



**FIFTH SEMESTER  
CIVIL ENGINEERING**

# REINFORCED CONCRETE DESIGN

L	T	P
6	-	-

Subject Code : 025003

## RATIONALE

This subject is an applied engineering subject. Diploma holders in Civil Engineering will be required to supervise RC Construction and fabrication. He may also be required to design simple structural elements, make changes in design depending upon availability of materials (bars of different diameters). This subject thus deals with elementary design principles as per IS:456-2000

## DETAILED CONTENTS

- 1. Introduction (03 periods)**
  - 1.1 Concept of Reinforced Cement Concrete (RCC)
  - 1.2 Reinforcement Materials:
    - Suitability of steel as reinforcing material
    - Properties of mild steel and HYSD steel
  - 1.3 Loading on structures as per IS: 875
- 2. Introduction to following methods of RCC design (03 periods)**
  - 2.1 Working stress method
  - 2.2 Limit state method
- 3. Shear and Development Length (05 periods)**

Shear as per IS:456-2000 by working stress method

  - i) Shear strength of concrete without shear reinforcement
  - ii) Maximum shear stress
  - iii) Shear reinforcement
- 4. Singly Reinforced Beam (Working stress method) (12 periods)**
  - 4.1 Basic assumptions and stress strain curve, neutral axis, balanced, under-reinforcement and over reinforced beams, Moment of resistance for singly reinforced beam.
  - 4.2 Design of singly reinforced beam including sketches showing reinforcement details.
- 5. Concept of Limit State Method (09 periods)**
  - 5.1 Definitions and assumptions made in limit state of collapse (flexure)
  - 5.2 Partial factor of safety for materials

- 5.3 Partial factor of safety for loads
- 5.4 Design loads
- 5.5 Stress block, parameters

**6. Singly Reinforced beam (11 periods)**

- 6.1 Theory and design of singly reinforced beam by Limit State Method.
- 6.2 Check for shear, Check for deflection, check for development length

**7. Doubly Reinforced Beams (11 periods)**

Theory and design of simply supported doubly reinforced rectangular beam by Limit State Method

**8. Study of Beams (05 periods)**

Behaviour of T beam, inverted T beam, isolated T beam and „L“ beams (No Numericals)

**9. One Way Slab (11 periods)**

- 9.1 Theory and design of simply supported one way slab including sketches showing reinforcement details (plan and section) by Limit State Method.
- 9.2 Check for shear, Check for deflection,

**10. Two Way Slab (11 periods)**

Theory and design of two-way simply supported slab with corners free to lift, no provisions for torsional reinforcement by Limit State Method including sketches showing reinforcement details (plan and two sections)

**11. Axially Loaded Column (11 periods)**

- 11.1 Definition and classification of columns
- 11.2 Effective length of column,
- 11.3 Specifications for longitudinal and lateral reinforcement
- 11.4 Design of axially loaded square, rectangular and circular short columns by Limit State Method including sketching of reinforcement (sectional elevation and plan)

**12. Prestressed Concrete (04 periods)**

- 12.1. Concept of pre-stressed concrete
- 12.2. Methods of pre-stressing : pre-tensioning and post tensioning
- 12.3. Advantages and disadvantages of prestressing
- 12.4. Losses in pre-stress Important

**Note: Use of IS: 456-2000 is permitted in the examination.**

## INSTRUCTIONAL STRATEGY

Teachers are expected to give simple problems for designing various RCC structural members. For creating comprehension of the subject, teachers may prepare tutorial sheets, which may be given to the students for solving. It would be advantageous if students are taken at construction site to show form work for RCC as well as placement of reinforcement in various structural members. Commentary on BIS:456 may be referred along with code for relevant clauses.

## RECOMMENDED BOOKS

1. Punmia, BC; "Reinforced Concrete Structure Vol I", Standard Publishers, Delhi
2. Ramamurtham, S; "Design and Testing of Reinforced Structures", Dhanpat Rai and Sons, Delhi
3. Gambhir, M.L., "Reinforced Concrete Design", Macmillan India Limited
4. Singh, Birinder "RCC Design and Drawing", Kaption Publishing House, New Delhi
5. Singh Harbhajan "Design of Reinforced Concrete Structures" Abhishek Publishers Ltd., Chandigarh
6. Mallick, SK; and Gupta, AP; "Reinforced Concrete", Oxford and IBH Publishing Co, New Delhi.
7. Singh Harbhajan "Limit State RCC Design" Abhishek Publishers Ltd., Chandigarh

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	03	03
2	03	03
3	05	05
4	12	10
5	09	10
6	11	12
7	11	12
8	05	5
9	11	12
10	11	12
11	11	12
12	04	04
<b>Total</b>	<b>96</b>	<b>100</b>

# HIGHWAY & AIRPORT ENGINEERING

L	T	P
4	-	6

Subject Code : 025005

## RATIONALE

Construction of roads is one of the area in which diploma holders in Civil Engineering may get employment. These diploma holders are responsible for construction and maintenance of highways and airports. Basic concepts of road geometrics, surveys and plans, elements of traffic engineering, road materials, construction of rigid and flexible pavements, special features of hill roads, road drainage system and various aspects of maintenance find place in above course.

