

SPPU

According to New Revised Credit System Syllabus

Second Year Degree Course In
CIVIL ENGINEERING (Sem - I)

SURVEYING




**Free
Seperate
MCQ's
Book**

Includes

- Sample Question Papers (End Sem-50 Marks)
- Univ. Question Papers (Dec.13 to May 17)

ANIL S. SHELAR
Dr. SANDIP T. MALI
UDAY S. PATIL

www.pragationline.com

 www.facebook.com/niralibooks

 **NIRALI**
PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

A TEXT BOOK OF
SURVEYING

FOR
SEMESTER – I

**SECOND YEAR DEGREE COURSE IN
CIVIL ENGINEERING**

**Strictly According to New Revised Credit System Syllabus
of Savitribai Phule Pune University
(w.e.f June 2016)**

A. S. SHELAR

B.E. M. Tech. (Town & Country Planning),
Senior Lecturer, Civil Engg. Deptt.,
Cusrow Wadia Institute of Technology,
Pune – 1

Dr. S. T. MALI

B.E. (Civil), M.E. (Env.), Ph.D.
Asso. Prof. & Head, Civil Engg. Deptt.,
Pimpri Chinchwad College of Engineering,
Akurdi, Pune.

U. S. PATIL

B.E. M. Tech (C & M),
Asso. Prof. & Head, Civil Engg. Deptt.,
Bharati Vidyapeeth's Group of Institutes Technical Campus,
College of Engineering, Lavale
Lavale, PUNE – 43

Price ₹ 500.00



N3530

SURVEYING (SE CIVIL)**ISBN 978-93-86084-04-0****Second Edition : June 2017****© : Authors**

The text of this publication, or any part thereof, should not be reproduced or transmitted in any form or stored in any computer storage system or device for distribution including photocopy, recording, taping or information retrieval system or reproduced on any disc, tape, perforated media or other information storage device etc., without the written permission of Authors with whom the rights are reserved. Breach of this condition is liable for legal action.

Every effort has been made to avoid errors or omissions in this publication. In spite of this, errors may have crept in. Any mistake, error or discrepancy so noted and shall be brought to our notice shall be taken care of in the next edition. It is notified that neither the publisher nor the authors or seller shall be responsible for any damage or loss of action to any one, of any kind, in any manner, therefrom.

Published By :**NIRALI PRAKASHAN**

Abhyudaya Pragati, 1312, Shivaji Nagar,

Off J.M. Road, Pune – 411005

Tel - (020) 25512336/37/39, Fax - (020) 25511379

Email : niralipune@pragationline.com

POLYPLATE**Printed By :****SHREE OM PRINTERS PVT. LTD.**

Survey No. 28/25, Dhayri Near Pari Company

PUNE - 411 041

Tel - (020) 24690371

DISTRIBUTION CENTRES**PUNE****Nirali Prakashan** : 119, Budhwar Peth, Jogeshwari Mandir Lane, Pune 411002, Maharashtra

Tel : (020) 2445 2044, 66022708, Fax : (020) 2445 1538

Email : bookorder@pragationline.com, niralilocal@pragationline.com

Nirali Prakashan : S. No. 28/27, Dhyari, Near Pari Company, Pune 411041

Tel : (020) 24690204 Fax : (020) 24690316

Email : dhyari@pragationline.com, bookorder@pragationline.com

MUMBAI**Nirali Prakashan** : 385, S.V.P. Road, Rasdhara Co-op. Hsg. Society Ltd.,

Girgaum, Mumbai 400004, Maharashtra

Tel : (022) 2385 6339 / 2386 9976, Fax : (022) 2386 9976

Email : niralimumbai@pragationline.com

DISTRIBUTION BRANCHES**JALGAON****Nirali Prakashan** : 34, V. V. Golani Market, Navi Peth, Jalgaon 425001,

Maharashtra, Tel : (0257) 222 0395, Mob : 94234 91860

KOLHAPUR**Nirali Prakashan** : New Mahadvar Road, Kedar Plaza, 1st Floor Opp. IDBI Bank

Kolhapur 416 012, Maharashtra. Mob : 9850046155

NAGPUR**Pratibha Book Distributors** : Above Maratha Mandir, Shop No. 3, First Floor,

Rani Jhanshi Square, Sitabuldi, Nagpur 440012, Maharashtra

Tel : (0712) 254 7129

DELHI**Nirali Prakashan** : 4593/21, Basement, Aggarwal Lane 15, Ansari Road, Daryaganj

Near Times of India Building, New Delhi 110002

Mob : 08505972553

BENGALURU**Pragati Book House** : House No. 1, Sanjeevappa Lane, Avenue Road Cross,

Opp. Rice Church, Bengaluru – 560002.

