I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

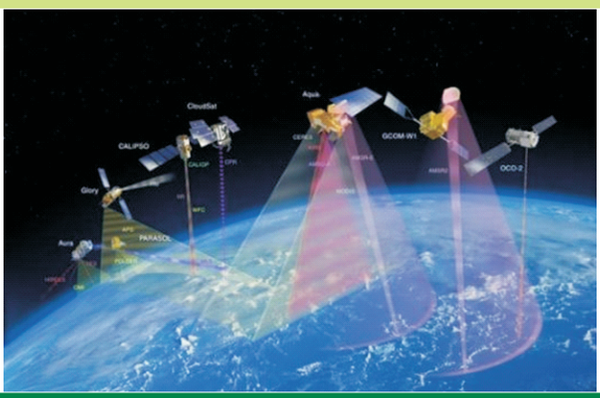
CIVIL GROUP | SEMESTER - III | DIPLOMA IN ENGINEERING AND TECHNOLOGY

A LABORATORY MANUAL

FOR

ADVANCED SURVEYING

(22301)



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 changing technological and 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 programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual

for

Advanced Surveying

(22301)

Semester-III

(CE/CR/CS)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO:9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO : 9001 : 2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai - 400051.
(Printed on June, 2018)

MAHARASHTRA STATE

BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that Mr. / Ms. ……..…… Roll No. ……..…., of Third Semester of Diploma in ……..…… of Institute, ……..…….……..… (Code: ……...) has completed the term work satisfactorily in course **Advanced Surveying (22301)** 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 primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-base education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practicals to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practicals to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

In the era of globalization today, the technology has brought the significant advancements in surveying instruments and technology. Available precise digital surveying instruments are used currently due to their accuracy, speed and easy operation of the same. These equipments and the applications are extensively used in the fields of civil engineering, mining engineering, environmental engineering, transportation engineering and marine engineering. Since, Remote sensing and Geographic Information System (GIS) is a vital discipline and being widely used for plotting and storing spatial information, it is expected the students should know the basics of the same to apply it in field. Through this course students will develop the desired skills and competencies which are expected from them for survey related works.

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.

Programme Outcomes

Following POs are expected to be achieved through the practicals of the (Advanced Surveying) course.

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

List of Industry 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. Use the given surveying instruments.
2. Enter data taken in the field in the required formats (field book).
3. Compute areas and Draw Plans based on the field data.
4. Prepare contour maps
5. Read and Interpret contour maps
6. Use the appropriate method and the instrument

Practical- Course Outcome matrix

Course Outcomes (COs)

a. Prepare plans using Plane Table Surveys.
b. Prepare plans using Theodolite surveys.
c. Find distances and elevations using Tacheometer.
d. Set out simple circular curves.
e. Prepare plans using Total Station instrument.
f. Locate coordinates of stations using GPS.

Sr. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.	CO f
1	Use Plane Table Survey to prepare plan of a 5 sided closed traverse by Radiation Method.	√	-	-	-	-	-
2	Use plane table survey to prepare plan of a plot of 7 sided closed traverse by Radiation Method.	√	-	-	-	-	-
3	Use plane table survey to prepare plan& to locate details by Intersection Method	√	-	-	-	-	-
4	Use plane table survey to prepare plan & to locate details by Traversing Method	√	-	-	-	-	-
5	Use plane table survey to carry out Survey Project for closed traverse for minimum 5 sides around a building**.(Compulsory)**	√	-	-	-	-	-
6	Set up the transit Theodolite	-	√	-	-	-	-
7	Use transit theodolite to measure Horizontal angle correctly by Direct Method.	-	√	-	-	-	-
8	Use transit theodolite to measure Vertical angle correctly.	-	√	-	-	-	-
9	Use transit theodolite to measure Horizontal angle correctly by method of Repetition.	-	√	-	-	-	-
10	Use transit theodolite to carry out Survey Project for closed traverse for minimum 5 sides(Compulsory).	-	√	-	-	-	-
11	Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Theodolite Survey Project.	-	√	-	-	-	-

12	Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Theodolite Survey Project.	-	√	-	-	-	-
13	Use thedolite as a Tacheometer to compute reduced levels and horizontal distances.	-	-	√	-	-	-
14	Set out a circular curve by offsets from Long Chord Method.	-	-	-	√	-	-
15	Set out a circular curve by Rankine's Method of Deflection Angles.	-	-	-	√	-	-
16	Use One Second Micro Optic Theodolite to Measure Horizontal angle by Direct Method	-	√	-	-	-	-
17	Use One Second Digital Theodolite to Measure Horizontal angle by Direct Method	-	√	-	-	-	-
18	Use EDM to measure horizontal distance.(PartI)	-	-	-	-	√	-
19	Use EDM to measure horizontal distance(Part II)	-	-	-	-	√	-
20	Set up the Total Station instrument. (PartI)	-	-	-	--	√	-
21	Set up the Total Station instrument. (Part II)	-	-	-	-	√	-
22	Use Total station instrument to measure horizontal distances.	-	-	-	-	√	-
23	Use Total station instrument to measure horizontal distances.	-	-	-	-	√	-
24	Use Total station instrument to measure horizontal distances.	-	-	-	-	√	-
25	Use Total station instrument to measure horizontal distances.	-	-	-	-	√	-
26	Use Total station instrument to measure horizontal angle.	-	-	-	-	√	-
27	Use Total station instrument to measure horizontal angle.	-	-	-	-	√	-
28	Use Total station instrument to measure horizontal angle.	-	-	-	-	√	-
29	Use Total station instrument to measure vertical angle.	-	-	-	-	√	-

30	Use Total station instrument to measure vertical angle.	-	-	-	-	√	-
31	Use Total station instrument to carry out Survey Project for closed traverse for minimum 5 sides**.(Compulsory)**	-	-	-	-	√	-
32	Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Total Station Survey Project.	-	-	-	-	√	-
33	Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Total Station Survey Project.	-	-	-	-	√	-
34	Use GPS to locate the coordinates of a station.	-	-	-	-	-	√

Guidelines to Teachers

1. *Teacher need to ensure that a dated field book* for the whole semester, apart from the laboratory manual is maintained by every student which s/he has to *submit for assessment to the teacher* in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practicals.
3. For difficult practicals if required, teacher could provide the demonstration of the practical emphasizing the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on practice after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question bank for each course.
7. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
8. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
9. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
10. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines
11. From practical 10 to practical 14 procedure may change slightly depending upon the model of the instrument.

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a *dated field book* for the whole semester, apart from this laboratory manual which s/he has to *submit for assessment to the teacher* in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the data books, IS codes, Safety norms, Electricity act/rules, technical manuals, etc.
4. Student should not hesitate to ask any difficulties they face during the conduct of practicals.

Content Page

List of Practicals and Progressive Assessment Sheet

Note: To be transferred to Proforma of CIAAN-2017.

Practical No. 01: Use of plane table survey to prepare plan of a 5 sided closed traverse by radiation method.

I. Practical Significance

The knowledge of plane table survey is essential to prepare the plans of given site. The plane table surveying is the fast method of surveying. In plane table surveying plotting of the plan and field observations can be done simultaneously. As drawing is completed in the site itself, Plane table survey is popularly used for small survey works.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Plane Table Surveys.

IV Practical Outcome

Use Plane Table Survey to prepare plan of a 5 sided closed traverse by Radiation Method..

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques.

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

Principle of plane table survey-Principle of plane tabling is parallelism means, “all the rays drawn through various details should pass through survey station”.

Accessories Required

1. Plane table with stand
2. Plane / telescopic Alidade
3. Spirit level
4. Trough compass
5. U-frame or Plumbing fork
6. Drawing sheet
7. Pins/clamps

VIII Experimental Set-up

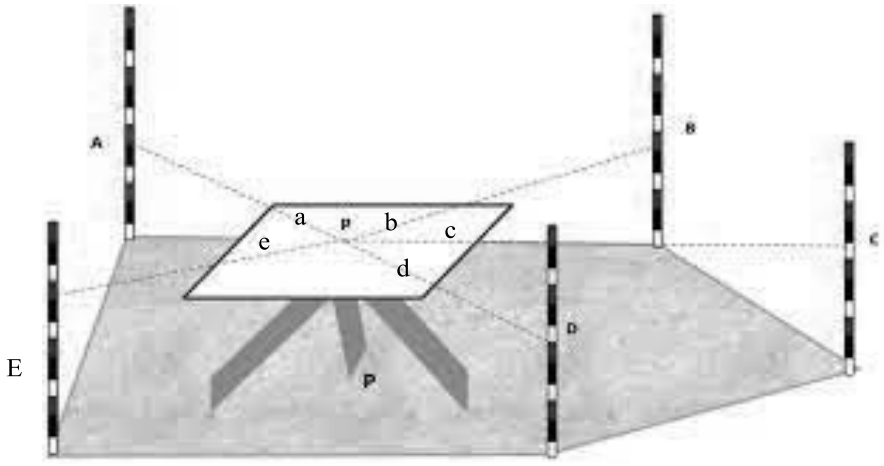


Figure: Set up of plane table survey

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Plane table	Well seasoned, good quality drawing board made of pine or teak wood having smooth, plane finish on its top and fitted with ball and socket arrangement or a leveling head, varying in size from 75cmX60cmX1.5cm or 60cmX50cmX1.5cm or 50cmX40cmX1.5cm.	**1**	For each batch
2	Plane/ telescopic Alidade	A plane alidade metallic (brass or gunmetal) or good quality wooden rule with a fine bevelled edge. A telescopic alidade consists of a telescope which provides a very accurate line of sight. The telescope is fitted onto an A-frame which is fitted onto a heavy rule.	**1**	For each batch
3	Spirit level	Tubular level, which can be placed in to perpendicular positions.	**1**	For each batch
4	Trough compass	Usually it is 15cm long and provided with magnetic needle to facilated orientation of the plane table and to mark north direction	**1**	For each batch
5	U-frame or Plumbing fork	It is a hairpin-shaped brass frame having two arms of equal length one end of frame is pointed, the end of the frame carries a plumb-bob	**1**	For each batch
6	Drawing sheet	Good quality drawing sheet, tinted off – white.	**1**	For each batch
7	clamps	Clamps of suitable size	**4**	For each batch

X Procedure:-

1. Select the station point P in such a way that from P all points should be visible.
2. Set up the plane table over the station P and perform temporary adjustment, i.e., leveling, orientation and centering of the table and transfer the point P over the drawing sheet and also mark the north direction at top right corner.
3. With alidade touching station P, bisect the ranging rod A and draw ray on drawing sheet. Measure the distance PA on ground and to a suitable scale mark the position of A on drawing sheet i.e., 'a'.
4. Repeat the above procedure and mark the station b, c, d and e
5. Join point a, b, c, d ,e and a on drawing sheet you will get required five sided closed traverse.