## DETAILED CONTENTS

### 1. Introduction (02 periods)

- 1.1 Importance of Highway engineering
- 1.2 Functions of IRC, CRRI, MORT&H, NHAI
- 1.3 IRC classification of roads
- 1.4 PMGSY and MNERGA Roads

### 2. Road Geometrics (08 periods)

- 2.1 Glossary of terms used in road geo-metrics and their importance: Right of way, formation width, road margin, road shoulder, carriage way, side slopes, kerbs, formation levels, camber and gradient
- 2.2 Average running speed, stopping and passing sight distance
- 2.3 Necessity of curves, horizontal and vertical curves including transition curves. Super elevation and methods of providing super elevation
- 2.4 Sketch of typical cross-sections in cutting and filling on straight alignment and at a curve

**(Note: No design/numerical problem to be taken)**

### 3. Highway Surveys and Plan (06 periods)

- 3.1 Topographic map, reading the data given on a topographic map
- 3.2 Basic considerations governing alignment for a road in plain and hilly area
- 3.3 Highway location; marking of alignment

#### 4. Road Materials

(08 periods)

- 4.1 Different types of road materials in use; soil, aggregate, binders – bitumen, cutback, Emulsion and Modified Bitumen (CRMB, PMB)
- 4.2 Binders: Common binders; bitumen, properties as per BIS specifications, penetration, softening point, ductility and viscosity test of bitumen, procedures and significance, cut back and emulsion and their uses, Bitumen modifiers

#### 5. Road Pavements

(10 periods)

- 5.1 Road pavement: Flexible and rigid pavement, their merits and demerits, typical cross-sections, functions of various components
- 5.2. Introduction to California Bearing Ratio, method of finding CBR value and its significance. Aggregate : Source and types, important properties, strength, durability
- 5.3 Sub-grade preparation: Setting out alignment of road, setting out bench marks, control pegs for embankment and cutting, borrow pits, making profiles of embankment, construction of embankment, compaction, preparation of subgrade, methods of checking camber, gradient and alignment as per recommendations of IRC, equipment used for subgrade preparation. Stabilization of subgrade. Types of stabilization mechanical stabilization, lime stabilization, cement stabilization, fly ash stabilization etc. **(introduction only)**
- 5.4 Introduction to Sub Base Course and Base Course:
  - a) Granular base course:
    - (i) Water Bound Macadam (WBM)
    - (ii) Wet Mix Macadam (WMM)
  - b) Bitumen Courses:
    - (i) Bituminous Macadam
    - (ii) Dense Bituminous Macadam (DBM)
  - c)\* Methods of construction as per MORT&H
- 5.5 Surfacing:
  - a)\* Types of surfacing
    - i) Prime coat and tack coat
    - ii) Surface dressing with seal coat
    - iii) Open graded premix carpet
    - iv) Mix seal surfacing
    - v) Semi dense bituminous concrete
    - vi) Bituminous Concrete/Asphaltic concrete
    - vii) Mastic Asphalt

b)\* Methods of constructions as per MORT&H specifications and quality control..

5.6 Rigid Pavements:

Construction of concrete roads as per IRC specifications: Form work laying, mixing and placing the concrete, compacting and finishing, curing, joints in concrete pavement, equipment used.

**6. Hill Roads: (05 periods)**

6.1 Introduction: Typical cross-sections showing all details of a typical hill road, partly in cutting and partly in filling

6.2 Special problems of hill areas

6.2.1 Landslides: Causes, prevention and control measures, use of geogrids, geoflexiles, geo-synthetics

6.2.2 Drainage

6.2.3 Soil erosion

6.2.4 Snow: Snow clearance, snow avalanches, frost

6.2.5 Land Subsidence

**7. Road Drainage (04 periods)**

7.1 Necessity of road drainage work, cross drainage works

7.2 Surface and subsurface drains and storm water drains. Location, spacing and typical details of side drains, side ditches for surface drainage. Intercepting drains, pipe drains in hill roads, details of drains in cutting embankment, typical cross sections

**8. Road Maintenance (05 periods)**

8.1 Common types of road failures of flexible pavements: Pot hole, rutting, alligator cracking, upheaval - their causes and remedies (brief description)

