



# ELEMENTS OF CIVIL ENGINEERING

By  
DR. Anurag Kandya

**Edition** : 3<sup>rd</sup> Edition : 2017 (First Reprint)  
**ISBN** : 9789385039072  
**Size** : 170 mm x 235 mm  
**Binding** : Paperback  
**Pages** : 704 + 20 = 724



₹ 400.00 **BUY**

## ABOUT THE BOOK

This is a single comprehensive book of its kind designed primarily to provide a clear-cut, contemporary and stimulating text in a convenient form for the first year engineering students. It provides quite modern and up-to-date coverage of the science and art of Civil Engineering which are changing rapidly. With the inclusion of the worked out examples, the book is almost a 'self-teaching' text material.

The book has been divided into 5 sections namely *Engineering Materials*, *Building Construction* (including Earthquake Resistant Structures), *Surveying and Levelling*, *Transportation engineering* and *Environmental Engineering* (including Global Environmental Problems).

*It begins with an Introduction to Engineering and spreads in 45 chapters. It contains:*

- \* 700 Self-explanatory and neatly drawn diagrams
- \* 145 Useful tables
- \* 425 Questions at the end of the chapters

A detailed list of *various signs and symbols used in civil engineering drawings* (as per Indian standards) has been included in the Appendix. A very extensive glossary of the key words used in civil engineering has been prepared which would greatly help the students in learning the fundamentals of the subject. Search engine, provided at the end, will facilitate the students to quickly find the topics of their interest.

Almost all topics and sub-topics consist of 'memory maps' – the first of their kind. These memory maps consist of key words and will help the readers to crystallize the important points in their minds, thereby helping them to structure their answers in the examinations.

The book almost covers the syllabi prescribed by the various Universities of India for the subjects ELEMENTS OF CIVIL ENGINEERING/BASIC CIVIL ENGINEERING and partially that of MATERIAL SCIENCE and CIVIL ENGINEERING GRAPHICS. It would be of immense help to the students preparing for Degree, Diploma or A.M.I.E. Examinations and various Boards of Technical Education. It should also prove a great asset to the students preparing for U.P.S.C. examinations. Questions from various university examination papers and competition examinations are discussed in the respective chapters. Neatly drawn sketches should definitely make the understanding of the students crystal-clear.

## CONTENT

- 1: INTRODUCTION TO ENGINEERING
- PART I : ELEMENTS OF ENGINEERING MATERIALS**
- 2: ENGINEERING MATERIALS
- 3: ORGANIC MATERIALS 8 : TILES
- 4: TIMBER 9 : REFRACTORIES
- 5: CERAMICS 10 : CEMENT
- 6: ROCKS AND STONES 11 : CONCRETE
- 7: BRICKS 12 : GLASS
- 13: PAINTS, VARNISHES AND DISTEMPERS
- PART II : ELEMENTS OF BUILDING CONSTRUCTION**
- 14: BUILDINGS AND THEIR CLASSIFICATIONS
- 15: FUNCTIONAL REQUIREMENTS OF A BUILDING
- 16: PRINCIPLES OF PLANNING OF A BUILDING
- 17: BRICK MASONRY
- 18: FLOORS AND FLOORINGS
- 19: DOORS AND WINDOWS
- 20: STAIRS
- 21: ROOFS
- 22: LOADS ON A STRUCTURE
- 23: FOUNDATIONS
- 24: EARTHQUAKE AND EARTHQUAKE RESISTANT STRUCTURES
- PART III : ELEMENTS OF SURVEYING AND LEVELLING**
- 25: BASICS OF SURVEYING
- 26: TOOLS OF SURVEYING
- 27: SCALES
- 28: CHAINING AND RANGING
- 29: LINEAR MEASUREMENTS
- 30: COMPASS SURVEYING
- 31: LEVELLING
- 32: CONTOURING
- 33: AREA AND VOLUME
- 34: THEODOLITE
- 35: RECENT ADVANCEMENTS IN SURVEYING
- PART IV : ELEMENTS OF TRANSFORMATION ENGINEERING**
- 36: TRANSPORTATION ENGINEERING
- 37: DEVELOPMENT OF ROADS IN INDIA
- 38: HIGHWAY CONSTRUCTION
- 39: TRAFFIC ENGINEERING
- 40: RAILWAY ENGINEERING
- 41: BRIDGES
- 42: TUNNELS
- PART V : ELEMENTS OF ENVIRONMENTAL ENGINEERING**
- 43: BASICS OF ENVIRONMENT
- 44: OUR RESOURCES
- 45: GLOBAL ENVIRONMENTAL PROBLEMS
- APPENDIX A TO APPENDIX C
- INDEX

