIII. Conclusions:

XIV. Practical Related Questions:

1. State the situation where Rise & Fall method is adopted.
2. State the functions used in calculation of RL using Total Station.

Space for Answer

XV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Fixing of TBM and Taking RL	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 16 &17 **Stack out (transferring the data on ground) using Total Station (Part I) (Part II)**

I. Practical Significance:

Contour maps are used to understand the topography of the site, locate watershed line, and determine reservoir capacity, inter-visibility between the two stations. Knowing the topography engineering projects can be planned accordingly & executed.

II. Industry/Employer expected outcome(s):

- The construction plan to the actual site by transferring dimensions from the layout plan to the ground.

III. Course Level Learning Outcome (COs):

- CO 4 -Locate the co-ordinates of a given stations using the relevant technology.

IV. Laboratory Learning Outcome (LLO):

- LLO 16.1 Using Total Station to stack out station points

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

In order to begin excavation of trenches required for a building's foundation, the Surveyor should recognize the positions and ranges of constructing traces proven on the development plans on the floor. That is, the exact duration, width, intensity, and function of the inspiration trenches need to be marked on the ground. This movement from the construction plan to using shifting dimensions from the format plan to the ground is referred to as starting off. It might be the maximum crucial step inside the entire creation technique.

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total station with stand	Standard make, Telescope 30x, Accuracy up to 5", Visible laser Plummet, Battery charger AC 100-240V, Output DC 7.5 V, Data process Internal memory, Coordinate data 10000, Display Graphic LCD, Keys Alpha numeric	01No
02	Target prism	Accuracy prism +(2+2ppmXD)mm	01 No
03	Peg	Wooden or metallic	01 No
04	hammer	Standard	01 No
05	Paint	Yellow Color	200 ml

VIII. Precautions to be followed:

1. Lay down the grid accurately using Chain/tape and cross staff.
2. Set the instrument exactly over the station on ground
3. Perform temporary adjustment accurately
4. Alidade should be properly placed while bisecting the objects
5. Measure the distances on the ground correctly
6. Take suitable scale for plotting.
7. Perform survey during dry weather.

IX. Procedure:

1. As picture shown below, Point M/N is occupied point,
2. Point P is stake-out point. The coordinate of P is unknown, while the plate coordinate system is known.
3. We can calculate the Angle β and Distance S by Point M/N and P.
4. Combine with the function of angle measurement and distance measurement in Total Station.
5. Set the equipment at Point M, set the prism/target at point N.
6. Aim at point N to record the BS point (back sight).
7. The back sight direction is from point M to N.
8. Rotate the EDM to aim at Point P, measure the distance from Point P to M.
9. The coordinate of Point P will show on the equipment.

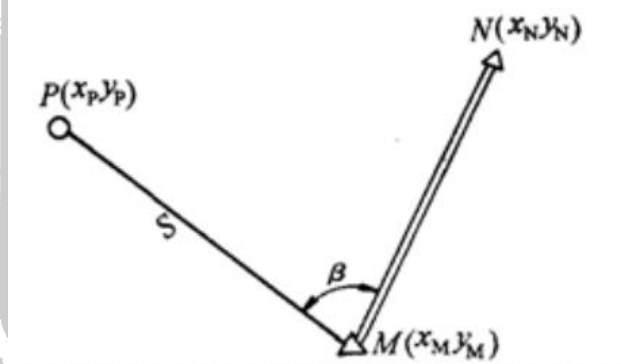

Fig. No.16.1 Coordinate of the point

X. Observation Table:

Point	Coordinate	
	X Coordinate	**Y Coordinate**

XI. Interpretation of results:

XII. Conclusions:

XIII. Practical Related Questions:

1. Describe stepwise procedure to transferring the data on ground using Total Station.
2. Which key are used during this practical.

Space for Answer

XIV. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Setting of Instrument.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 18 &19 Road profile of 100m length using Total Station instrument (Part I&II)

I. Practical Significance:

Road profile are used to understand the topography of the site, locate Alignment of rout from starting station to end station , determine cross section of particular distance , inter-visibility between the two stations. Knowing the topography engineering projects can be planned accordingly & executed.

II. Industry/Employer expected outcome(s):

- Preparation of road profile by using total station.

III. Course Level Learning Outcome (COs):

- CO 4 -Locate the co-ordinates of a given stations using the relevant technology.