8.2 Maintenance of bituminous road such as seal-coat, patch-work and recarpeting.

8.3 Maintenance of concrete roads-filling cracks, repairing joints, maintenance of shoulders (berms), maintenance of traffic control devices

**9. Road Construction Equipment (06 periods)**

Output and use of the following plant and equipment

9.1 Hot mix plant

9.2 Tipper, tractors (wheel and crawler) scraper, bulldozer, dumpers, shovels, grader, roller, dragline

9.3 Asphalt mixer and tar boilers

9.4 Road pavers

## 10 Airport Engineering

(10 periods)

- 10.1 Necessity of study of airport engineering, aviation transport scenario in India.
- 10.2 Factors to be considered while selecting a site for an airport with respect to zoning Laws, Importance of Wind rose diagram in airport design.
- 10.3 Introduction to Runways, Taxiways and Apron.

\* **An expert may be invited from field/industry for extension lecture on this topic.**

### PRACTICAL EXERCISES

1. Determination of penetration value of bitumen
2. Determination of softening point of bitumen
3. Determination of ductility of bitumen
4. Determination of impact value of the road aggregate
5. Determination of abrasion value (Los Angeles") of road aggregate
6. Determination of the California bearing ratio (CBR) for the sub-grade soil
7. Visit to Hot mix plant
8. Visit to highway construction site for demonstration of operation of: Tipper, tractors (wheel and crawler), scraper, bulldozer, dumpers, shovels, grader, roller, dragline, road pavers, JCB etc.
9. Mixing and spraying equipment
10. A compulsory visit to Ready Mix Concrete plant.
11. Determination of Viscosity of Tar/Bitumen

### INSTRUCTIONAL STRATEGY

While imparting instructions, it is recommended that emphasis should be laid on constructional details and quality control aspects. Students should be asked to prepare sketches and drawings, clearly indicating specifications and constructional details for various sub components of a highway. It will be also advantageous to organize field visits to show the actual construction of roads at site.

### RECOMMENDED BOOKS

- i) Khanna, SK and Justo, CEG, "Highway Engineering", Nem Chand and Bros., Roorkee
- ii) Vaswani, NK, "Highway Engineering", Roorkee Publishing House, Roorkee,
- iii) Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall
- iv) Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" S Chand and Co, Delhi
- v) Bindra, SP; "A Course on Highway Engineering" , Dhanpat Rai and Sons, New Delhi



- vi) Sharma, RC; and Sharma, SK; "Principles and Practice of Highway Engineering", Asia Publishing House, New Delhi
- vii) Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering", New Age Publishers (P) Ltd, Delhi,
- viii) NITTTR, Chandigarh "Laboratory Manual in Highway Engineering",
- ix) RK Khitoliya, "Principles of Highway Engineering (2005)", Dhanpat Rai Publishing Co., New Delhi
- x) Rao, GV "Transportation Engineering
- xi) Duggal AK, "Maintenance of Highway – a Reader", NITTTR, Chandigarh
- xii) Duggal AK "Types of Highway constitution", NITTTR Chandigarh
- xiii) Rao, "Airport Engineering"
- xiv) Singh, Jagrup, "Highway Engineering", Eagle Publications Jalandhar IRC Publications
- i) MORTH Specifications for Road and Bridge Works (Fifth Revision)
  - ii) MORTH Pocket book for Highway Engineers, 2001
  - iii) MORTH Manual for Maintenance of Roads, 1983

#### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	03
2	08	12
3	06	10
4	08	12
5	10	15
6	05	08
7	04	07
8	05	08
9	06	10
10	10	15
<b>Total</b>	<b>64</b>	<b>100</b>

# RAILWAYS, BRIDGES AND TUNNEL ENGINEERING

L	T	P
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Subject Code : 025006

## RATIONALE

The subject will cater to the needs of those technicians who would like to find employment in the construction of railway tracks, bridges and tunnels. The subject aims at providing broad based knowledge regarding various components and construction of railway track, bridges and tunnels

## DETAILED CONTENTS

### PART – I: RAILWAYS

(27 periods)

1. Introduction to Indian Railways
2. Railway surveys: Factors influencing the railways route, brief description of various types of railway survey
3. Classification of permanent way describing its component parts
4. Rail Gauge: Definition, types, practice in India
5. Rails –types of rails
6. Rail Fastenings: Rail joints, types of rail joints, fastenings for rails, fish plates, bearing plates
7. Sleepers: Functions of sleepers, types of sleepers, requirements of an ideal material for sleepers.
8. Ballast: Function of ballast, requirements of an ideal material for ballast
9. Crossings and signalings: Brief description regarding different types of crossings/signalings (Latest electronics operated signal devices)
10. Maintenance of track: Necessity, maintenance of track, inspection of soil, track and fixtures; maintenance and boxing of ballast maintenance gauges, tools
11. Earth work and drainage: Features of rail road, bed level, width of formation, side slopes, drains, methods of construction, requirement of drainage system