Catalogue Checklist

Charotar Publishing House Pvt. Ltd. Opposite Amul Dairy, Civil Court Road, ANAND 388 001 India

+91 2692 256237, 240089, +91 99249 78998 charotar@cphbooks.com, https://cphbooks.in

Follow us:

/charotar /cphpl1511 /charotarpub /in/charotar

**ELEMENTS OF CIVIL ENGINEERING**  
**DETAILED CONTENTS**

**Chapter 1 INTRODUCTION TO ENGINEERING**

- 1-1. Introduction
  - 1-2. Engineering and its various branches
  - 1-3. Modern engineering trends
  - 1-4. Civil engineering and its branches
  - 1-5. Civil engineering and basic human needs
  - 1-6. Role of a civil engineer
  - 1-7. Necessity and role of Indian Standards (I.S.) in civil engineering
- Questions I

**PART ONE : ELEMENTS OF ENGINEERING MATERIALS**

**Chapter 2 ENGINEERING MATERIALS**

- 2-1. Introduction
  - 2-2. Classification of engineering materials
  - 2-3. Properties of engineering materials
    - 2-3-1. Mechanical properties
    - 2-3-2. Thermal properties
    - 2-3-3. Electrical properties
    - 2-3-4. Magnetic properties
    - 2-3-5. Chemical properties
    - 2-3-6. Optical properties
    - 2-3-7. Physical properties
    - 2-3-8. Technological properties
- Selection of materials
- Questions II

**Chapter 3 ORGANIC MATERIALS**

- 3-1. Introduction
  - 3-2. Monomers and polymers
  - 3-3. Structure of polymers
  - 3-4. Synthesis of polymers
  - 3-5. Additives in polymers
  - 3-6. Strengthening mechanism of polymers
  - 3-7. Plastics
    - 3-7-1. History of plastics
    - 3-7-2. General properties of plastics
    - 3-7-3. Types of plastics
    - 3-7-4. Important types of plastics
    - 3-7-5. Uses of plastics
    - 3-7-6. Manufacturing plastic products
    - 3-7-7. Plastics and the environment
  - 3-8. Elastomers (rubber)
    - 3-8-1. Types of rubber
    - 3-8-2. Vulcanization of rubber
    - 3-8-3. Modern manufacturing processes of natural rubber articles
    - 3-8-4. Uses of rubber
- Questions III

**Chapter 4 TIMBER**

- 4-1. Introduction
  - 4-2. Timber as a constructional material
  - 4-3. Classification of trees
  - 4-4. Soft wood and hard wood
  - 4-5. Properties of a good timber
  - 4-6. Processing of timber
  - 4-7. Market forms of timber
  - 4-8. Industrial timber
  - 4-9. Indian timber
- Questions VI

**Chapter 5 CERAMICS**

- 5-1. Introduction
  - 5-2. Ceramics and silicates
  - 5-3. Silicate structures
  - 5-4. Classification of ceramic material
  - 5-5. Properties of ceramic materials
  - 5-6. Applications of ceramics
- Questions V

**Chapter 6 ROCKS AND STONES**

- 6-1. Introduction
  - 6-2. Classification of rocks
    - 6-2-1. Geological classification of rocks
    - 6-2-2. Physical classification of rocks
    - 6-2-3. Chemical classification of rocks
  - 6-3. Requirements of a good building stone
  - 6-4. Quarry and quarrying
- Questions VI