IV. Laboratory Learning Outcome (LLO):

- LLO 18.1 Use Total station instrument to measure Reduced Level for given road profile project

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Total station is a surveying equipment combination of Electromagnetic Distance Measuring Instrument and electronic theodolite. It is also integrated with microprocessor, electronic data collector and storage system. The instrument can be used to measure horizontal and vertical angles as well as sloping distance of object to the instrument. Total stations with different accuracy, in angle measurement and different range of measurements are available in the market.

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total station with stand	Standard make, Telescope 30x, Accuracy up to 5", Visible laser Plummet, Battery charger AC 100-240V, Output DC 7.5 V, Data process Internal memory, Coordinate data 10000, Display Graphic LCD, Keys Alpha numeric	01No
02	Target prism	Accuracy prism +(2+2ppmXD)mm	01 No
03	Peg	Wooden or metallic	01 No
04	hammer	Standard	01 No
05	Paint	Yellow Color	200 ml

VIII. Precautions to be followed:

1. Lay down the grid accurately using Chain/tape and cross staff.
2. Set the instrument exactly over the station on ground
3. Perform temporary adjustment accurately
4. Alidade should be properly placed while bisecting the objects
5. Measure the distances on the ground correctly
6. Take suitable scale for plotting.
7. Perform survey during dry weather.

IX. Procedure:

1. The total station instrument is mounted on a tripod and is levelled by operating leveling screws. Within a small range instrument is capable of adjusting itself to the level position.
2. Then vertical and horizontal reference directions are indexed using onboard keys.
3. It is possible to set required units for distance, temperature and pressure (FPS or SI).
4. Surveyor can select measurement mode like fine, coarse, single or repeated.
5. When target is sighted, horizontal and vertical angles as well as sloping distances are
6. Measured and by pressing appropriate keys they are recorded along with point number. Heights of instrument and targets can be keyed in after measuring them with tapes.
7. Then processor computes various information about the point and displays on screen.
8. This information is also stored in the electronic notebook. At the end of the day or whenever electronic note book is full, the information stored is downloaded to computers.
9. The point data downloaded to the computer can be used for further processing. There is software like auto civil and auto plotter clubbed with AutoCAD which can be used for plotting contours at any specified interval and for plotting cross-section along any specified line.

X. Observation Table:

Inst. Station	Target Station	Reduced Level	Remark

XI. Interpretation of results:

XII. Conclusions:

XIII. Practical Related Questions:

1. What is use of road profile survey
2. Explain the temporary adjustment of Total Station.

Space for Answer

XIV. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Fixing the alignment of the road.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 20 Contouring using Total Station instruments for the area of size 50 X 50 m

I. Practical Significance:

Contour maps are used to understand the topography of the site, locate watershed line, and determine reservoir capacity, inter-visibility between the two stations. Knowing the topography engineering projects can be planned accordingly & executed.

II. Industry/Employer expected outcome(s):

- Drawing contours & preparation of Contour map by using total station.

III. Course Level Learning Outcome (COs):

- CO 4 -Locate the co-ordinates of a given stations using the relevant technology.

IV. Laboratory Learning Outcome (LLO):

- LLO 20.1 Contouring using Total Station instruments for the area of size 50 X 50 m

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Contour maps are drawn by using total station to know the topography of the site from which different civil engineering projects. Procedure of locating a contour between two given points by linear interpolation is a prerequisite. Knowing the characteristics of contours is also essential. Contour is a line joining the points of equal elevations. Contour interval is the vertical difference between two successive contours. By observing contour map it is very easy to find depressions, hills or other topographical features within the area.