Tel : (080) 64513344, 64513355, Mob : 9880582331, 9845021552

Email: bharatsavla@yahoo.com

CHENNAI**Pragati Books** : 9/1, Montieth Road, Behind Taas Mahal, Egmore,

Chennai 600008 Tamil Nadu, Tel : (044) 6518 3535,

Mob : 94440 01782 / 98450 21552 / 98805 82331,

Email : bharatsavla@yahoo.com

niralipune@pragationline.com | www.pragationline.com**Also find us on  www.facebook.com/niralibooks**

PREFACE TO THE SECOND EDITION

We are glad and excited to announce that the First Edition of this book received an overwhelming response from the engineering student community, compelling us to release its **Second Edition** within a very short period of time.

This thoroughly revised **Second Edition** has been updated with additional matter, many solved problems, including solutions to Numerous Exercises and University Question Papers (December 2013 to May 2017) for practice.

Special care has been taken to maintain high degree of accuracy in the theory and numericals throughout the book.

We take this opportunity to express our sincere thanks to Dineshbhai Furia of Nirali Prakashan, a reputed pioneer in the publication field. Our special thanks to Jignesh Furia for their effective cooperation and great care in bringing out this revised edition. We also appreciate the efforts of M. P. Munde and the entire staff of Engineering Books Deptt. of Nirali Prakashan namely Mrs. Deepali Lachake (Co-ordinator) for bringing this book to the students in a timely manner.

We sincerely hope that this "**Second Edition**" will also be warmly received by all concerned as in the past.

Valuable suggestions from our esteemed readers to improve the book are most welcome and highly appreciated.

Pune

Authors

PREFACE TO THE FIRST EDITION

It gives us great pleasure in publishing this text book on "**Surveying**" for the Students of Second Year Degree Course in Civil Engineering. This book is strictly written According to New Revised Credit System Syllabus of Savitribai Phule Pune University (2015 Pattern).

As per the policy of the University, Engineering Syllabi is revised every five years. Last revision was in the year 2012. New revision is coming little earlier, as university has introduced **Online** system of examination from year 2012.

As per the New Credit System, the **In Sem (Online – 50 Marks) Examinations** (Combined Phase-I and Phase-II) will be conducted based on first, second, third and fourth units. The **Online** examinations will have objective types of questions with multiple choices. **End Semester Examination (Theory Paper 50 Marks)** will be based on all the six units and that will be conducted in traditional way and the theory course will have 4 credits.

One of the main concerns of Civil Engineer is survey work either in stage of planning or execution of different types of Civil Engineering Projects. He/she shall be well acquainted with the principles, concepts, facts and procedures in surveying. With this knowledge and skills, he/she will be able to develop or select and use appropriate techniques and instruments to establish controls, locate details, measure distances and directions, reduce positions, areas, volumes etc. during the survey for construction or maintenance or repair or extension of various civil engineering works in different roles.

The text book has been thoroughly prepared according to six units as per revised curriculum of 2015. An attempt is made to give due justice to the use of modern equipments in routine survey activities. The authors with their professional and academic experience have taken all efforts to present the text in lucid manner. The theoretical matter has been explained with number of diagrams and illustrations supported by solved examples. Questions from previous papers of the University of Pune are included at end of each chapter.

We have given Free Separate book of Multiple Choice Questions (MCQ's) which will be very useful to the students, especially for Online Examinations.

We take this opportunity to express our sincere thanks to Shri. Dineshbhai Furia, Shri. Jignesh Furia, MRs. Nirali Verma and Shri. M. P. Munde and entire team of Nirali Prakashan namely Mrs. Deepali Lachake (Co-ordinator) who really have taken keen interest and untiring efforts in publishing this text.

Finally, we express our gratitude to our family members for their continuous support and encouragement, thanks to all.

We have no doubt that like our earlier texts, student's community will respond favourably to this new venture.