**Chapter 7 BRICKS**

- 7-1. Introduction
  - 7-2. Composition of brick earth
  - 7-3. Harmful ingredients of brick earth
  - 7-4. Manufacture of bricks
  - 7-5. Properties of good bricks
  - 7-6. Classification of bricks
  - 7-7. Tests for bricks
- Questions VII

**Chapter 8 TILES**

- 8-1. Introduction
  - 8-2. Ingredients of tiles
  - 8-3. Manufacturing process of tiles
  - 8-4. Uses of tiles
  - 8-5. Characteristics of a good tile
- Questions VIII

**Chapter 9 REFRACTORIES**

- 9-1. Introduction
  - 9-2. Desirable properties of refractories
  - 9-3. Classification of refractories
  - 9-4. Manufacture of refractories
  - 9-5. Uses of refractories
  - 9-6. High temperature refractory materials
- Questions IX

**Chapter 10 CEMENT**

- 10-1. Introduction
  - 10-2. Chemical composition of ordinary cement
  - 10-3. Cement compounds
  - 10-4. Manufacture of cement
  - 10-5. Production of cement
  - 10-6. Testing of cement
  - 10-7. Types of cement
- Questions X

**Chapter 11 CONCRETE**

- 11-1. Introduction
  - 11-2. Ingredients of concrete
  - 11-3. Reinforced cement concrete
  - 11-4. Prestressed cement concrete
  - 11-5. Requirements of a good concrete
  - 11-6. Water-cement ratio
  - 11-7. Workability
  - 11-8. Curing
  - 11-9. Grades of concrete
  - 11-10. Concrete as a construction material
- Questions XI

**Chapter 12 GLASS**

- 12-1. Introduction
  - 12-2. Composition of glass
  - 12-3. Classification of glass
  - 12-4. Properties of glass
  - 12-5. Manufacture of glass
  - 12-6. Types of commercial glass
  - 12-7. Special types of glasses
- Questions XII

### Chapter 13 PAINTS, VARNISHES AND DISTEMPERS

- 13-1. Introduction
- 13-2. Paints
- 13-3. Varnishes
- 13-4. Distempers
- Questions XIII

## PART TWO : ELEMENTS OF BUILDING CONSTRUCTION

### Chapter 14 BUILDINGS AND THEIR CLASSIFICATIONS

- 14-1. Introduction to buildings
- 14-2. Classification of buildings according to national building code (NBC)
- 14-3. Urban buildings
- 14-4. Rural buildings
- 14-5. Load bearing structures
- 14-6. Framed structures
- 14-7. Composite structures
- 14-8. Comparison of load bearing structures and framed structures
- Questions XIV

### Chapter 15 FUNCTIONAL REQUIREMENTS OF A BUILDING

- 15-1. Introduction
- 15-2. Basic requirements of a building
- 15-3. Components of a building with their basic requirements
- 15-4. Requirements of various buildings
  - 15-4-1. Requirements of a residential building
  - 15-4-2. Requirements of a hostel
  - 15-4-3. Requirements of a hotel
  - 15-4-4. Requirements of a school
  - 15-4-5. Requirement of a library
  - 15-4-6. Requirements of a shopping centre
  - 15-4-7. Requirements of an industrial building
  - 15-4-8. Requirements of banks
- Questions XV

### Chapter 16 PRINCIPLES OF PLANNING OF A BUILDING

- 16-1. Introduction
- 16-2. Principles of planning
- 16-3. Practical considerations
- 16-4. Orientation criteria under Indian conditions
- 16-5. Optimum orientation of buildings
- 16-6. Vaastu Shilpa shastra
  - 16-6-1. Principles of site selection according to vaastu shastra
  - 16-6-2. Principles of planning according to vaastu shastra
- Questions XVI