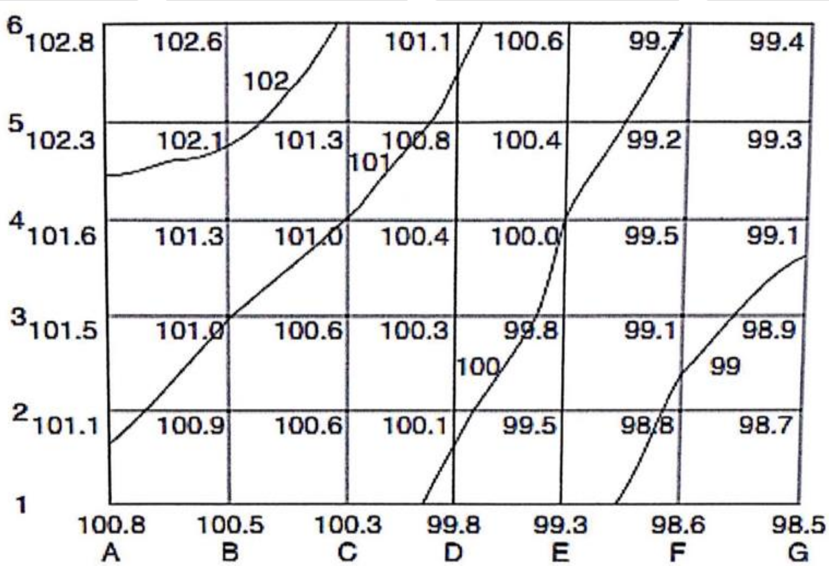

Figure No 20.1 Block contouring by using Total station

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total station with stand	Standard make, Telescope 30x, Accuracy up to 5”, Visible laser Plummet, Battery charger AC 100-240V, Output DC 7.5 V, Data process Internal memory, Coordinate data 10000, Display Graphic LCD, Keys Alpha numeric	01No
02	Target prism	Accuracy prism +(2+2ppmXD)mm	01 No
03	Peg	Wooden or metallic	01 No
04	hammer	Standard	01 No
05	Paint	Yellow Color	200 ml

VIII. Precautions to be followed:

1. Lay down the grid accurately using Chain/tape and cross staff.
2. Set the instrument exactly over the station on ground
3. Perform temporary adjustment accurately
4. Alidade should be properly placed while bisecting the objects
5. Measure the distances on the ground correctly
6. Take suitable scale for plotting.
7. Perform survey during dry weather.

IX. Procedure:

1. Preliminary set up -Fix the total station over a station and level it. Press the power button to switch on the instrument. Level instrument using electronic vial. Set bisection target as prism. Select MODE B -------> S function------->file management------>create (enter a name)------->accept. Then press ESC to go to the starting page.
2. Then go to S function ------> measure-----> rectangular co-ordinate---->station --->press enter. Here enter the point number or name, X, Y, Z co-ordinates, instrument height and prism code. Then press accept (F 3)
3. Adopt Cross section method for establishing the major grid around the study area. Project suitably spaced cross sections on either side of the centre line of the area. Choose several points at reasonable distances on either side.
4. Orient the instrument to the magnetic north, or any other reference direction. Then set zero by double clicking on 0 set (F3).
5. Keep the reflecting prism on the first point and turn the total station to the prism, focus it and bisect it exactly using horizontal and vertical clamps. Then select MEAS and the display panel will show the point specification. Now select edit and re-enter the point number or name point code and enter the prism height that we have set.
6. 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. 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.
7. Transfer the data stored in file to computer in the appropriate format.
8. Using appropriate application software, contour map will be prepared.

X. Observation Table:

Inst. Station	Target Station	Reduced Level	Remark

XI. Results:

1. Contours at required interval are ________________________________

XII. Interpretation of results:

XIII. Conclusions:

XIV. Practical Related Questions:

1. State the situations where block contouring is adopted.
2. Suggest suitable method to draw contour map of a hill.
3. State the practical situations where two contours crosses each other.

Space for Answer

XV. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Fixing of Contour interval and marking the grid.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 21& 22 **Prepare Building site layout by using Total Station (Project) (Part I) & (Part II). Plot the project details on A1 size imperial drawing sheet.**

I. Practical Significance:

Site layout and association are critical management capabilities which impact all elements of work on a building so plot the layout on ground by using total station with details.

II. Industry/Employer expected outcome(s):

- Prepare Building site layout by using Total Station

III. Course Level Learning Outcome (COs):

- CO 4 -Locate the co-ordinates of a given stations using the relevant technology.

IV. Laboratory Learning Outcome (LLO):

- LLO 21.1 Using Total Station to prepare Building site layout

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

We can also use an existing or a new point as a back sight. Place the prism pole on the back sight and align the prism with the total station. Then, use the data collector to enter the coordinates and elevation of the back sight and calculate the azimuth and distance between the reference point and the back sight.

Staking out points is one of the most common uses for a total station. The process for staking out points begins by setting up the device at known coordinates

Total stations enable contractors to measure angles and distances extremely accurately for laying out new construction and as-building existing construction using discrete points.