XI Precautions to be followed

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

XII Actual procedure followed

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XIII Resources used -

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					
4					

XIV Precautions followed

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

XVI Results

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XVII Interpretation of results

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XVIII Conclusions

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XIX Practical Related Questions

1. State each of the accessories required for plane table surveying.
2. State the limitations of Radiation method
3. What are the likely errors in Radiation method and precaution to be taken to eliminate them?

[Space to Write Answers]

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1……..

2……..

3……..

4……..

5……..

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

Practical No. 02: Use of plane table survey to prepare plan and to locate details by intersection method

I Practical Significance

The knowledge of plane table survey is essential to prepare the plans of given site and to locate inaccessible points/stations. The plane table surveying is the fast method of surveying. In plane table surveying plotting of the plan and field observations can be done simultaneously. As drawing is completed in the site itself, Plane table survey is popularly used for small survey works.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Plane Table Surveys.

IV Practical Outcome

Use plane table survey to prepare plan locate details by Intersection Method

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques.

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

Principle of plane table survey-Principle of plane tabling is parallelism means, “all the rays drawn through various details should pass through survey station”.

Accessories Required

1. Plane table with stand
2. Plane / telescopic Alidade
3. Spirit level
4. Trough compass
5. U-frame or Plumbing fork
6. Drawing sheet
7. Pins/clamps

VIII Experimental Set-up

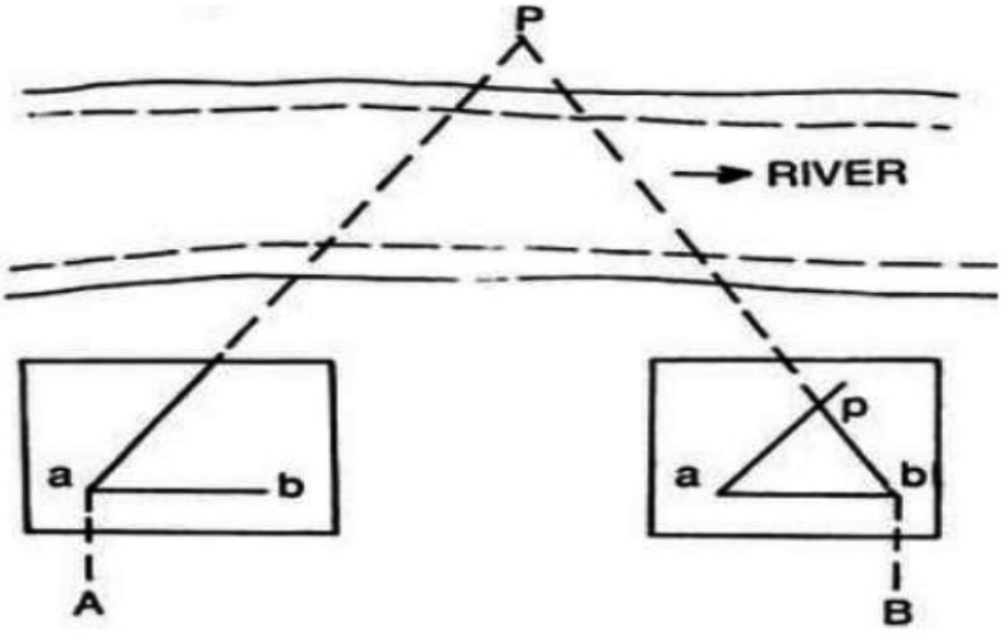

Figure: Set up of plane table survey by intersection method

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Plane table	Well seasoned, good quality drawing board made of pine or teak wood having smooth, plane finish on its top and fitted with ball and socket arrangement or a leveling head, varying in size from 75cmX60cmX1.5cm or 60cmX50cmX1.5cm or 50cmX40cmX1.5cm.	**1**	For each batch
2	Plane/ telescopic Alidade	A plane alidade metallic (brass or gunmetal) or good quality wooden rule with a fine bevelled edge. A telescopic alidade consists of a telescope which provides a very accurate line of sight. The telescope is fitted onto an A- frame which is fitted onto a heavy rule.	**1**	For each batch
3	Spirit level	Tubular level, which can be placed in to perpendicular positions.	**1**	For each batch
4	Trough compass	Usually it is 15cm long and provided with magnetic niddle to facilated orientation of the plane table and to mark north direction	**1**	For each batch

5	U-frame or Plumbing fork	It is a hairpin-shaped brass frame having two arms of equal length one end of frame is pointed, the end of the frame carries a plumb-bob	**1**	For each batch
6	Drawing sheet	Good quality drawing sheet, tinted off – white.	**1**	For each batch
7	clamps	Clamps of suitable size	**4**	For each batch

X Procedure

1. Collect the required instruments as per Table IX from the store
2. Select the station points A and B in such a way that both are intervisible and station P is also visible from stations A and B.
3. Setting up the plane table over the station A and perform temporary adjustment, i.e., leveling and centering of the table. Transfer station A from ground to sheet as ‘a’ and mark north direction at top right corner.
4. With alidade touching station ‘a’, bisect the ranging rod held at station B. measure distance AB on the ground and mark the position ‘b’ on drawing sheet..
5. Alidade touching with ‘a’ bisect ranging rod at P and draw ray ‘ap’.
6. Shift the instrument at station B and perform orientation by back sighting or magnetic meridian method
7. With alidade touching station ‘b’, bisect the ranging rod at station P. Draw ray ‘bp’. The intersection of ‘ap’ and ‘bp’ is the position of station P on drawing sheet.
8. Return the instruments to the survey store.

XI Precautions to be followed

1. Ground point should be transferred accurately on drawing sheet and mark with small alphabets.
2. Perform temporary adjustments accurately
3. Alidade should be properly placed while bisecting the objects
4. Measure the distances on the ground correctly
5. Take suitable scale for plotting.
6. Perform survey during dry weather.

XII Actual procedure followed

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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

XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any)

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XIX Practical Related Questions

1. Explain the function of each accessory required for plane table surveying.
2. State the limitations of Intersection method
3. What are the likely errors in Intersection method and precautions to be taken to eliminate them?

[Space to Write Answers]

XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1 ……..

2 ……..

3. ……..

4.. ……..

5. ……..

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

Practical No. 03: Use of plane table survey to prepare plan locate details by traversing method

I Practical Significance

The plane table surveying is the fast method of surveying. In plane table surveying plotting of the plan and field observations can be done simultaneously. As drawing is completed in the site itself, Plane table survey is popularly used for small survey works.
The knowledge of plane table survey is essential to prepare the plans and to locate field details in drawing. Depending upon the site conditions student should be able to decide method of plane tabling.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Plane Table Surveys.

IV Practical Outcome

Use plane table survey to prepare plans locate details by Traversing Method

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

Principle of plane table survey-Principle of plane tabling is parallelism means, “all the rays drawn through various details should pass through survey station”.

Orientation of plane table

(a) By Back Sighting method

(b) By Magnetic meridian method

Accessories Required:-

1. Plane table with stand
2. Plane / telescopic Alidade
3. Spirit level
4. Trough compass
5. U-frame or Plumbing fork
6. Drawing sheet
7. Pins/clamp

VIII Experimental Set-up

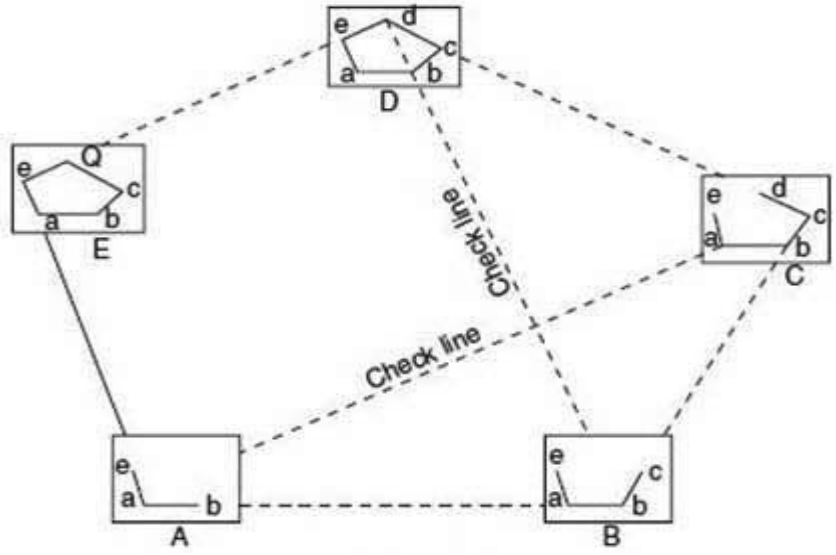

Figure: Traversing method

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Plane table	Well seasoned, good quality drawing board made of pine or teak wood having smooth, plane finish on its top and fitted with ball and socket arrangement or a leveling head, varying in size from 75cmX60cmX1.5cm or 60cmX50cmX1.5cm or 50cmX40cmX1.5cm.	**1**	For each batch
2	Plane telescopic Alidade	A plane alidade metallic (brass or gunmetal) or good quality wooden rule with a fine bevelled edge. A telescopic alidade consists of a telescope which provides a very accurate line of sight. The telescope is fitted onto an A- frame which is fitted onto a heavy rule.	**1**	For each batch
3	Spirit level	Tubular level, which can be placed in to perpendicular positions.	**1**	For each batch
4	Trough compass	Usually it is 15cm long and provided with magnetic niddle to facilated orientation of the plane table and to mark north direction	**1**	For each batch
5	U-frame or Plumbing fork	It is a hairpin-shaped brass frame having two arms of equal length one end of frame is pointed, the end of the frame carries a plumb-bob	**1**	For each batch
6	Drawing sheet	Good quality drawing sheet, tinted off – white.	**1**	For each batch
7	clamps	Clamps of suitable size	**4**	For each batch