### Chapter 17 BRICK MASONRY

- 17-1. Introduction
- 17-2. Fundamentals of brick masonry
- 17-3. Necessity of a proper bond
- 17-4. Principles of a good bond in brick work
- 17-5. General principles for brick masonry
- 17-6. Bonds in brick work
  - 17-6-1. Stretcher bond
  - 17-6-2. Header bond
  - 17-6-3. English bond
  - 17-6-4. Flemish bond
  - 17-6-5. Garden wall bond
  - 17-6-6. Raking bond
  - 17-6-7. Dutch bond
  - 17-6-8. English cross bond
  - 17-6-9. Facing bond
- Questions XVII

### Chapter 18 FLOORS AND FLOORINGS

- 18-1. Introduction
- 18-2. Fundamentals of flooring
- 18-3. Factors affecting the choice of flooring materials
- 18-4. Construction of ground floors
- 18-5. Construction of upper floors
- Questions XVIII

### Chapter 19 DOORS AND WINDOWS

- 19-1. Introduction
- 19-2. Location of doors and windows
- 19-3. Technical terms
- 19-4. Types of doors
- 19-5. Types of windows
- Questions XIX

### Chapter 20 STAIRS

- 20-1. Introduction
- 20-2. Technical terms used in stairs
- 20-3. Requirements of a good staircase
- 20-4. Types of stairs
- Questions XX

### Chapter 21 ROOFS

- 21-1. Introduction
- 21-2. Requirements of a good roof
- 21-3. Fundamentals of roofs
- 21-4. Classification of roofs
- 21-5. Roof coverings for pitched roofs
- Questions XXI

### Chapter 22 LOADS ON A STRUCTURE

- 22-1. Introduction
- 22-2. Types of loads
- Questions XXII

### Chapter 23 FOUNDATIONS

- 23-1. Introduction
- 23-2. Functions of foundation
- 23-3. Requirements of a good foundation
- 23-4. Types of foundations
- 23-5. Shallow foundations
- 23-6. Dimension detailing of shallow foundations
- 23-7. Deep foundations
- 23-8. Necessity of deep foundations / pile foundations
- 23-9. Different types of deep foundations
- 23-10. Machine foundation
- 23-11. Causes of failure of foundations
- Questions XXIII

### Chapter 24 EARTHQUAKE AND EARTHQUAKE RESISTANT STRUCTURES

- 24-1. Introduction
- 24-2. Fundamentals of an earthquake
- 24-3. Classification of an earthquake
- 24-4. Causes of earthquakes
- 24-5. Effects of an earthquake
- 24-6. Predicting earthquakes
- 24-7. Earthquake statistics
- 24-8. Seismic map of India
- 24-9. Earthquake resistant structures
- 24-10. General design principles of earthquake resistant structures
- 24-11. Earthquake: Do's and Don'ts
- Questions XXIV

## PART THREE : ELEMENTS OF SURVEYING AND LEVELLING

### Chapter 25 BASICS OF SURVEYING

- 25-1. Introduction
- 25-2. Primary divisions of surveying
- 25-2-1. Plane surveying
- 25-2-2. Geodetic surveying
- 25-3. Classification of surveying
- 25-4. Principles of surveying
- Questions XXV

### Chapter 26 TOOLS OF SURVEYING

- 26-1. Introduction
- 26-2. Various instruments of surveying
- Questions XXVI

### Chapter 27 SCALES

- 27-1. Introduction
- 27-2. Different types of scales
- Questions XXVII

### Chapter 28 CHAINING AND RANGING

- 28-1. Introduction
- 28-2. Fundamentals of chain surveying
- 28-3. Selection of survey stations
- 28-4. Instruments required in a chain survey
- 28-5. Procedure for carrying out chain survey
- 28-6. Entering data in a field-book
- 28-7. Ranging
- 28-8. Different types of ranging
- Questions XXVIII

### Chapter 29 LINEAR MEASUREMENTS

- 29-1. Introduction
- 29-2. Methods of linear measurements
- 29-3. Chaining on a plain ground
- 29-4. Chaining on a sloping ground
- 29-5. Obstacles in linear measurement
- 29-6. Numericals: Related to obstacles in chaining and ranging
- 29-7. Errors in linear measurement
- 29-7-1. Sources of errors
- 29-7-2. Nature of errors
- 29-7-3. Various types of errors
- 29-7-4. Summary of corrections
- 29-7-5. Testing and adjusting the chain
- 29-8. Numericals: Related to errors in linear measurement
- Questions XXIX