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total station with stand	Standard make, Telescope 30x, Accuracy up to 5", Visible laser Plummet, Battery charger AC 100-240V, Output DC 7.5 V, Data process Internal memory, Coordinate data 10000, Display Graphic LCD, Keys Alpha numeric	01No
02	Target prism	Accuracy prism +(2+2ppmXD)mm	01 No
03	Peg	Wooden or metallic	01 No
04	Hammer	Standard	01 No
05	Paint	Yellow Color	200 ml

VIII. Precautions to be followed:

1. Lay down the grid accurately using Chain/tape and cross staff.
2. Set the instrument exactly over the station on ground
3. Perform temporary adjustment accurately
4. Alidade should be properly placed while bisecting the objects
5. Measure the distances on the ground correctly
6. Take suitable scale for plotting.
7. Perform survey during dry weather.

IX. Procedure:

1. On the plan supplied by an architect, number the column serially from left to right and top to bottom starting from top left corner.
2. Work out coordinates of column center with respect to one plot corner or well defined point, assuming line parallel to any one face of building as meridian.
3. Create an excel document with 4 independent columns one for column number and rest three for N, E & H coordinates. Upload this file to total station by using transfer software provided with instrument.
4. Set the total station at site at a point with respect which the coordinates of column center are work out. Initiate the total station by proving with the coordinates of station and by orienting the telescope along the reference meridian.
5. Now, activate the setting out programed of the total station. Open the uploaded file & bring in the coordinates of any column to be set out.
6. Hold prism pole at tentative position of that column on ground, bisect it & get measured its coordinates.
7. In next reading machine will display the discrepancies in the coordinates of the point & point to be set out.
8. Direct the reflector man accordingly to occupy the new position, bisect him again & get measured its coordinates to know the discrepancy.
9. Repeat the process till you get no discrepancy in the coordinates of point occupied & point to be set out. In this way get marked center of rest of the columns.
10. Check the accuracy of the process of setting out by comparing the diagonal distance between the extreme column centers to their calculated values.

X. Observation Table:

(Students make A1 Size Full imperial sheet for his project)

Point	**Coordinate**	
	X Coordinate	**Y Coordinate**

XI. Interpretation of results:

XII. Conclusions:

XIII. Practical Related Questions:

1. Describe stepwise procedure to prepare the layout of a small building using total station.
2. Which key are used during this practical

Space for Answer

XIV. **Assessment Scheme.**

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Temporary Adjustments of Total Station.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 23 & 24 **Carry out 5-Sided closed traverse Surveying project by using Total Station. (Project) (Part I) & (Part II). Plot the traverse details on A1 size imperial drawing sheet.**

I. Practical Significance:

Contour maps are used to understand the topography of the site, locate watershed line, and determine reservoir capacity, inter-visibility between the two stations. Knowing the topography engineering projects can be planned accordingly & executed.

II. Industry/Employer expected outcome(s):

- Drawing contours & preparation of Contour map by using total station.

III. Course Level Learning Outcome (COs):

- CO 4 -Locate the co-ordinates of a given stations using the relevant technology.

IV. Laboratory Learning Outcome (LLO):

- LLO 20.1 Contouring using Total Station instruments for the area of size 50 X 50 m

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Closed traverse Survey

In Closed traverse survey the bearing of first line and included angles are measured.
When the finishing point of survey coincides with the starting point of the survey, it is known as closed traverse. It is suitable for the survey of boundaries of plots, forests, estate, etc.

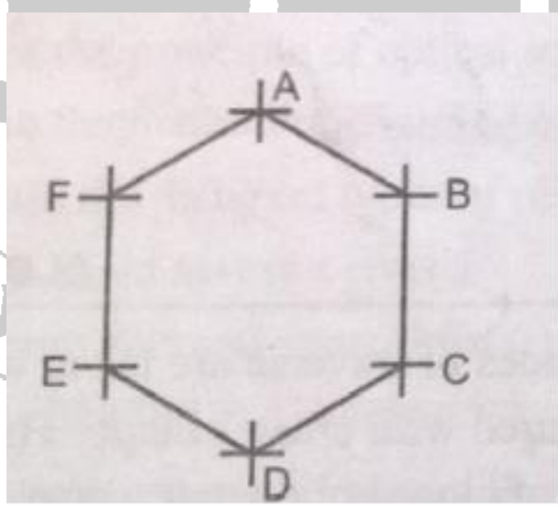

Fig. No. 23.1 Closed Traverse Survey

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Total station with stand	Standard make, Telescope 30x, Accuracy up to 5”, Visible laser Plummet, Battery charger AC 100-240V, Output DC 7.5 V, Data process Internal memory, Coordinate data 10000, Display Graphic LCD, Keys Alpha numeric	01No
02	Target prism	Accuracy prism +(2+2ppmXD)mm	01 No
03	Peg	Wooden or metallic	01 No
04	hammer	Standard	01 No
05	Paint	Yellow Color	200 ml