The advice and suggestions of our esteemed readers to improve the text are most welcomed, and will be highly appreciated.

25th June 2016
Pune

Authors

SYLLABUS

Unit I : Compass and Plane Table Surveying (08 Hrs)

(a) Definition, objective and fundamental classification of surveying (Plane and Geodetic), concept of Scale, Ranging, Chaining, Offsetting and Traversing. Concept of bearing, meridian and their types, construction and use of prismatic compass, local attraction and correction for local attraction, dip, declination and calculation of true bearings.

(b) Equipment required for plane table surveying and their uses, advantages and disadvantages, methods of plane table survey: Radiation, intersection, traversing.

Unit II : Levelling and Contouring (08 Hrs)

(a) Introduction to leveling, Types of leveling, Types of bench marks, Study and use of dumpy level, auto level, digital level and laser level in construction industry, principle axes of dumpy level, testing and permanent adjustments, reciprocal leveling, curvature and refraction corrections, distance to the visible horizon.

(b) Contouring – direct and indirect methods of contouring, uses of contour maps, study and use of topo-sheets, profile leveling and cross-sectioning and their applications.

Unit III : Theodolite Surveying (08 Hrs)

(a) Study of vernier transit 20" theodolite, uses of theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles, measurement of deflection angles using transit theodolite and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite.

(b) Theodolite traversing – Computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gales traverse table. Checks, omitted measurements, area calculation by independent co-ordinates.

Unit IV : Tacheometry and Electronic Measurement Techniques (08 Hrs)

(a) Tacheometry – Application and limitations, principle of stadia tacheometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points, finding tacheometric constants. Tacheometric contouring.

(b) Surveying using Total Station – Study and use of Electronic Tacheometer (Total station) types, functions (remote elevation measurements, remote distance measurements, area measurement).

Unit V : Curves (08 Hrs)

Introduction to horizontal and vertical curves (no numerical and derivations to be asked on vertical curves and reverse curves), different types and their applications, simple and compound circular curves, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord and offsets from chords produced. Angular methods: Rankine's method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves and compound curves to be asked), Transition curves: necessity and types.

Unit VI : Construction Survey and Space Based Positioning System (SBPS) (08 Hrs)

(a) Introduction to construction survey, establishing of horizontal and vertical controls, setting out of buildings, maintaining verticality of tall buildings, survey for open traverse (roadway, railways, drainage lines, water lines, canals).

(b) Introduction to SBPS, SBPS Systems GPS, GLONASS, Galileo, GAGAN, BeiDou and their features, Segments of SBPS (Space, Control and User), applications of SBPS in surveying.

CONTENTS

Unit I : Compass and Plane Table Surveying

Chapter 1 : Compass	1.1-1.68
1.1 Introduction	1.1
1.2 Fundamental Classification of Surveying	1.1
1.3 Principles of Surveying	1.4
1.4 Scale	1.4
1.5 Ranging	1.5
1.6 Chaining	1.9
1.6.1 Chaining on Flat Ground	1.9
1.6.2 Chaining along Sloping Ground	1.9
1.7 Offsetting	1.10
1.7.1 Types of Offsets	1.10
1.7.2 Methods of Offsetting and Instruments Required for Offsetting	1.11
1.8 Traversing	1.13
1.9 Compass Surveying	1.15
1.10 Concept of Bearing, Meridian & their Types	1.15
1.11 Construction & Use of Prismatic Compass	1.16
1.11.1 Construction of a Prismatic Compass	1.16
1.11.2 Use of a Prismatic Compass	1.19
1.12 Systems of Bearing Designation	1.20
1.13 System to System Conversion of Bearings	1.21
1.14 Fore Bearing (F.B.) and Back Bearing (B.B.)	1.21
1.15 Calculation of Angles from Bearings	1.25
1.15.1 Calculation of Station Angle from Whole Circle Bearings	1.26
1.15.2 Calculation of Station Angle from Quadrantal/Reduced Bearings	1.28
1.16 Calculation of Bearings from Angles	1.30
1.17 Local Attraction	1.36
1.17.1 Detecting Local Attraction	1.37
1.17.2 Methods of Correcting Bearings of Lines Affected by Local Attraction	1.37
1.18 Dip of the Needle	1.49
1.19 Magnetic Declination	1.50
1.19.1 Concept of Declination	1.50
1.19.2 Variations in Declination	1.50
1.19.3 Referring the Declination	1.50
1.19.4 Correction for Declination	1.51
• Exercise	1.66
• University Questions	1.67
Chapter 2 : Plane Table Surveying	2.1 – 2.10
2.1 Introduction and Principle	2.1
2.1.1 Introduction	2.1
2.1.2 Principle of Plane Table Surveying	2.1
2.2 Features of Plane Table Surveying	2.1
2.3 Equipments Required for Plane Table Surveying	2.1
2.4 Temporary Adjustment of a Plane Table	2.4
2.5 Uses of the Plane Table Survey	2.6
2.6 Advantages of Plane Tabling	2.6