### Chapter 30 COMPASS SURVEYING

- 30-1. Introduction
- 30-2. Fundamentals of compass surveying
- 30-3. Traverse
- 30-4. Meridians
- 30-5. Bearing
- 30-6. Methods of designating the bearings
- 30-7. Fore bearing and back bearing
- 30-8. Calculation of included angles from bearings
- 30-9. Magnetic compass
- 30-9-1. Temporary adjustments of a compass
- 30-10. Magnetic declination
- 30-10-1. Determination of true bearing from magnetic declination
- 30-10-2. Variation of the magnetic declination
- 30-11. Local attraction
- 30-12. Chain and compass survey
- 30-12-1. Plotting of a compass survey
- 30-12-2. Closing error

- 30-13. Steps to solve the closed traverse in compass surveying
- 30-14. Typical problems on compass surveying
- 30-15. Steps to solve an open traverse in compass surveying
- 30-16. Few important comparisons
- Questions XXX

### Chapter 31 LEVELLING

- 31-1. Introduction
- 31-2. Fundamentals of levelling
- 31-3. Instruments used for levelling
- 31-3-1. Level
- 31-3-2. Levelling staff
- 31-4. Benchmarks
- 31-5. Classification of levelling
- 31-5-1. Direct levelling
- 31-5-2. Indirect levelling
- 31-6. Temporary adjustments of a dumpy level
- 31-7. Calculation of reduced level
- 31-8. Typical problems
- Questions XXXI

### Chapter 32 CONTOURING

- 32-1. Introduction
- 32-2. Fundamentals of contouring
- 32-3. Factors affecting the Contour Interval
- 32-4. Methods of location of contour
- 32-4-1. Direct method
- 32-4-2. Indirect methods
- 32-5. Contour of natural features
- 32-6. Characteristics of contours
- 32-7. Uses of contour maps
- Questions XXXII

### Chapter 33 AREA AND VOLUME

- 33-1. Introduction
- 33-2. Methods of area computation
- 33-3. Planimeter
- 33-3-1. Parts of an amsler polar planimeter
- 33-3-2. Working of a planimeter
- 33-3-3. Zero circle
- 33-3-4. Computation of area of zero circle
- 33-3-5. Determination of multiplying constant M
- 33-4. Methods of volume computation
- 33-5. Estimation of reservoir capacity
- 33-6. Summary of the formulae
- Questions XXXIII

### Chapter 34 THEODOLITE

- 34-1. Introduction
- 34-2. Types of theodolite
- 34-3. Essential parts of a theodolite
- 34-4. Fundamentals of a theodolite
- 34-5. Temporary adjustments of theodolite
- 34-6. Angular measurements by a theodolite
- Questions XXXIV

### Chapter 35 RECENT ADVANCEMENTS IN SURVEYING

- 35-1. Introduction
- 35-2. Necessity of electronic distance meter
- 35-3. Electronic Distance Meter (E.D.M.)
- 35-4. Remote sensing
- 35-4-1. Working principle of remote sensing
- 35-4-2. Applications of remote sensing
- Questions XXXV

## PART FOUR : ELEMENTS OF TRANSPORTATION ENGINEERING

### Chapter 36 TRANSPORTATION ENGINEERING

- 36-1. Introduction
  - 36-2. Role and importance of transportation in national development
  - 36-3. Comparison of different modes of transportation
  - 36-4. Different modes of transportation
    - 36-4-1. Airways
    - 36-4-2. Waterways
    - 36-4-3. Railways
    - 36-4-4. Roadways/highways
- Questions XXXVI

### Chapter 37 DEVELOPMENT OF ROADS IN INDIA

- 37-1. Introduction
  - 37-2. Major road development plans
  - 37-3. Classification of roads
  - 37-4. Minor classification of roads
- Questions XXXVII