VIII. Precautions to be followed:

1. Lay down the grid accurately using Chain/tape and cross staff.
2. Set the instrument exactly over the station on ground
3. Perform temporary adjustment accurately
4. Alidade should be properly placed while bisecting the objects
5. Measure the distances on the ground correctly
6. Take suitable scale for plotting.
7. Perform survey during dry weather.

IX. Procedure:

Traversing is carried out with three (3) tripod, one (1) tripod is for the instrument and the other two (2) are for the back and front stations. A minimum of three people are required in a traversing team. The leader of the team performs setting up and reads the instrument, while the 2nd person has the important job of recording the readings on the booking sheet. The 3rd person has the task of moving and setting up the prism as the traverse progresses. There are several steps which should be followed that will lead to a smooth traverse.

1. Traverse stations are established at the proposed site (say) (peg 1, peg 2, peg 3 & peg 4 etc.)
2. The total station is plumbed over peg 1 and accurately levelled. Prisms are plumbed over peg 2 & 4.
3. Take bearing of first line by bisecting prism at peg 2.
4. Sight the prism at peg 4.Measure the distance between peg 4 and peg 1. Set the instrument to zero. Rotate the instrument and bisect prism at peg 2. Vertical and horizontal angles are displayed in relation to peg 4. The reading is taken and entered in the field book. Distance between peg 1 and 2 also measured with the same technique.
5. Record face left horizontal angle reading.
6. Transit the instrument to change to the face right setting.
7. Record face right horizontal angle by same procedure.
8. The total station is moved to peg 2. Prisms are plumbed over peg 1 and 3. Horizontal distances and angles are measured and recorded similarly.

X. Observation Table:

Point	Coordinate	
	X Coordinate	Y Coordinate

XI. Interpretation of results:

XII. Conclusions:

XIII. Practical Related Questions:

1. State the situations where block contouring is adopted.
2. Suggest suitable method to draw contour map of a hill.
3. State the practical situations where two contours crosses each other.

Space for Answer

XIV. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Fixing of station point and angular measurement.	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 25 **Locate the coordinates of a station with the help of GPS.**

I. Practical Significance:

Absolute location of point is essential to know its precise position. The GPS (Global Positioning System) is a "constellation" of approximately 30 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. The location accuracy is anywhere from 100 to 10 meters for most equipment.

II. Industry/Employer expected outcome(s):

- Locate co-ordinates of station using GPS

III. Course Level Learning Outcome (COs):

- CO 4 -Locate the co-ordinates of a given stations using the relevant technology.

IV. Laboratory Learning Outcome (LLO):

- LLO 25.1 Use GPS technology to locate the coordinates of a station.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices.
- Demonstrate working as a leader/ team member.
- Maintain tools and equipment

VI. Relevant Theoretical Background:

The Global Positioning System (GPS) is a satellite-based navigation and surveying system for determination of precise position and time, using radio signals from the satellites, in real time or in post-processing mode. GPS is being used all over the world for numerous navigational and positioning applications, including navigation on land, in air and on sea, determining the precise coordinates of important geographical features as an essential input to mapping.

GPS is primarily a navigation system for real-time positioning. However, with the transformation from the ground-to-ground survey measurements to ground-to-space measurements made possibly by GPS, this technique overcomes the numerous limitations of terrestrial surveying methods, like the requirement of inter visibility of survey stations, dependability on weather, difficulties in night observations, etc.. These advantages over the conventional techniques, and the economy of operations make GPS the most promising surveying technique of the future. With the well-established high accuracy achievable with GPS in positioning of points separated by few hundreds of meters to hundreds of km, this unique surveying technique has found important applications in diverse fields. The Global Positioning System basically consists of three segments: the Space Segment, The Control Segment and the User Segment.

Space Segment

The Space Segment contains 24 satellites, in 12-hour near-circular orbits at altitude of about 20000 km, with inclination of orbit 55°. The constellation ensures at least 4 satellites in view from any point on the earth at any time for 3-D positioning and navigation on world-wide basis. The three axis controlled, earth-pointing satellites continuously transmit navigation and system data comprising predicted satellite ephemeris, clock error etc., on dual frequency LI and L2 bands.