2.7	Disadvantages of Plane Tabling	2.6
2.8	Methods of Plane Table Survey	2.6
2.8.1	Method of Radiation	2.7
2.8.2	Method of Intersection	2.7
2.8.3	The Method of Traversing	2.8
•	Exercise	2.9
•	University Questions	2.10

Unit II : Levelling and Contouring

Chapter 3 : Levelling 3.1 – 3.62

3.1	Introduction to Levelling	3.1
3.1.1	Definition of Levelling	3.1
3.1.2	Technical Terms in Levelling	3.1
3.2	Types of Bench Marks	3.3
3.3	Study and Use of Instruments for Levelling	3.4
3.3.1	Dumpy Level	3.4
3.3.2	Auto Level	3.6
3.3.3	Laser Level	3.8
3.3.4	Digital Level	3.10
3.3.5	Levelling Staff	3.11
3.4	Types of Levelling	3.12
3.4.1	Simple Levelling	3.12
3.4.2	Compound Leveling or Differential Leveling	3.12
3.4.3	Fly Levelling and Check Levelling	3.18
3.4.4	Profile Levelling and Cross-Sectioning	3.18
3.4.5	Reciprocal Levelling	3.18
3.4.6	Trigonometric Levelling	3.19
3.4.7	Barometric Levelling	3.19
3.5	Principal Axis or Fundamental Lines of a Dumpy Level	3.31
3.6	Testing and Permanent Adjustments of a Dumpy Level	3.31
3.6.1	Principle of Reversal	3.32
3.6.2	Permanent Adjustment of Dumpy Level	3.32
3.7	Reciprocal Levelling	3.35
3.8	Correction for Curvature of Earth and Refraction	3.41
3.8.1	Curvature of Earth	3.41
3.8.2	Refraction	3.42
3.8.3	Combined Correction for Curvature and Refraction	3.42
3.9	Distance to the Visible Horizon	3.43
•	Exercise	3.57
•	University Questions	3.59

Chapter 4 : Contouring 4.1 – 4.32

4.1	Introduction to Contouring	4.1
4.1.1	Need of Contouring	4.1
4.1.2	Definition of Contour	4.1
4.1.3	Contour Interval	4.1
4.1.4	Horizontal Equivalent	4.2
4.2	Characteristics of Contour	4.2

4.3	Methods of Contouring	4.4
4.3.1	Direct Method of Contouring	4.5
4.3.2	Indirect Methods of Contouring	4.6
4.3.3	Comparison between Direct and Indirect Method of Contouring	4.8
4.4	Interpolation of Contours	4.8
4.4.1	Interpolation of Contours by Estimation	4.9
4.4.2	Interpolation of Contours by Arithmetical Calculation	4.9
4.4.3	Interpolation of Contours by Graphical Method	4.10
4.5	Uses of Contour Map	4.11
4.6	Toposheets	4.14
4.6.1	Introduction	4.14
4.6.2	Information Available on Toposheets	4.14
4.6.3	Uses of Toposheets	4.18
4.6.4	Engineering Applications of a Toposheets	4.19
4.6.5	Some Important Tips to Use a Toposheets	4.19
4.7	Profile Levelling (Longitudinal Levelling)	4.20
4.7.1	Field Work in Profile Levelling	4.21
4.7.2	Points to be Kept in Mind While Carrying out Longitudinal Sectioning	4.23
4.7.3	Plotting the Profile (Longitudinal Section)	4.23
4.7.4	Selection of a Formation Line for Working Profile	4.24
4.7.5	Calculation of Formation Levels	4.25
4.8	Cross-Sectioning	4.25
4.8.1	Plotting the Cross-Sections	4.27
4.9	Calculation of Volume of Earthwork	4.27
4.9.1	Introduction	4.27
4.9.2	Areas of Cross-sections	4.27
4.9.3	Level Section	4.28
4.9.4	Two Level Section in Cutting	4.28
4.9.5	Two Level Section in Filling	4.29
4.9.6	Side Hill Two Level Section	4.29
4.9.7	Calculation of Volumes of Earthwork	4.30
	• Exercise	4.31
	• University Questions	4.32