### Chapter 38 HIGHWAY CONSTRUCTION

- 38-1. Introduction
  - 38-2. Highway materials
  - 38-3. Highway pavements
  - 38-4. Functions of pavement components
  - 38-5. Cross-sectional elements of highway
  - 38-6. Low cost roads
  - 38-6-1. Different types of low cost roads
- Questions XXXVIII

### Chapter 39 TRAFFIC ENGINEERING

- 39-1. Introduction
  - 39-2. Objectives of traffic engineering
  - 39-3. Traffic surveys
  - 39-4. Traffic control devices
- Questions XXXIX

### Chapter 40 RAILWAY ENGINEERING

- 40-1. Introduction
  - 40-2. Comparison of railways and roadways
  - 40-3. Classification of Indian railways
  - 40-4. Classification of Indian railways based on Speed Criterion
  - 40-5. Railway track/permanent way
  - 40-6. Parts of a railway track/permanent way
- Questions XL

### Chapter 41 BRIDGES

- 41-1. Introduction
  - 41-2. Components of a bridge
  - 41-3. Types of bridges
  - 41-4. Bridge planning and construction
- Questions XLI

### Chapter 42 TUNNELS

- 42-1. Introduction
  - 42-2. Different types of tunnels
  - 42-3. Modern tunnelling methods
  - 42-4. Hazards of tunnel construction
  - 42-5. Famous tunnels of the world
- Questions XLII

## PART FIVE : ELEMENTS OF ENVIRONMENTAL ENGINEERING

### Chapter 43 BASICS OF ENVIRONMENT

- 43-1. Introduction
  - 43-2. Fundamentals of environment
  - 43-3. Components of environment
  - 43-4. Biodiversity
  - 43-5. Ecosystem and its components
  - 43-6. Ecosystem and its various types
  - 43-7. Ecological pyramids
  - 43-8. Biomagnification
  - 43-9. The biosphere and its functioning
  - 43-10. Role of various species in an ecosystem
  - 43-11. Ecological balance
  - 43-12. Role of forests in maintaining the ecological balance
- Questions XLIII

### Chapter 44 OUR RESOURCES

- 44-1. Introduction
  - 44-2. Various types of resources
  - 44-3. Energy sources
    - 44-3-1. Conventional energy sources
    - 44-3-2. Non-conventional energy sources
- Questions XLIV

### Chapter 45 GLOBAL ENVIRONMENTAL PROBLEMS

- 45-1. Introduction
  - 45-2. Pollution and pollutants
  - 45-3. Various types of pollutions
    - 45-3-1. Air pollution
    - 45-3-2. Water pollution
    - 45-3-3. Noise pollution
    - 45-3-4. Land pollution
    - 45-3-5. Thermal pollution
    - 45-3-6. Population pollution
  - 45-4. Human interference in the ecological balance
  - 45-5. Global environmental problems
    - 45-5-1. Ozone depletion
    - 45-5-2. Green house effect
    - 45-5-3. Acid rain
  - 45-6. Individual's role in curbing the environmental problems
- Questions XLV

### Appendix A To Appendix C

#### Appendix A SIGNS AND SYMBOLS FOR CIVIL ENGINEERING DRAWINGS

- A-1 Signs and symbols for civil engineering drawings (as per I.S.: 962-1967)
  - Table A-1 Symbols for various materials (in section)
  - Table A-2 Types of lines and their uses
  - Table A-3 Symbols for windows
  - Table A-4 Symbols for doors
  - Table A-5 Symbols for electrical installations
  - Table A-6 Symbols for sanitary installations
  - Table A-7 Symbols for fitments
  - Table A-8 Symbols for land surveying
  - Table A-9 Specimens of north direction

### Appendix B GLOSSARY

### Appendix C CONVERSION FACTORS IN MEASUREMENTS

- Table C-1 Length
- Table C-2 Area
- Table C-3 Volume
- Table C-4 Weight

### Index