X Procedure

1. Collect the required instruments as per Table IX from the store
2. Select the station points A,B,C,D and E in such a way that adjoining stations are intervisible from the instrument station
3. Set up the plane table over the station A and perform temporary adjustment, i.e., leveling and centering of the table. Mark north direction with trough compass at right top corner. Simultaneously Transfer station A from ground to sheet as 'a'
4. With alidade touching station 'a', bisect the ranging rod at station B. measure distance AB on the ground and mark the position 'b' on drawing sheet..
5. Shift the instrument at station B and perform temporary adjustment and orientation by back sighting or magnetic meridian method. And continue the same procedure at C, D, and E.
6. Return the instruments to the survey store

XI Precautions to be followed

1. Ground point should be transferred accurately on drawing sheet and mark with small alphabets.
2. Perform temporary adjustment accurately
3. Alidade should be properly placed while bisecting the objects
4. Measure the distances on the ground correctly
5. Take suitable scale for plotting.
6. Perform survey during dry weather

XII Actual procedure followed

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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

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XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any)

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XIX Practical Related Questions

1. State the suitability of Traversing method
2. Which method of orientation is more accurate? Justify

[Space to Write Answers]

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837
4	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

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

Practical No. 04: Use of transit theodolite to measure horizontal angle by direct method.

I Practical Significance

Using the lengths and angles, traverses can be plotted. A theodolite is a precision instrument for measuring angles in the horizontal planes.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Theodolite Surveys.

IV Practical Outcome

Use transit theodolite to measure horizontal angle correctly by direct method.

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

1. Temporary adjustment of Transit Theodolite
2. Function of each component part of Transit Theodolite.
3. Concept of face left and face right

VIII Experimental Set-up

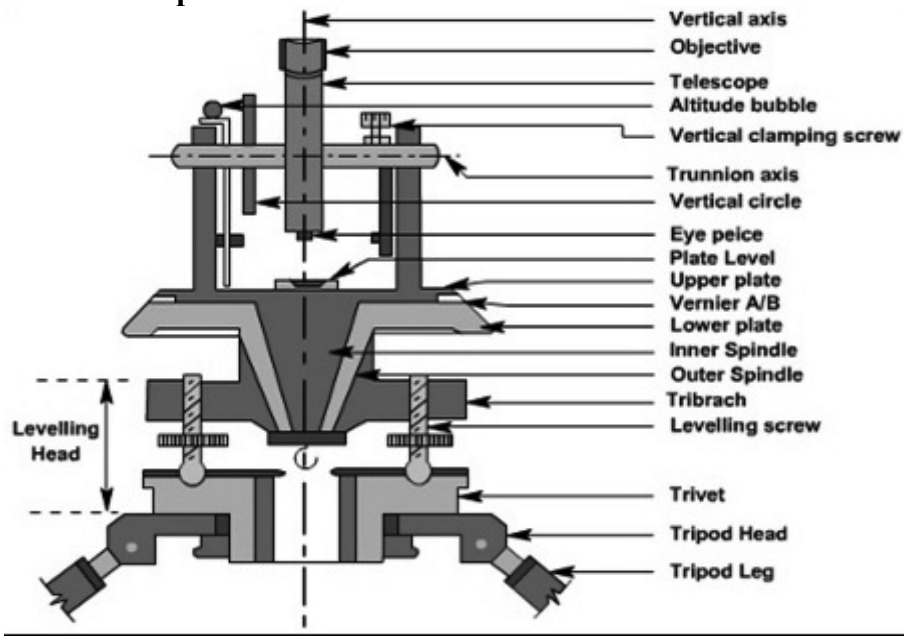

Figure: Transit Theodolite

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Transit Theodolite with Tripod Stand	In this type of theodolite the line of sight can be revolved about trunion axis/ horizontal axis through 180 degrees in the vertical plane, least count of instrument 20”	**1**	For each batch
2	Peg	Wooden or metallic	**3**	For each batch
3	Ranging Rods	2m long	**2**	For each batch
4	Hammer	As per specification	**1**	For each batch

X Procedure

1. Collect the required instruments as per Table IX from the store.
2. Set up the tripod over the given station O 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 Horizontal circle vernier A to 00^0 00’ 00” and B at 180^0 00’ 00” accurately using upper tangent screw.

8. Unclamp the lower clamp and bisect A approximately, Clamp lower clamp. Using lower tangent screw bisect the object A with face left precisely.
9. Unclamp upper clamp, Swing the telescope in clockwise direction and bisect the object in forward direction i.e B approximately. Clamp upper clamp. Using upper tangent screw bisect B precisely. Take readings at the vernier A and B
10. Repeat the same procedure with face right
11. The Average of face left and face right is the required horizontal angle AOB.
12. Return the instruments to the survey store.

XI Precautions to be followed

1. Temporary adjustments are done precisely
2. Bisect A and B precisely.
3. Read the verniers accurately.
4. Enter the readings in the appropriate columns

XII Actual procedure followed

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
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XIIIV Precautions followed

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XV Observations

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XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any)

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XIX Practical Related Questions

1. When lower clamp and lower tangent screw is used
2. When Upper clamp and upper tangent screw is used

Space to Write Answers

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837
4	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

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

Practical No. 05: Use of transit theodolite to measure vertical angle

I Practical Significance

Vertical angle is required when heights are to be computed. A theodolite is a precision instrument for measuring angles in the vertical planes.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Theodolite Surveys.

IV Practical Outcome

Use transit theodolite to measure vertical angle correctly.

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

1. Temporary adjustment of Transit Theodolite
2. Function of each component part of Transit Theodolite.
3. Angle of elevation
4. Angle of depression

VIII Experimental Set-up

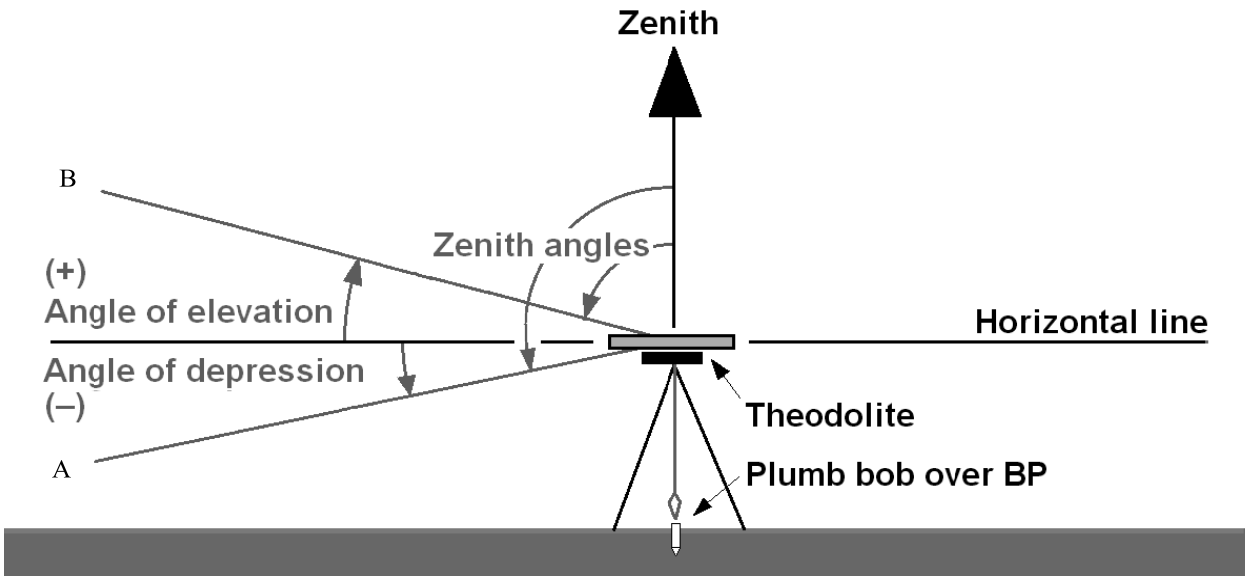

Figure: measure vertical angle with Theodolite

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Transit Theodolite with Tripod Stand	In this type of theodolite the line of sight can be revolved about trunnion axis/ horizontal axis through 180 degrees in the vertical plane. least count of instrument 20”	**1**	For each batch
2	Peg	Wooden or metallic	**3**	For each batch
3	Ranging Rods	As per specification	**2**	For each batch
4	Hammer	As per specification	**1**	For each batch

X 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 plum bob.
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 00^0 00’ 00” and D at 0^0 00’ 00” accurately using vertical clamp and vertical tangent screw.

8. Unclamp the Vertical clamp and bisect the object A approximately, Clamp Vertical clamp. Using vertical tangent screw bisect the object A precisely.
9. Take readings at the Vernier C and D and get the vertical angle of depression.
10. Unclamp vertical clamping screw, transit the telescope bisect the object i.e. B approximately. Clamp vertical clamp. Using vertical tangent screw bisect B precisely. Take readings at the Vernier C and D and get the angle of elevation.
11. Repeat the same procedure with face right
12. The Average of face left and face right is the required vertical angle.
13. Return the instruments to the survey store.