Control Segment

This has a Master Control Station (MCS), few Monitor Stations (MSs) and an Up Load Station (ULS). The MSs are transportable shelters with receivers and computers; all located in U.S.A., which passively track satellites, accumulating ranging data from navigation signals. This is transferred to MCS for processing by computer, to provide best estimates of satellite position, velocity and clock drift relative to system time. The data thus processed generates refined information of gravity field influencing the satellite motion, solar pressure parameters, position, clock bias and electronic delay characteristics of ground stations and other observable system influences. Future navigation messages are generated from this and loaded into satellite memory once a day via ULS which has a parabolic antenna, a transmitter and a computer. Thus, role of Control Segment is:

- To estimate satellite [space vehicle (SV)] ephemerides and atomic clock behavior.
- To predict SV positions and clock drifts.
- To upload this data to SVs.

User Segment

The user equipment consists of an antenna, a receiver, a data-processor with software and a control/display unit. The GPS receiver measures the pseudo range, phase and other data using navigation signals from minimum 4 satellites and computes the 3-D position, velocity and system time. The position is in geocentric coordinates in the basic reference coordinate system: World Geodetic reference System 1984 (WGS 84), which are converted and displayed as geographic, UTM, grid, or any other type of coordinates.

Corrections like delay due to ionosphere and tropospheric refraction, clock errors, etc. are also computed and applied by the user equipment / processing software.

VII Experimental Set-up

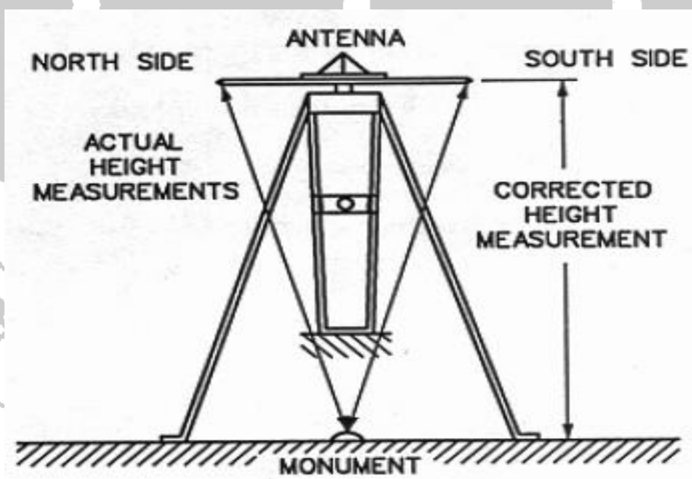

Fig. No 25.1 GPS Set up

VIII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	GPS instrument	Standard make	01 For Each Batch

IX. Precautions to be followed:

1. Set the instrument exactly over station on ground

X. Procedure:

The following are some general GPS field survey procedures that should be performed at each station, observation, and/or session on a GPS survey.

A. Receiver setup.

GPS receivers shall be set up in accordance with manufacturer's specifications prior to beginning any observations. To eliminate any possibility of missing the beginning of the observation session, all equipment should be set up with power supplied to the receivers at least 10 min prior to the beginning of the observation session. Most receivers will lock-on to satellites within 1-2 min of powering up.

B. Antenna setup.

All Tribach used on a project should be calibrated and adjusted prior to beginning each project. Dual use of both optical plummets and standard plumb bobs is strongly recommended since cantering errors represent a major error source in all survey work, not just GPS surveying.

C. Height of instrument measurements.

Height of instrument (HI) refers to the correct measurement of the distance of the GPS antenna above the reference monument over which it has been placed. HI measurements will be made both before and after each observation session. The HI will be made from the monument to a standard reference point on the antenna These standard reference points for each antenna will be established prior to the beginning of the observations so all observers will be measuring to the same point. All HI measurements will be made in meters. HI measurements shall be determined to the nearest millimeter in metric units It should be noted whether the HI is vertical or diagonal.