Unit III : Theodolite Surveying

Chapter 5 : Theodolite Surveying		5.1 – 5.32
5.1	Study of Vernier Transit 20" Theodolite	5.1
5.2	Classification of Theodolite	5.1
5.2.1	Classification as Per Capability of Telescope to Rotate in Vertical Plane	5.1
5.2.2	Classification as per Number of Spindles or Vertical Axes	5.1
5.2.3	Types of Theodolites as per Type of Scale Used	5.1
5.3	Various Uses of Theodolite	5.2
5.4	Component Parts of a Vernier Theodolite	5.2
5.5	Important Terms in Theodolite Surveying	5.4
5.6	Temporary Adjustments of a Theodolite	5.4
5.7	Measurement of Horizontal Angle with a Theodolite	5.5
5.7.1	Measurement of Horizontal Angle by Method of Repetition	5.7
5.7.2	Measurement of Horizontal Angle by Method of Reiteration	5.9
5.8	Measurement of a Vertical Angle	5.11

5.9	Measurement of Deflection Angles	5.13
5.10	Measurement of Magnetic Bearing	5.13
5.11	To Prolong a Straight Line	5.14
	5.11.1 Method of Double Fore Sighting	5.14
	5.11.2 Method of Double back Sighting	5.15
5.12	Lining in	5.15
5.13	Setting Out an Angle with the Theodolite	5.16
5.14	Fundamental Lines or Principal Axes of a Theodolite	5.22
5.15	Permanent Adjustment of a Theodolite	5.23
	5.15.1 Conditions of Permanent Adjustment of a Theodolite	5.23
	5.15.2 Procedure for Testing and Adjustment of a Theodolite	5.23
	• Exercise	5.28
	• University Questions	5.29

Chapter 6 : Theodolite Traversing **6.1 – 6.64**

6.1	Concept of Theodolite Traversing	6.1
6.2	Field Work in Theodolite Traversing	6.1
6.3	Different Methods of Running a Theodolite Traverse	6.1
	6.3.1 Determining Relative Direction of a Traverse Lines in Terms of Angle Made by Line with Adjoining Line	6.2
	6.3.2 Measuring Relative Direction of a Traverse Lines in Terms of Bearing	6.3
6.4	Locating Details in Theodolite Traversing	6.3
6.5	Checks in Theodolite Traversing	6.3
	6.5.1 Checks in Closed Traverse Survey	6.3
	6.5.2 Checks on Open Traverses	6.6
6.6	Balancing a Closed Traverse	6.7
6.7	Rules to Correct Consecutive Coordinates	6.10
6.8	Plotting of Theodolite Traverse and Independent Coordinates	6.17
	6.8.1 Working out Independent Coordinates	6.18
6.9	Calculating WCFBS and Lengths for the Lines of a Balanced Traverse	6.31
6.10	Omitted Measurements	6.35
6.11	Area Calculation by Independent Co-Ordinates	6.48
	• Exercise	6.59
	• University Questions	6.62

Unit IV : Tacheometry and Electronic Measurement Techniques

Chapter 7 : Tacheometry **7.1 – 7.50**

7.1	Introduction	7.1
	7.1.1 Definition of Tacheometry	7.1
	7.1.2 Accuracy of Tacheometry	7.1
	7.1.3 Instruments for Tacheometry	7.1
	7.1.4 Tacheometric Methods or Systems of Tacheometry	7.2
7.2	Applications of Tacheometry	7.3
7.3	Limitations and Advantages of Tacheometry	7.3
	7.3.1 Limitations of Tacheometry	7.3
	7.3.2 Advantages of Tacheometry	7.3
7.4	Principle of Stadia Tacheometry	7.4