XI Precautions to be followed

1. Temporary adjustments are done precisely
2. Bisect A and B precisely.
3. Read the Vernier accurately.
4. Enter the readings in the appropriate columns

XII Actual procedure followed (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					
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XIIIV Precautions followed

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XV Observations

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XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any)

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XIX Practical Related Questions

1. When vertical clamp and vertical tangent screw is used
2. Define angle of elevation and angle of depression

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837
4	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
	Process related:15 Marks	**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
	Product related:10 Marks	**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
	Total: 25 Marks	**100%**

List of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

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

Practical No. 06: Use of transit theodolite to measure horizontal angle by repetition method.

I Practical Significance

Traverse can be plotted accurately knowing the length and angles. Angle are measured most accurately by the method of Repetition using Transit Theodolite.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Theodolite Surveys.

IV Practical Outcome

Use transit theodolite to measure horizontal angle correctly by repetition method.

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

1. Temporary adjustment of Transit Theodolite
2. Function of each component part of Transit Theodolite.
3. Concept of face left and face right

VIII Experimental Set-up

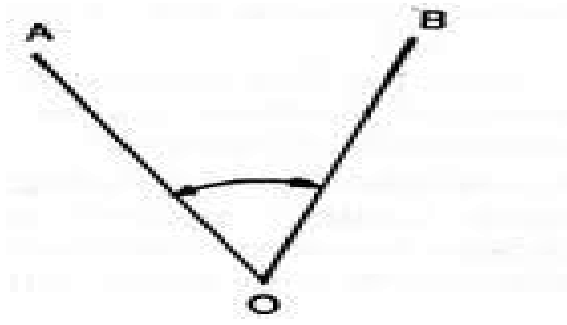

Figure: Horizontal angle measure by Transit Theodolite

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Transit Theodolite with Tripod Stand	In this type of theodolite the line of sight can be revolved about trunion axis/ horizontal axis through 180 degrees in the vertical plane. least count of instrument 20”	**1**	For each batch
2	Peg	Wooden or metallic	**3**	For each batch
3	Ranging Rods	As per specification	**2**	For each batch
4	Hammer	As per specification	**1**	For each batch

X Procedure

1. Collect the required instruments as per Table IX from the store.
2. Set up the tripod over the given station O and fix theodolite over it. Perform Approximate levelling by tripod stand
3. Perform Centering by using plum bob.
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 Horizontal circle Vernier A to 00^0 00’ 00” and B at 180^0 00’ 00” accurately using upper tangent screw.
8. Unclamp the lower clamp and bisect A approximately, Clamp lower clamp. Using lower tangent screw (LTS) bisect the object A with face left precisely.
9. Unclamp upper clamp, Swing the telescope in clockwise direction and bisect the object in forward direction i.e B approximately. Clamp upper clamp. Using upper tangent screw (UTS) bisect B precisely. Take readings at the Vernier A and B.
10. Unclamp lower clamp and bisect A approximately and bisect it precisely using LTS. Reading will be same as before.
11. Unclamp upper clamp and bisect B approximately and bisect B precisely using UTS.
12. Read the Vernier A and B accurately.
13. Repeat this procedure one more time. i.e., 3 repetitions with face left.
14. Change the face and repeat the above procedure for face right observations.
15. Average of face left and face right will give the accurate horizontal angle AOB
16. Return the instruments to the survey store.

XI Precautions to be followed

1. Temporary adjustments are done precisely
2. Bisect A and B precisely.
3. Read the verniers accurately.
4. Enter the readings in the appropriate columns

XII Actual procedure followed (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIIIV Precautions followed

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XV Observations

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XVI Results

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XVI Interpretation of results (Give meaning of the above obtained results)

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XVII Conclusions and Recommendations (if any)

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XIX Practical Related Questions

1. When lower clamp and lower tangent screw is used
2. When Upper clamp and upper tangent screw is used
3. When repetition method is necessarily adopted

Space to Write Answers

XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837
4	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

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

Practical No. 07: Use of transit theodolite as a tacheometer to compute the RLs and horizontal distances.

I Practical Significance

To measure the RLs and horizontal distances using Transit Theodolite as Tacheometer. It is not so accurate method of finding the horizontal distances as the Chaining is, but it is most suitable for carrying out the surveys to find the distances in the hilly area where other methods are quite difficult to be carried out. Tacheometry is a system of rapid surveying, by which the horizontal and vertical positions of points on the earth's surface relative to one another are determined without using a chain or tape, or a separate levelling instrument. A levelling staff is used.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Find distances and elevations using Tacheometer.

IV Practical Outcome

Use transit Theodolite as a Tacheometer to compute the RLs and horizontal distances**.**

V Competency and Practical Skills

Prepare plans using Advanced Surveying equipment and techniques

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

1. Principle of tacheometry
2. Anallatic lens.
3. Additive and multiplying constant of tacheometer

VIII Experimental Set-up

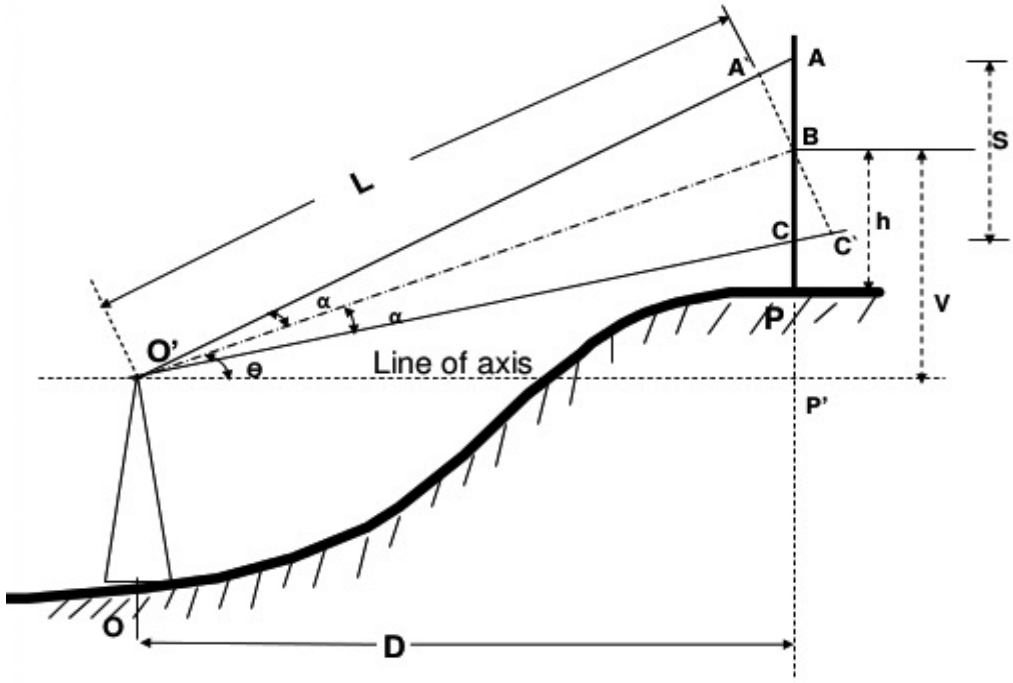

Figure: Tacheometry

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Tacheometer with Tripod Stand	Transit theodolite fitted with Anallatic lens.	**1**	For each batch
2	Peg	Wooden or metallic	**3**	For each batch
3	Levelling staff	4m long telescopic.	**1**	For each batch
4	Hammer	As per specification	**1**	For each batch

X 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 0^0 00’ 00” and D at 0^0 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. Return the instruments to the survey store.

XI Precautions to be followed

1. Temporary adjustments are done precisely
2. Bisect staff held at A and B precisely.
3. Read the hair readings accurately.
4. Enter the readings in the appropriate columns

XII Actual procedure followed (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					
4					

XIV Precautions followed

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XV Observations

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XVI Results

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XVI Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any)

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XIX Practical Related Questions

1. State the use of Anallatic lens.
2. Explain the procedure of finding additive and multiplying constants when staff held vertical and line of sight horizontal

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
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4	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

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

Practical No. 8: To Set out a circular curve by offsets from long chord method

I Practical Significance

Curves provide a smooth passage for vehicles when the direction of the alignment is changed. A horizontal curve provides a transition between two tangent strips of roadway, allowing a vehicle to negotiate a turn at a gradual rate rather than a sharp cut. The design of the curve is dependent on the intended design speed for the roadway, as well as other factors including drainage and friction. These curves are semicircles as to provide the driver with a constant turning rate with radii determined by the laws of physics surrounding centripetal force.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Setout simple circular curves

IV Practical Outcome

Set out a circular curve by offsets from Long chord method

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques

VI Relevant Affective domain related

a. Follow safety practices & precautions.
b. Demonstrate working as a leader/a team member.
c. Maintain tools and equipment.

VII Minimum Theoretical Background

Component parts of simple circular curve, Notations used in curves, Formulae for finding Long chord length, Tangent length , length of curve, Relations between radius of curve and degree of curve. Finding the ordinates.

Let AB and BC be two tangents meeting at a point B with a deflection angle ∅. The following data are calculated for setting out the curve.

i. The tangent length is calculated according to the formula,

$$\text{Tangent length } BT_1 = R\ tan\frac{\emptyset}{2}$$

ii. The length of the curve is calculated according to formula

$$\text{Length of the curve} = \frac{\pi R \emptyset}{180}$$

iii. The chainages of T_1 and T_2 are calculated,
Chainage at T_1 = Chainage at intersection point B - Tangent length
Chainage at T_2 = Chainage at T_1 + length of curve

iv. The length of the long chord L is calculated ,

$$L = 2Rsin\frac{\emptyset}{2}$$

v. The long chord is divided into equal part. i.e. (left half and right half).

vi. O_0 = Mid ordinate (Versed sine distance)

$O_0 = R\left(1 - cos\frac{\emptyset}{2}\right)$ If the deflection angle is given

$O_0 = R - \sqrt{R^2 - \left(\frac{L}{2}\right)^2}$ If the deflection angle is not given

vii. Consider the left half of the long chord, the ordinates O_1, O_2, ---------- are calculated at distance X_1, X_2, ------- taken from E towards the tangent point T_1.