D. Field GPS observation recording procedures.

Field recording books, log sheets, or log forms will be completed for each station and/or session. Any acceptable recording media may be used. For archiving purposes, standard bound field survey books are preferred; however, USACE Commands may require specific recording sheets/ forms to be used in lieu of a survey book. The amount of record- keeping detail will be project-dependent; low-order topographic mapping points need not have as much descriptive information as would permanently marked primary control points. The following typical data may be included on these field log records,

(1) Project, construction contract, observer(s) name(s), and/or contractor firm and contract number.
(2) Station designation.
(3) Station file number.
(4) Date, weather conditions, etc.
(5) Time start/stop session (local and UTC).
(6) Receiver, antenna, data recording unit, and Tribach make, model, and serial numbers.
(7) Antenna height: vertical or diagonal measures in inches (or feet) and meters
(8) Space vehicle designations (satellite number).
(9) Sketch of station location.
(10) Approximate geodetic location and elevation.
(11) Problems encountered.

E. Field processing and verification.

It is strongly recommended that GPS data processing and verification be performed in the field where applicable. This is to identify any problems that may exist which can be corrected before returning from the field.

XI. Observations and Calculations (Use blank sheet provided if space not sufficient)

Point	Coordinate	
	X Coordinate	Y Coordinate

XII. Results:

XIII. Interpretation of results:

XIV. Conclusions:

XV. Practical Related Questions:

1. State the situations where block contouring is adopted.
2. Suggest suitable method to draw contour map of a hill.
3. State the practical situations where two contours crosses each other.

Space for Answer

XVI. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Using the Hand GPS Instrument	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 26 & 27 **Create the images of contouring map with given data (Photogrammetry images, etc.) using the freeware/open source software (Part I) (Part II)**

I. Practical Significance:

Photographic surveying also called photogrammetry is a method of surveying in which plans or maps are prepared from photographs taken at suitable camera stations. And make photogrammetry contour map by use software

II. Industry/Employer expected outcome(s):

- Drawing contours & preparation of Contour map by using Photogrammetry images.

III. Course Level Learning Outcome (COs):

- CO 4 -Interpret the images of given terrain using Photogrammetry Techniques.

IV. Laboratory Learning Outcome (LLO):

- LLO 26.1 Develop the contour maps using photogrammetry images

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Photographic surveying is suitable for small scale mapping of open hilly or mountainous country. It is well adapted to topographical or preliminary surveys. It is not suitable for flat or wooded country in which case Aerial surveying can be used to advantage. Aerial surveying is used with great success for reconnaissance and preliminary surveys for roads, railways, transmission lines etc., for surveying of buildings, towns, harbours etc. It is also particularly suitable for inaccessible regions, forbidden properties, unhealthy malarial regions, etc.

According to the direction of the camera axis at the time of exposure aerial photographs may be

Classified into:

1. Vertical photographs

2. Oblique photographs

1. Vertical photographs

- These photographs are taken from the air with the axis of the Camera vertical or nearly vertical.
- A truly vertical Photograph closely resembles a map.
- These are utilized for the compilation of topographic and engineering surveys on various scales.

2. Oblique Photo graphs

- Photographs are taken from air with the axis of the camera intentionally tilted from the vertical.
- An oblique photograph covers larger area of the ground but clarity of details diminishes towards the far end of the photograph.

- Depending upon the angle of obliquity, oblique photographs may he further divided into two categories?

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
1	Auto desk land desktop	-	1
2	Auto Civil	-	1
3	Foresight	-	1
4	Topcon	-	1

VIII. Precautions to be followed:

1. Perform temporary adjustment accurately
2. It should be properly placed while bisecting the objects
3. Measure the distances on the ground correctly
4. Take suitable scale for plotting.
5. Perform survey during dry weather.

IX. Students should be search various software for preparing contour map according to Photogrammetry images (*Student can stick images below*)

X. Interpretation of results:

XI. Conclusions:

XII. Practical Related Questions:

1. State the importance of Photogrammetry.
2. Suggest suitable software to draw contour map of a hill.

Space for Answer

XIII. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Basics of Photogrammetry	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 28 & 29 **Create the images of Road Profile plan with given data (Photogrammetry images, etc.) using the freeware/open source software (Part I) (Part II)**

I. Practical Significance:

It has helped us in understanding the faraway objects and the surfaces of the earth. Create the images of Road Profile Due to Photogrammetry application, its helps to decide earth work on road construction.

II. Industry/Employer expected outcome(s):

- Drawing Road Profile plan by using Photogrammetry images.

III. Course Level Learning Outcome (COs):

- CO 4 -Interpret the images of given terrain using Photogrammetry Techniques.