7.5	Fixed Stadia Tacheometry	7.4
7.5.1	Distance Elevation Formulae when Line of Sight Horizontal and Stadia Rod (or Staff) Held Vertical	7.5
7.5.2	Distance Elevation Formulae When the Line of Sight is Inclined to the Horizontal and the Staff is Held Vertical	7.7
7.6	To Determine the Constants of a Tacheometer	7.24
7.7	Tacheometric Contouring	7.30
7.7.1	Basic Steps in Tacheometric Contour Survey	7.30
7.7.2	Equipments Required for Tacheometric Contour Survey	7.30
7.7.3	Field Party for Tacheometric Contour Survey	7.30
7.7.4	Field Work Tacheometric Contour Survey	7.31
	• Exercise	7.46
	• University Questions	7.47

Chapter 8 : Total Station Surveying **8.1 – 8.32**

8.1	Introduction	8.1
8.2	The Electronic Total Station (ETS)	8.2
8.2.1	Construction of a Total Station	8.3
8.2.2	Types of Total Stations	8.4
8.2.3	Advantages of a Total Station	8.5
8.2.4	Features of Electronic Total Station (ETS)	8.6
8.2.5	The Prism Reflector	8.8
8.2.6	Fundamental Measurements Made by a Total Station	8.10
8.2.7	Some Common Onboard Programs Available With ETS Instruments	8.11
8.2.8	Uses of a Total Station	8.18
8.2.9	Factors Affecting Use of an ETS	8.19
8.2.10	Temporary Adjustments of a Total Station	8.19
8.2.11	Recording Measurements with a Total Station	8.19
8.2.12	Generalized Procedure for Survey with a Total Station	8.22
8.2.13	Softwares Essentially Required With a Total Station	8.23
8.2.14	Errors in Total Station Surveying	8.24
8.2.15	Mistakes in Total Station Surveying	8.29
	• Exercise	8.31
	• University Questions	8.31

Unit V : Curves

Chapter 9 : Curves **9.1 – 9.70**

9.1	Introduction	9.1
9.1.1	Definition of a Curve	9.1
9.1.2	Object behind Provision of Curve	9.1
9.1.3	Principle Types of Curve	9.1
9.2	Horizontal Curve	9.1
9.2.1	Types of Horizontal Curve	9.1
9.2.2	Principle Points, Lines and Angles on Simple Circular Curve	9.3
9.2.3	Working out Magnitudes of Angle of Intersection and Central Angle	9.4
9.2.4	Elements of Circular Curve	9.5
9.2.5	Nomenclature for Circular Curve	9.7
9.2.6	Relation between Radius and Degree of a Curve	9.7
9.2.7	Working out Chainages of Tangent Points T_1 and T_2	9.8

9.2.8	Concept of Peg Interval	9.11
9.2.9	Concept of Unit Chord and Sub-chord	9.11
9.2.10	Working out Length of Sub Chords and Number of Unit Chords	9.11
9.3	Vertical Curves	9.12
9.3.1	Definition	9.12
9.3.2	Necessity of Vertical Curves	9.12
9.3.3	Types of Vertical Curves	9.13
9.4	Methods of Ranging/Setting out for Horizontal (Simple Circular) Curves	9.14
9.4.1	Linear Methods of Curve Ranging	9.14
9.5	Angular Methods of Curve Ranging	9.32
9.5.1	Rankine's Method of Tangential/Deflection Angles	9.32
9.5.2	Two Theodolite Method	9.38
9.6	Compound Curves	9.39
9.6.1	Elements of Compound Curve	9.40
9.6.2	Working out Chainages of Key or Control Points for a Compound Curve	9.41
9.6.3	Field Procedure to Set out a Compound Curve	9.41
9.7	Transition Curve	9.45
9.7.1	Introduction and Definition	9.45
9.7.2	Necessity of the Transition Curve	9.46
9.7.3	Functions of the Transition Curves	9.46
9.7.4	Advantages of Transition Curve	9.46
9.7.5	Requirements of an Ideal Transition Curve	9.46
9.7.6	Types of the Transition Curve	9.47
	• Exercise	9.67
	• University Questions	9.68

Unit VI : Construction Survey and Space Based Positioning System (SBPS)