$O_x = \sqrt{R^2 - x^2} - (R - O_0)$

VIII Experimental Set-up

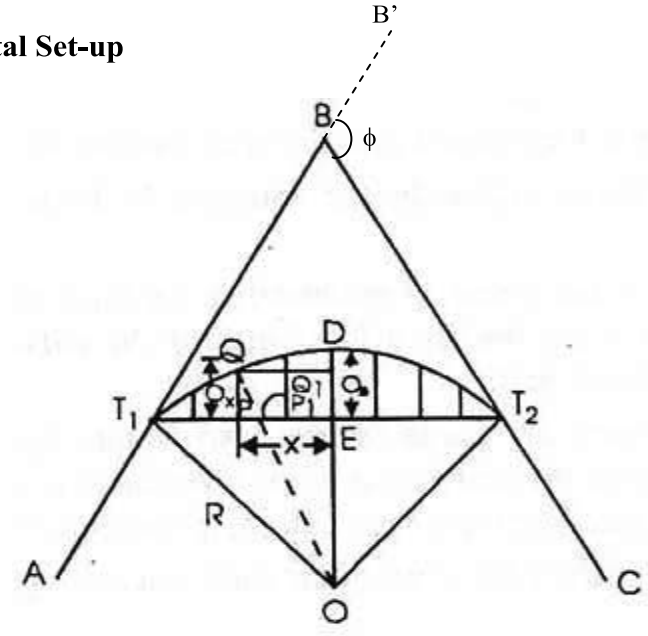

Figure: Curve setting by long chord method

IX Resource Required:-

Sr. No.	Particulars	Specification	Quantity	Remark
1	Chain and Tape	Standard specifications	01	Each batch
2	Ranging rods	Standard specifications	05	Each batch
3	Pegs	Standard specifications	10	Each batch
4	Hammer	Standard specifications	1	Each batch

X Procedure

1. Collect the required instruments as per Table IX from the store.
2. Calculate the necessary data required for setting out the curve like Tangent length, Length of curve, Chaninage at starting point of curve, Length of long chord, Chaninage at point of tangency, Ordinates at regular intervals and mid ordinate.
3. Mark the positions of T1 and T2 on the ground and length T1 T2= Length of long chord
4. Mark midpoint of T_1T_2 and set perpendicular O_0 i.e., mid ordinate.
5. Mark points on the long chord at regular intervals as per calculations.
6. Set perpendiculars using cross staff at above points equal to O_{10}, O_{20}, O_{30} etc and mark them as P1, P2, P3 etc using pegs
7. In the right half, points O'_{10}, O'_{20}, O'_{30} are marked with pegs and corresponding ordinates are set out to mark the point P1',P2',P3' etc
8. All the points P_1, P2,------ and P'_1 , P'_2,------ are joined and smooth curve is obtained.
9. Return the instruments to the store.

XI Precautions to be followed

1. Chain and Tape should be stretched properly without any sag
2. Calculations are done accurately.

XII Actual procedure followed

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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

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XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

1. State the purpose of horizontal circular curve
2. Mention how the positions of points T1 and T2 are marked on the ground.

Space to Write Answers

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837
4	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

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

Practical No. 9: To Set out a circular curve by Rankine's method of deflection angles.

I Practical Significance

Curves provide a smooth passage for vehicles when the direction of the alignment is changed. A horizontal curve provides a transition between two tangent strips of roadway, allowing a vehicle to negotiate a turn at a gradual rate rather than a sharp cut. The design of the curve is dependent on the intended design speed for the roadway, as well as other factors including drainage and friction. These curves are semicircles as to provide the driver with a constant turning rate with radii determined by the laws of physics surrounding centripetal force.

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Setout simple circular curves

IV Practical Outcome

Set out a circular curve by Rankine's method of deflection angles.

V Competency and Practical Skills

Prepare plans using Surveying equipment and techniques

VI Relevant Affective domain related

a. Follow safety practices & precautions.
b. Demonstrate working as a leader/a team member.
c. Maintain tools and equipment.

VII Minimum Theoretical Background

Component parts of simple circular curve, Notations used in curves, Formulae for finding Long chord length, Tangent length , length of curve, Relations between radius of curve and degree of curve. Finding the ordinates.

Let AB and BC be two tangents meeting at a point B with a deflection angle ∅. The following data are calculated for setting out the curve.

1. The tangent length is calculated according to the formula,
   Tangent length $BT_1 = R\ tan\frac{\emptyset}{2}$

2. The length of the curve is calculated according to formula
   Length of the curve = $\frac{\pi R\emptyset}{180}$

3. The chainages of T_1 and T_2 are calculated,
Chainage at T_1 = Chainage at intersection point B - Tangent length

Chainage at T_2 = Chainage at T_1 + length of curve

4. The length of the long chord L is calculated ,

$$L = 2Rsin\frac{\emptyset}{2}$$

T_1, P, Q and T_2 are the points on the curve.

δ_1= tangential or deflection angle made by chord T_1P and first tangent

δ_2= Tangential or deflection angle made by PQ and second tangent

δ_3= Tangential or deflection angle made by QT_2 and third tangent

Δ_1 = total tangential or deflection angle between first tangent and chord T_1P

Δ_2 = total tangential or deflection angle between first tangent and chord PQ

Δ_3= total tangential or deflection angle between first tangent and chord QT_2

C_1, C2, C3 = length of chord T_1P, PQ and QT_2

$$\delta_1 = \frac{1719}{R} C_1 \ minutes$$

Similarly

$$\delta_2 = \frac{1719}{R} C_2 \ minutes$$

In general

$$\delta_n = \frac{1719}{R} C_n \ minutes$$

Total Tangential or deflection angle

$$\Delta_1 = \delta_1$$

$$\Delta_2 = \Delta_1 + \delta_2$$

In general

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

VIII Experimental Set-up

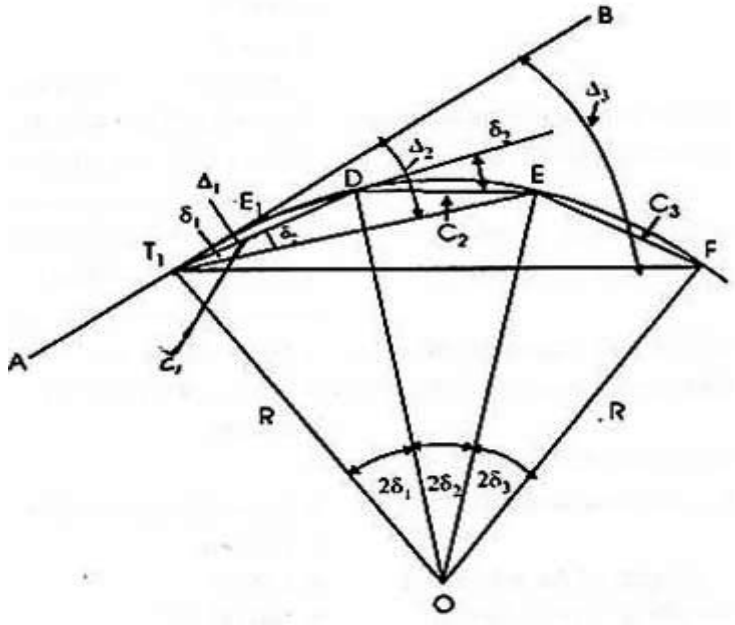

Figure: Curve setting by Rankine's method

IX Resource Required:-

Sr. No.	Particulars	Specification	Quantity	Remark
1	Transit theodolite with tripod	Standard specifications	1	Each batch
1	Chain and Tape	Standard specifications	01	Each batch
2	Ranging rods	Standard specifications	05	Each batch
3	Pegs	Standard specifications	10	Each batch
4	Hammer	Standard specifications	1	Each batch

X Procedure

1. Collect the required instruments as per Table IX from the store.
2. Locate the tangent points T_1 and T_2 on the straight line AB and BC.
3. Set the theodolite at the beginning of the curve T_1
4. With the Vernier A of the horizontal circle set to zero, direct the telescope towards the ranging rod at the point of intersection B and bisect it.
5. Unclamp the upper clamp screw and the Vernier A to the first tangential angle (Δ_1) and the telescope being directed along T_1P.
6. With the zero end of the tape at T_1 and length equal to the first sub chord swing the tape till the line of sight bisects the arrow thus fix the point P.
7. Set Vernier A is equal to zero and direct the telescope toward the ranging rod fixed at the point of intersection B and bisects it.
8. Unclamp the upper clamp screw and set the Vernier A to the second tangential angle (Δ_2) and the telescope being directed along PQ.

9. With the zero end of chain or tape at P and with an arrow held at distance of PQ =C2 (second chord or normal chord) swing the chain about P until the line sight bisect the arrow thus fix the second point Q on the curve.
10. Repeat the process till the last point T2 is reached.
11. Join all the points by a smooth circular curve.
12. Return the equipment to the store

XI Precautions to be followed

1. Calculations are done accurately.
2. Temporary adjustments are done precisely
3. Set the angles correctly on the Vernier

XII Actual procedure followed

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XIII Resources used

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XIIIV Precautions followed

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

XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

1. Define deflection angle/ tangential angle
2. Mention the common radii and deflection angle for standard circular curves

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837
4	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

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

Practical No. 10: To Set Up the Total Station Instrument

II. Practical Significance

The Total station is designed for measuring of slant distances, horizontal and vertical angles and elevations in topographic and geodetic works, tachometric surveys, as well as for solution of application geodetic tasks. The measurement results can be recorded into the internal memory and transferred to a personal computer

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

(a) Prepare plans using Total Station instrument

IV Practical Outcome

set up the total station instrument

V Competency and Practical Skills

Prepare plans using Advanced Surveying equipment and techniques.