IV. Laboratory Learning Outcome (LLO):

- LLO 26.1 Develop the Road Profile plan using photogrammetry images

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Contour maps are drawn by using total station to know the topography of the site from which different civil engineering projects. Procedure of locating a contour between two given points by linear interpolation is a prerequisite. Knowing the characteristics of contours is also essential. Contour is a line joining the points of equal elevations. Contour interval is the vertical difference between two successive contours. By observing contour map it is very easy to find depressions, hills or other topographical features within the area.

Aerial Photograph

- Aerial camera is used to have aerial photographs which are fixed on flying aircraft
- Primary function of the terrestrial camera as well as the aerial camera is the same, i.e., that of taking pictures.
- Aerial camera is mounted on a fast moving airplane, its requirements are quite different.

Aerial camera requires

- Fast Lens
- High speed & sufficient shutter
- High speed emulsion for the film
- A Magazine to hold large rolls of film
- Aerial camera is considered to be a surveying instrument of great precision.

Advantages of Aerial survey are,

- The survey work is done with great speed.
- It is used with great success for other purposes such as classification of land and soil,
- Geological and archaeological investigations etc.
- Aerial survey is a highly technical and specialized work and must be carried out by

- Skilled, specially trained and experienced personnel and very expensive it is mainly made by government organization's personnel. Since aerial survey is very elaborate and expensive, it is carried out by government organizations (by Survey of India Department in India).

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
1	Auto desk land desktop	-	1
2	Auto civil	-	1
3	Foresight	-	1
4	Topcon	-	1

VIII. Precautions to be followed:

1. Perform temporary adjustment accurately
2. It should be properly placed while bisecting the objects
3. Measure the distances on the ground correctly
4. Take suitable scale for plotting.
5. Perform survey during dry weather.

IX. Students should be search various software for preparing contour map according to Photogrammetry images (*Student can stick images below*)

X. Interpretation of results:

XI. Conclusions:

XII. Practical Related Questions:

1. State the classification of Photogrammetry.
2. Suggest suitable software to draw contour map of a hill.

Space for Answer

XIII. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Basics of Photogrammetry	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 30 **Write a brief report on the visit to nearby surveying software laboratory for visualization of image creation of contouring map of given area using given data OR Arrange Expert Lecture OR Show study videos of Photogrammetry surveying.**

I. Practical Significance:

Survey software program streamlines the complete method, making it smooth to distribute surveys digitally and collect responses in real-time. Survey software permits OR Expert Lecture OR study videos of Photogrammetry surveying. Universities to create tailor-made surveys that target particular problems and concerns.

II. Industry/Employer expected outcome(s):

- To study and preparation map, explore ground detailed with using software or expert lecture

III. Course Level Learning Outcome (COs):

- CO 5 -Interpret the images of given terrain using Photogrammetry Techniques.

IV. Laboratory Learning Outcome (LLO):

- LLO 30.1 Use relevant software for preparation of contour maps using given image data

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Demonstrate working as leader or a team leader.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Surveying software program assists within the process of evaluating a 3D panorama to decide the angles and distances among a series of factors. Measuring the positioning of those points is commonly used to set up maps and obstacles for homes and different subterranean civic tasks.

List of Survey software program

1. Autodesk land desktop
2. Auto Civil
3. Foresight
4. Topcon
5. Trimble
6. BIM
7. Building information modelling
8. Captivate
9. Questionpro
10. Field genius
11. Geonov survey solutions
12. Carlson software
13. ProgeCAD
14. Treramodelz

VII. Report on visit/ Expert Lecture/ study videos of Photogrammetry surveying. :

(Students can used blank paper for report writing)

VIII. Precautions to be followed:

1. Take prior permission from concern department well in advance
2. Maintain discipline during site visit at survey department
3. Record all necessary information in field book.
4. Wear college uniform, shoes, cap, dupatta, sun- glass during visit.
5. Keep safe distance from moving parts/ machines at site.

IX. Conclusions:

X. Practical Related Questions:

1. State the List out software which is used in survey.
2. Suggest suitable software for Road profile survey.

Space for Answer

XI. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	**Process Related (15 marks)**	**60%**
1.	Handling of equipment's & Survey Conduction	40%
2.	Basics of Photogrammetry	20%
B.	**Product Related (10 marks)**	**40%**
3.	Conclusion of practical	20%
4.	Practical Question Answer	20%
C.	**Total marks (25 marks)**	**100%**

Marks Obtained			**Dated sign of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	