Chapter 10 : Construction Survey 10.1 – 10.38

10.1	Introduction	10.1
10.2	Horizontal and Vertical Controls in Construction Surveys	10.1
10.2.1	Equipments for Construction Surveys	10.2
10.3	Setting out a Building	10.2
10.3.1	Setting/Lining out for a RCC Framed Building with Conventional Instruments	10.4
10.3.2	Setting/Lining out for a RCC Framed Building with a Total Station	10.6
10.4	Maintaining Verticality of Tall Buildings	10.7
10.4.1	Checking Verticality of a Building Edge with a Theodolite	10.7
10.4.2	Checking Verticality of a Building Edge with a Total Station	10.10
10.5	Survey for Road/Railway	10.11
10.5.1	Road/Railway Alignment	10.11
10.5.2	Steps in Survey for a Road/Railway	10.12
10.6	Survey for Drainage Line	10.23
10.6.1	Introduction	10.23
10.6.2	Objectives of Survey for Drainage Lines	10.23
10.6.3	Steps in Survey for Drainage Lines	10.24
10.6.4	Use of Laser Aligner in Laying Down a Drainage Pipe Line	10.27

10.7	Survey for Water Lines	10.28
10.7.1	Introduction	10.28
10.7.2	Objectives of Survey for Water Lines	10.29
10.7.3	Steps in Survey for Water Lines	10.29
10.8	Survey for Canal	10.30
10.8.1	Introduction	10.30
10.8.2	Points to be Borne in Mind, while Marking Alignment of Canals on Toposheets	10.31
10.8.3	Reconnaissance Survey for Canal	10.31
10.8.4	Preliminary Survey	10.32
10.8.5	Final Location Survey	10.33
10.8.6	Position of Slope Stake for Embankment or Cutting	10.33
10.9	Errors and Mistakes in Construction Survey	10.35
10.9.1	Error in Construction Surveys	10.35
10.9.2	Mistakes in Construction Surveys	10.36
	• Exercise	10.36
	• University Questions	10.38
Chapter 11 : Space Based Positioning System (SBPS)		11.1 – 11.20
11.1	Introduction	11.1
11.1.1	Limitations of Prevalent Surveying Techniques	11.1
11.1.2	Advantages of Space Based Positioning Systems	11.1
11.2	The Space Based Positioning Systems in Action	11.2
11.3	The Global Positioning System (GPS)	11.3
11.4	The Global Navigation and Surveying System (GLONASS)	11.7
11.5	The Galileo	11.8
11.6	BeiDou	11.8
11.6.1	Introduction	11.8
11.6.2	BeiDou-2	11.9
11.7	GAGAN and IRNSS	11.10
11.7.1	GAGAN	11.10
11.8	Segments of Space Based Positioning Systems	11.12
11.8.1	The Space Segment	11.12
11.8.2	The Control Segment	11.13
11.8.3	User Segment	11.13
11.9	Applications of SBPS	11.13
11.9.1	General Applications of SBPS	11.14
11.9.2	Applications of SBPS in Surveying	11.14
11.9.3	Surveying with SBPS	11.14
	• Exercise	11.20
	• University Questions	11.20
• Sample Questions Paper (End. Sem. Theory Exam. 50 Marks)		SQP.1 – SQP.2



Unit I : Compass and Plane Table Surveying

Chapter 1

COMPASS

1.1 INTRODUCTION

In the process of planning, design execution of any kind of the civil engineering project on land, we shall know shape, sizes, area, unevenness at the surface of that land and details of natural and man made features on that parcel of the land. To know these things about the land we require collecting some measurements of land in horizontal and vertical plane. Here the surveying becomes necessary to an engineer. Surveying is unavoidable almost in all kind of civil engineering projects. Every civil engineer shall know in details the process of surveying. Hence surveying is one of the main concerns of a civil engineer. This subject will acquaint the concerned about the principles, concepts, facts, and procedures in Surveying.

Definition of Surveying

Surveying is an art and science of making measurements on the surface of earth to determine relative position of the points in horizontal as well in vertical plane, in order to prepare maps, plan or sections.

Objectives of Surveying

- To find out horizontal or vertical distance between two points or places or objects.
- To find out direction of a line joining two points or places or objects.
- To determine relative positions of points or places or objects in horizontal plane.
- To prepare plan or map for the allotted area.
- To determine relative positions of points or places or objects in vertical plane.
- To prepare relief plan/map and the sections at given locations for the allotted area.
- To find out the area of field.
- To divide and re-divide piece of land.
- To define and redefine boundaries of piece of land.
- To work out volumes.