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

Total Station:-

An electronic total station means an electronic distance meter (EDM) and a digital theodolite built as a one unit.

Component parts of Total station:-

a. **Telescope:-**
It consists of eyepiece and diaphragm at one end and objective end at the other end. By using focusing screw object can be bisected.

b. **Clamp Screw:-**

1. **Horizontal clamp screw:-** It is used to control the motion of the telescope in horizontal plane.

2. **Vertical clamp screw:-** It is used for the control the motion of the telescope in vertical plane.

c. **Tangential motion Screw:-** It is provided perpendicular to the clamp screw and used for slow motion of the telescope.

d. **Display window:-** Reading of horizontal and vertical angle is displayed on display window.

e. **Optical plummet:-** For the centering the instrument.

f. **Levelling head:-** For the levelling the instrument.

VIII Experimental Set-up

Figure: Total station

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Total station with stand	Standard make	**1**	For each batch
2	target prism	standard	**1**	For each batch
3	Peg	Wooden or metallic	**3**	For each batch
4	hammer	Standard	**1**	For each batch
5	Paint	Yellow colour	**200ml**	----------

X Procedure:-

General setting required for station point or temporary adjustment of total Station:-

Temporary Adjustments of a Total Station

A total station is basically a theodolite hence temporary adjustments of the total station are more or same as that of a theodolite. Following are the temporary adjustments of a total station.

1. Setting up of tripod, taking out instrument from box & fixing the instrument on tripod head.
2. Levelling up of the instrument
   a) Coarse leveling with spirit level by leg adjustment.
   b) Fine leveling with digital bubble and foot screws.
3. Centering Up of the instrument
   a) Coarse centering by leg adjustment.
   b) Fine centering with laser plummet by shifting the instrument bodily on machine finished tripod head.

   Levelling & centering shall be done in succession to each other till both of them are satisfactory.
4. Setting up the Station
   a) By inputting station name, instrument height & coordinates at first station &
   b) By recalling the station occupied from the memory at next stations.
5. Orienting the instrument
   a) By setting horizontal angle to 00 when instrument is directed toward the accepted meridian (usually North direction) at first station and
   b) By taking back sight to previously occupied traverse station (So that same meridian will be referred).

XI Precautions to be followed

1. Set the instrument exactly over the station on ground
2. Perform temporary adjustment accurately

XII Actual procedure followed

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XIII Resources used -

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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

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XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions

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XIX Practical Related Questions

1. State the function of each of the component part of TS.

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling	Subramanian, R.	Oxford University Press. New Delhi ISBN 13:978-0-19-808542-3
2	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837
3	Surveying theory and practice	Anderson, James M and Mikhail, Edward M.	Mc Graw Hill Education, Noida ISBN:13-978-1-25-902564-8

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

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

Practical No. 11: Use of Total Station to Measure the Horizontal Distance

III. Practical Significance

The Total station is designed for measuring of slant distances, horizontal and vertical angles and elevations in topographic and geodetic works, tachometric surveys, as well as for solution of application geodetic tasks. The measurement results can be recorded into the internal memory and transferred to a personal computer

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Total Station instrument

IV Practical Outcome

Use Total Station to measure the horizontal distance

V Competency and Practical Skills

Prepare plans using Advanced Surveying equipment and techniques.

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

Total Station:-

An electronic total station means an electronic distance meter (EDM) and a digital theodolite built as a one unit.

Component parts of Total station:-

a. **Telescope:-**
It consists of eyepiece and diaphragm at one end and objective end at the other end. By using focusing screw object can be bisected.

b. **Clamp Screw:-**

c. **Horizontal clamp screw:-** It is used to control the motion of the telescope in horizontal plane.

d. **Vertical clamp screw:-** It is used for the control the motion of the telescope in vertical plane.

e. **Tangential motion Screw:-** It is provided perpendicular to the clamp screw and used for slow motion of the telescope.

f. **Display window:-** Reading of horizontal and vertical angle is displayed on display window.

g. **Optical plummet:-** For the centring the instrument.

h. **Levelling head:-** For the levelling the instrument.

VIII Experimental Set-up

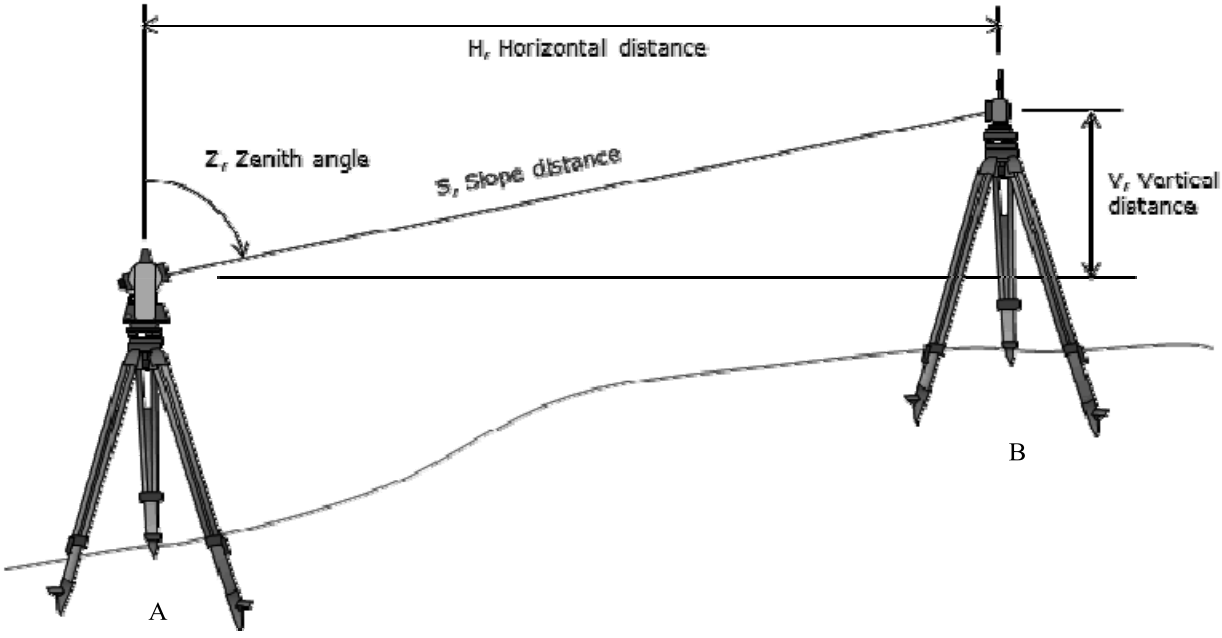

Figure: Total station

IX Resources required

Sr. No	Particulars	Specification	Qty	Remark
1	Total station with stand	Standard make, Telescope 30x, Accuracy upto 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	**1**	For each batch
2	target prism	Accuracy prism ±(2+2ppmX D)mm	**1**	For each batch
3	Peg	Wooden or metallic	**3**	For each batch
4	hammer	Standard	**1**	For each batch
5	Paint	Yellow colour	**200ml**	----------

X Procedure:-

General setting required for station point or temporary adjustment of total Station:-
Temporary Adjustments of a Total Station

A total station is basically a theodolite, hence temporary adjustments of the total station are same as that of a theodolite. Following are the temporary adjustments of a total station.

1. Setting up of tripod, taking out instrument from box & fixing the instrument on tripod head.
2. Levelling up of the instrument
   c) Coarse leveling with spirit level by leg adjustment.
   d) Fine leveling with digital bubble and foot screws.
3. Centering Up of the instrument
   a. Coarse centering by leg adjustment.
   b. Fine centering with laser plummet by shifting the instrument bodily on machine finished tripod head.
   Levelling & centering shall be done in succession to each other till both of them are satisfactory.
4. Setting up the Station
   a. By inputting station name, instrument height & coordinates at first station &
   b. By recalling the station occupied from the memory at next stations.
5. Orienting the instrument
   a. By setting horizontal angle to 00 when instrument is directed toward the accepted meridian (usually North direction) at first station and
   b. By taking back sight to previously occupied traverse station (So that same meridian will be referred).

To measure Horizontal Distance between Two Points

1. To measure horizontal distance between two points say A and B, set up ETS at station A and perform only first three temporary adjustments as enumerated above. Machine gets switched on in the process temporary adjustments. Select the measuring screen/mode ready to show the horizontal distance and ascertain that clamping screws (if any) are loose.
2. Hold vertically the prism pole at station B, so that face of the prism is directed towards the ETS at station A.
3. Look against optical collimator, rotate the telescope in horizontal & vertical plane and bisect approximately the prism at station B and tighten horizontal & vertical circle clamp screws if instrument do not have friction clamping arrangement.
4. Look through telescope, rotate the telescope in horizontal & vertical plane by making use of horizontal & vertical circle tangent screws and bisect exactly the centre of prism at station B by point of intersection of cross hairs on diaphragm of telescope.
5. Press the button (DIST or MEAS) exclusively created for carrying out distance measurement process. Within few seconds machine will display the results. Read the value against horizontal distance.

6. Record this horizontal distance reading manually on your record book. Please note that ETS is usually not programmed to store in its memory, an individual angle or distance. Observation Table

Instru. Stn.	Stn. Obs.	Horizontal Distance	Remark
A	B		
	C		
	D		

XI Precautions to be followed

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

XII Actual procedure followed

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XIII Resources used -

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV **Observations and Calculations** (Use blank sheet provided if space not sufficient)

XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions

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XIX Practical Related Questions

1. Explain the temporary adjustments of TS
2. State the various function keys used to measure horizontal distance
3. Mention the sources of errors in TS survey

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling	Subramanian, R.	Oxford University Press. New Delhi ISBN 13:978-0-19-808542-3
2	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837
3	Surveying theory and practice	Anderson, James M and Mikhail, Edward M.	Mc Graw Hill Education, Noida ISBN:13-978-1-25-902564-8

XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

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

Practical No. 12: Use of total station to measure the horizontal angle

I Practical Significance

The Total station is designed for measuring of slant distances, horizontal and vertical angles and elevations in topographic and geodetic works, tachometric surveys, as well as for solution of application geodetic tasks. The measurement results can be recorded into the internal memory and transferred to a personal computer

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Total Station instrument

IV Practical Outcome

Use Total Station to measure the horizontal angle

V Competency and Practical Skills

Prepare plans using Advanced Surveying equipment and techniques.

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

Total Station:-

An electronic total station means an electronic distance meter (EDM) and a digital theodolite built as a one unit.

Component parts of Total station:-

a. Telescope:-
   a. It consists of eyepiece and diaphragm at one end and objective end at the other end.
   b. By using focusing screw object can be bisected.

b. Clamp Screw:-
   1. Horizontal clamp screw:- It is used to control the motion of the telescope in horizontal plane.
   2. Vertical clamp screw:- It is used for the control the motion of the telescope in vertical plane.

c. Tangential motion Screw:- It is provided perpendicular to the clamp screw and used for slow motion of the telescope.

d. Display window:- Reading of horizontal and vertical angle is displayed on display window.

e. Optical plummet:- For the centering the instrument.

f. Levelling head:- For the levelling the instrument.

Features of Total Station:-

1. High accuracy and long measuring range
   - Measuring range with mini prism:- 0.9Km
   - Measuring range with single Prism: - 2Km
   - Measuring range with three Prism: - 2.7Km
2. Control Panel:- Total station is activated through its control panel. It consists of key board with multifunction key.
3. Power Supply:- Rechargeable Ni-Cd batteries are used for power supply.
4. Large internal memory up to 24000 Pts.
5. Water resistant and dust proof.
6. Angle measurement:- An electronic theodolite of a total station is used to measure angle and record it.
7. Distance measurement: - An electronic distance meter (EDM) of a total station is used to measure distance and record it.

VIII Experimental Set-up

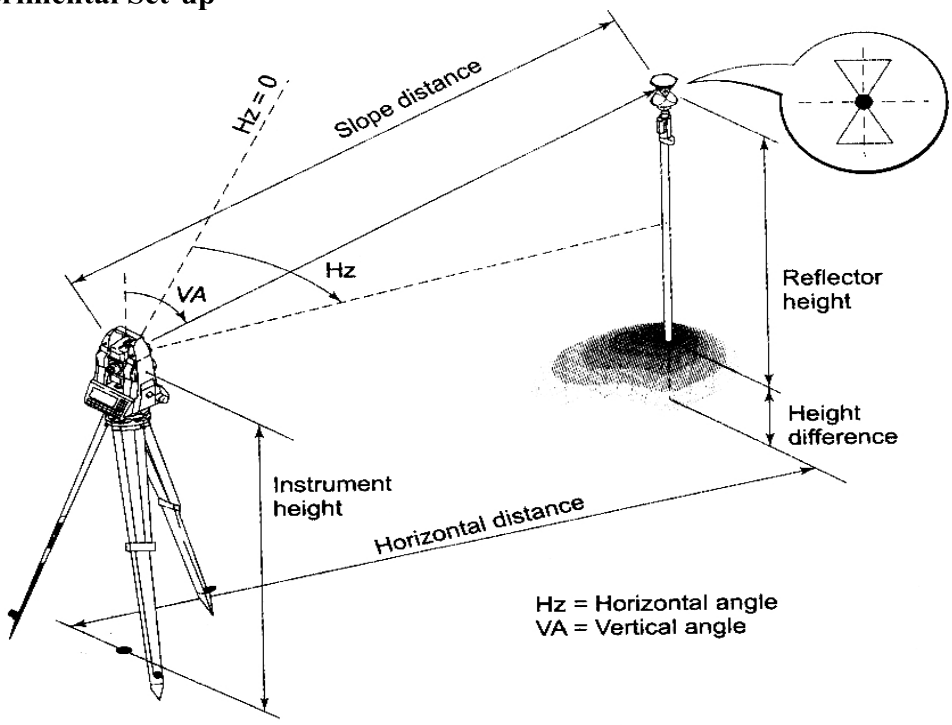

Figure: Total station

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Total station with stand	Standard make, Telescope 30x, Accuracy upto 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	**1**	For each batch
2	target prism	Accuracy prism ±(2+2ppmX D)mm		
3	Peg	Wooden or metallic	**3**	For each batch
4	hammer	Standard	**1**	For each batch
5	Paint	Yellow colour	**200ml**	----------

X Procedure:-

General setting required for station point or temporary adjustment of total Station:-

Temporary Adjustments of a Total Station

A total station is basically a theodolite, hence temporary adjustments of the total station are same as that of a theodolite. Following are the temporary adjustments of a total station.

1. Setting up of tripod, taking out instrument from box & fixing the instrument on tripod head.

2. Levelling up of the instrument

a) Coarse leveling with spirit level by leg adjustment.

b) Fine leveling with digital bubble and foot screws.

3. Centering Up of the instrument

a) Coarse centering by leg adjustment.

b) Fine centering with laser plummet by shifting the instrument bodily on machine finished tripod head.

Levelling & centering shall be done in succession to each other till both of them are satisfactory.

4. Setting up the Station

a) By inputting station name, instrument height & coordinates at first station &

b) By recalling the station occupied from the memory at next stations.

5. Orienting the instrument

a) By setting horizontal angle to 00 when instrument is directed toward the accepted meridian (usually North direction) at first station and

b) By taking back sight to previously occupied traverse station (So that same meridian will be referred).

Measuring Horizontal Angle

1. To measure horizontal angle AOB with an ETS, set up instrument at station O and perform only first three temporary adjustments as enumerated above. Machine gets switched on in the process temporary adjustments. Keep face left, select a measurement screen/mode which displays the horizontal angle and ascertain that clamping screws (if any) are loose.
2. Look against optical collimator, rotate the telescope in horizontal & vertical plane and bisect approximately the peg at station A by vertical cross hair and tighten horizontal & vertical circle clamp screws if instrument do not have friction clamping arrangement.
3. Look through telescope, rotate the telescope in horizontal & vertical plane by making use of horizontal & vertical circle tangent screws and bisect exactly bottom of nail over peg at station A by point of intersection of cross hairs on diaphragm of telescope.
4. Set horizontal angle to 00 by pressing the appropriate key.
5. Bisect station B in the same way as like that for station A and read the reading in display against the horizontal angle.
6. Record this horizontal angle reading manually on your record/field book. Please note that ETS is usually not programmed to store in its memory, an individual angle or distance.
7. If required repeat the steps 2, to 6 by changing face to right to obtain one more set of reading. This is highly essential, especially when A, O and B are at different elevation, to avoid error due to imperfect permanent adjustments.

Observation Table:

Inst. Stn	Stn. Obs.	Face	Window Reading	Angle	Mean Angle	Remark
O	A	L				For deriving more precision one may take 2 more repetitions with face left & 2 more with face right.
	B	L				
	A	R				
	B	R				

XI Precautions to be followed

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

XII Actual procedure followed

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XIII Resources used -

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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

XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions

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XIX Practical Related Questions

1. State the use of clamping screws
2. State various function keys used to measure the horizontal angle using TS

Space to Write Answers

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling	Subramanian, R.	Oxford University Press. New Delhi ISBN 13:978-0-19-808542-3
2	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837
3	Surveying theory and practice	Anderson, James M and Mikhail, Edward M.	Mc Graw Hill Education, Noida ISBN:13-978-1-25-902564-8

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1……..

2……..

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

Practical No. 13: Use of total station to measure the vertical angle

I Practical Significance

The Total station is designed for measuring of slant distances, horizontal and vertical angles and elevations in topographic and geodetic works, tachometric surveys, as well as for solution of application geodetic tasks. The measurement results can be recorded into the internal memory and transferred to a personal computer

II Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Prepare plans using Total Station instrument

IV Practical Outcome

Use Total Station to measure the vertical angle

V Competency and Practical Skills

Prepare plans using Advanced Surveying equipment and techniques.

VI Relevant Affective domain related

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

VII Minimum Theoretical Background

Total Station:-

An electronic total station means an electronic distance meter (EDM) and a digital theodolite built as a one unit.

Component parts of Total station:-

a. Telescope:-
   a. It consists of eyepiece and diaphragm at one end and objective end at the other end.
   b. By using focusing screw object can be bisected.

b. Clamp Screw:-
   1. Horizontal clamp screw:- It is used to control the motion of the telescope in horizontal plane.
   2. Vertical clamp screw:- It is used for the control the motion of the telescope in vertical plane.

c. Tangential motion Screw:- It is provided perpendicular to the clamp screw and used for slow motion of the telescope.

d. Display window:- Reading of horizontal and vertical angle is displayed on display window.

e. Optical plummet:- For the centering the instrument.

f. Levelling head:- For the levelling the instrument.

Features of Total Station:-

1. High accuracy and long measuring range
   - Measuring range with mini prism:- 0.9Km
   - Measuring range with single Prism: - 2Km
   - Measuring range with three Prism: - 2.7Km
2. Control Panel:- Total station is activated through its control panel. It consists of key board with multifunction key.
3. Power Supply:- Rechargeable Ni-Cd batteries are used for power supply.
4. Large internal memory up to 24000 Pts.
5. Water resistant and dust proof.
6. Angle measurement:- An electronic theodolite of a total station is used to measure angle and record it.
7. Distance measurement: - An electronic distance meter (EDM) of a total station is used to measure distance and record it.