1.2 FUNDAMENTAL CLASSIFICATION OF SURVEYING

Based upon the consideration of the shape of the earth, surveying is fundamentally classified as :

1. Plane surveying
2. Geodetic surveying.

1. Plane Surveying

In plane surveying, the mean surface of the earth is considered as a plane and the spheroidal shape is neglected. The earth's surface is considered as a plane, the line connecting any two points as a straight line and the angles of polygons as plane angles. The degree of accuracy required in this type of surveying is comparatively low. As a rough estimate, American surveyors put the limit 250 km^2 for treating the survey as plane. Most of the civil engineering works are concerned only with a small portion of the earth which seems to be plane surface.

2. Geodetic Surveying

In Geodetic surveying the curvature of earth is taken into consideration while making measurements on the earth surface. Hence use of spherical trigonometry and highly refined instruments are needed. In Geodetic surveys distances measured are along the arc of great circle and the angles measured are spherical angles.

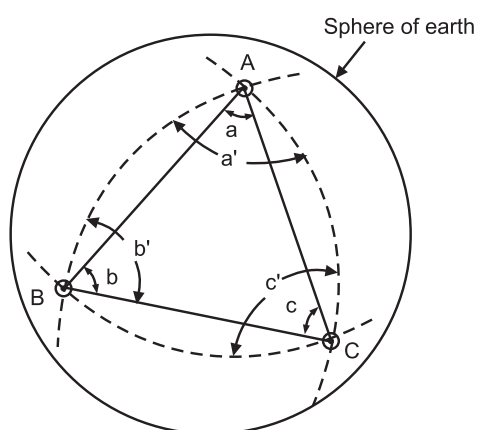


Fig. 1.1 : Plane and spherical triangles

ΔABC formed by straight and continuous lines is a plane triangle.

ΔABC formed by curved and dotted lines is a spherical triangle.

Straights AB, BC and CA are sides of the plane ΔABC .

Arcs AB, BC and CA are sides of the spherical ΔABC .

$\angle a$, $\angle b$ and $\angle c$ are the angles of the plane ΔABC .

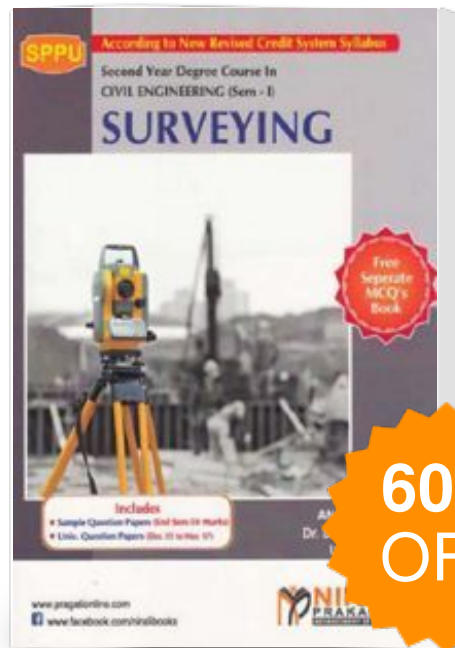
$\angle a'$, $\angle b'$ and $\angle c'$ are the angles of the spherical ΔABC .

It is observed that there is only a difference of 0.1 m in a length of arc and its corresponding chord on earth's surface in 18.2 km. The sum of angles of spherical triangle and its corresponding plane triangle differs only 1 second on the earth's surface over the area of 195.5 sq.km. Thus the American surveyors' suggest assuming the area to be surveyed as plane if its area is not likely to exceed 265.5 Sq. km. (10 miles x 10 miles).

The technique of Geodetic surveying is used to set up the network of the control stations over a wide spread area in multiples of 265.5 Sq. km, like that of a district or a state or a country. Triangulation and Trilateration are the principal methods of geodetic surveying.

Few Points of Differences between Geodetic Surveying and Plane Surveying are tabulated below.

A Text Book Of Surveying



Publisher : **Nirali Prakashan**

ISBN : 9789386084040

Author : A. S. Shelar, Dr. S.
T. Mali, U. S. Patil

Type the URL : <http://www.kopykitab.com/product/21097>



Get this eBook