VIII Experimental Set-up

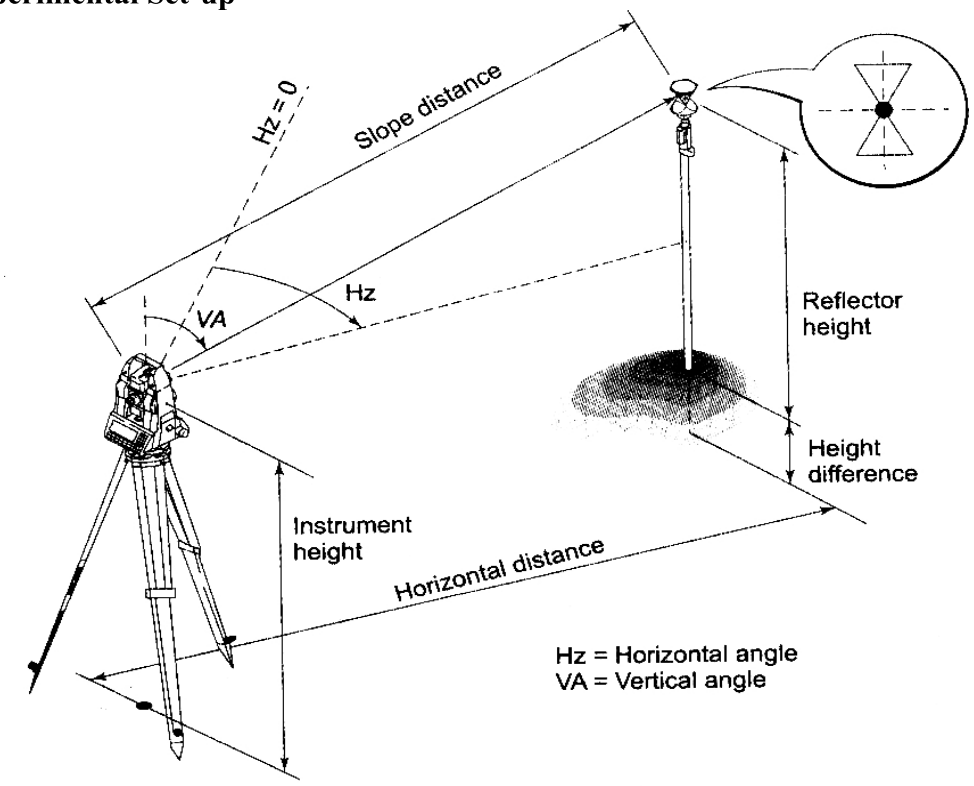

Figure: Total station

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Total station with stand	Standard make, Telescope 30x, Accuracy upto 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	**1**	For each batch
2	target prism	Accuracy prism ±(2+2ppmX D)mm		
3	Peg	Wooden or metallic	**3**	For each batch
4	hammer	Standard	**1**	For each batch
5	Paint	Yellow colour	**200ml**	----------

X Procedure:-

General setting required for station point or temporary adjustment of total Station:-

Temporary Adjustments of a Total Station

A total station is basically a theodolite; hence temporary adjustments of the total station are same as that of a theodolite. Following are the temporary adjustments of a total station.

1. Setting up of tripod, taking out instrument from box & fixing the instrument on tripod head.
2. Levelling up of the instrument
   a. Coarse levelling with spirit level by leg adjustment.
   b. Fine levelling with digital bubble and foot screws.
3. Centering Up of the instrument
   a. Coarse centering by leg adjustment.
   b. Fine centering with laser plummet by shifting the instrument bodily on machine finished tripod head.

Levelling & centering shall be done in succession to each other till both of them are satisfied

4. Setting up the Station
   a. By inputting station name, instrument height & coordinates at first station &
   b. By recalling the station occupied from the memory at next stations.
5. Orienting the instrument
   a. By setting horizontal angle to 00 when instrument is directed toward the accepted meridian (usually North direction) at first station and
   b. By taking back sight to previously occupied traverse station (So that same meridian will be referred).

Measuring Vertical Angle

Before starting with measurement of vertical angle with an ETS, one should borne in mind that many of the total ETS instruments are designed to measure the vertical angles either with respect to a vertical line or with respect to an horizontal line or in percentage mode. So first decide what way you have to measure the vertical angle, and accordingly carry out initial setting by following the appropriate procedure as suggested by the manufacturer of the instrument.

1. To measure from station O, a vertical angle to any object say E above or D below the horizontal line of sight, set up instrument at station O and perform only first three temporary adjustments as enumerated above. Machine gets switched on in the process temporary adjustments. Keep face left, select a measurement screen/mode which displays the vertical angle and ascertain that clamping screws (if any) are loose.
2. Look against optical collimator, rotate the telescope in horizontal & vertical plane and bisect approximately the station E or D by horizontal cross hair and tighten horizontal & vertical circle clamp screws if instrument do not have friction clamping arrangement.
3. Look through telescope, rotate the telescope in horizontal & vertical plane by making use of horizontal & vertical circle tangent screws and bisect exactly the station E or D by point of intersection of cross hairs on diaphragm of telescope. Read the reading in display against the vertical angle.
4. Record this vertical angle reading manually on your record/field book. Please note that ETS is usually not programmed to store in its memory, an individual angle or distance.

5. If required repeat the steps 2 to 4 by changing face to right to obtain one more set of reading. This is highly essential, especially when there is possibility of vertical index error.

Observation Table

Inst. Stn	Stn. Obs.	Face	Window Reading	Vertical Angle	Remark
O	E	L			E is an object above the horizontal line of sight. Vertical angle measured to E will be an angle of elevation. D is an object below the horizontal line of sight. Vertical angle measured to D will be an angle of depression.
	E	R			
	D	L			
	D	R			

XI Precautions to be followed

1) Set the instrument exactly over the station on ground
2) Perform temporary adjustment accurately
3) Alidade should be properly placed while bisecting the objects
4) Measure the distances on the ground correctly
5) Take suitable scale for plotting.
6) Perform survey during dry weather.

XII Actual procedure followed

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XIII Resources used -

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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

XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions

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XIX Practical Related Questions

1. State the least count of the TS used
2. State various function keys used to measure the vertical angle using TS

Space to Write Answers

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XX References / Suggestions for further Reading

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling	Subramanian, R.	Oxford University Press. New Delhi ISBN 13:978-0-19-808542-3
2	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837
3	Surveying theory and practice	Anderson, James M and Mikhail, Edward M.	Mc Graw Hill Education, Noida ISBN:13-978-1-25-902564-8

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1……..

2……..

3……..

4……..

5……..

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

Practical No. 14: Use of GPS to locate co-ordinates of a station

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 Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Civil engineering problems.

PO 2. ***Discipline knowledge:*** Apply Civil engineering knowledge to solve broad-based Civil engineering related problems.

PO 3. ***Experiments and practice:*** Plan to perform experiments and practices to use the results to solve broad-based Civil engineering problems.

III Relevant Course Outcomes

Locate co-ordinates of station using GPS

IV Practical Outcome

Use GPS to locate co-ordinates of a station

V Competency and Practical Skills

Prepare plans using Advanced Surveying equipment and techniques.

VI Relevant Affective domain related

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

VII Minimum 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 L1 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 behaviour.
- 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 ionospheric and tropospheric refraction, clock errors, etc. are also computed and applied by the user equipment / processing software..

VIII Experimental Set-up

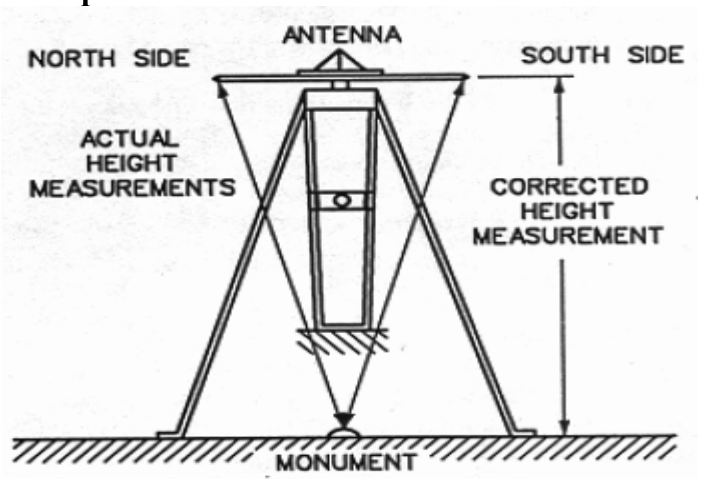

Figure: GPS Set up

IX Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	GPS instrument	Standard make	1	For each batch

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 tribrachs 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 centering 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 tribrach 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 Precautions to be followed

1. Set the instrument exactly over the station on ground

XII Actual procedure followed

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XIII Resources used -

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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

XVI Results

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions

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XIX Practical Related Questions

1. Explain the function GPS.
2. State the limitations of GPS

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XXI Suggested Assessment Scheme

S.No	Performance Indicators	Weightage (%)
Process related:15 Marks		**60%**
1	Identifying the different accessories	20%
2	Selection of suitable site	10%
3	Correct procedure of surveying	10%
4	Preparation of final drawing	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

List of Student Team Members

1……..

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

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	'C' programming Language	22218
15	Basic Electronics	22225
16	Programming in "C"	22226
17	Fundamentals of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemicals	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurements	22420
12	Digital Electronics And Microcontroller Applications	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048

Fifth Semester:

1	Design of Steel and RCC Structures	22502
2	Public Health Engineering	22504
3	Heat Transfer Operation	22510
4	Environmental Technology	22511
5	Operating Systems	22516
6	Advanced Java Programming	22517
7	Software Testing	22518
8	Control Systems and PLC's	22531
9	Embedded Systems	22532
10	Mobile and Wireless Communication	22533
11	Industrial Machines	22523
12	Switchgear and Protection	22524
13	Energy Conservation and Audit	22525
14	Power Engineering and Refrigeration	22562
15	Solid Modeling and Additive Manufacturing	22053
16	Guidelines & Assessment Manual for Micro Projects & Industrial Training	22057

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

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