### PART-II: BRIDGES

(27 periods)

#### 12. Introduction

Bridge – its function and component parts, difference between a bridge and a culvert

#### 13. Classification of Bridges

Their structural elements and suitability:

13.1 According to life-permanent and temporary

13.2 According to deck level – Deck, through and semi-through

- 13.3 According to material –timber, masonry, steel, RCC, pre-stressed
- 13.4 According to structural form;
- Grade Separators - Railway Over bridges (ROB), Railway under bridge (RUB)
  - Beam type –RCC, T-Beam, steel girder bridges, plate girder and box girder, balanced cantilever, Trussed bridges.
  - Arch type – open spandrel and filled spandrel barrel and rib type
  - Suspension type – unstiffened and stiffened and table (its description with sketches)
  - According to the position of highest flood level submersible and non submersible
- 13.5 IRC classification
14. Bridge Foundations: Introduction to open foundation, pile foundation, well foundation
15. Piers, Abutments and Wingwalls
- 15.1 Piers-definition, parts; types –solid (masonry and RCC), open
- 15.2 Abutments and wing walls – definition, types of abutments (straight and tee), abutment with wing walls (straight, splayed, return and curved)
- 15.3 Launching of Equipment Bridges
16. Bridge bearings
- Purpose of bearings; types of bearings – fixed plate, rocker and roller.
17. Maintenance of Bridges
- 17.1 Inspection of Steel and Equipment bridges
- 17.2 Routine maintenance

### **PART - III: TUNNELS**

**(10 periods)**

18. Definition and necessity of tunnels
19. Typical section of tunnels for a national highway and single and double broad gauge railway track
20. Ventilation –necessity and methods of ventilation, by blowing, exhaust and combination of blowing and exhaust
21. Drainage method of draining water in tunnels
22. Lighting of tunnels

**Notes:** i) Field visits may be organized to Bridge construction site or a Bridge/Tunnel construction site/Railways tracks to explain the various components and a field visit report shall be prepared by the students, as teamwork

- ii) Examiners should set questions from all the parts

### **INSTRUCTIONAL STRATEGY**

This subject is of practical nature. While imparting instructions, teachers are expected to organize demonstrations and field visits to show various components and construction of railway track, bridges and tunnel.

### **RECOMMENDED BOOKS**

1. Vaswani, NK, "Railway Engineering", Publishing House, Roorkee
2. Rangwala, SC, "Railway Engineering", Anand, Charotar Book Stall
3. Deshpande, R, "A Text Book of Railway Engineering", Poonam United Book Corporation
4. Algia, JS "Bridge Engineering", Anand, Charotar Book Stall
5. Victor Johnson, "Essentials of Bridge Engineering" Oxford and IBH, Delhi
6. Rangwala S.C., "Bridge Engineering", Anand, Charotar Book Stall
7. IRC Bridge Codes
8. MORTH drawings for various types of bridges
9. MORTH pocket books for bridge Engineers, 2000 (First Revision)
10. Subhash C Saxena, "Tunnel Engineering", Dhanpat Rai and Sons, Delhi

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	27	42
2	27	42
3	10	16
<b>Total</b>	<b>64</b>	<b>100</b>

## ESTIMATING & COSTING

Subject Code : 025001

L	T	P
7	-	-

### RATIONALE

Diploma holders in Civil Engineering are supposed to prepare material estimates for various Civil Engineering works namely; buildings, irrigation works, public health works and roads etc. In addition, they must have basic knowledge regarding analysis of rates, contracting, principles of valuation. Therefore, this subject has great importance for diploma holders in Civil Engineering.

### DETAILED CONTENTS

1. Introduction to quantity surveying and its importance. Duties of quantity surveyor **(02 periods)**
2. **Types of estimates** **(03 periods)**
  - 2.1 Preliminary estimates
    - Plinth area estimate
    - Cubic rate estimate
    - Estimate per unit base
  - 2.2 Detailed estimates
    - Definition
    - Stages of preparation – details of measurement and calculation of quantities and abstract
3. **Measurement** **(03 periods)**
  - 3.1 Units of measurement for various items of work as per BIS:1200
  - 3.2 Rules for measurements
  - 3.3 Different methods of taking out quantities – centre line method and long wall and short wall method
4. **Preparation of Detailed and Abstract Estimates from Drawings for:** **(25 periods)**
  - 4.1 A small residential building with a flat roof and pitched roof building comprising of One/Two rooms with W.C., bath, kitchen and verandah
  - 4.2 Earthwork for unlined channel
  - 4.3 WBM road and pre-mix carpeting

- 4.4 Single span RCC slab culvert
- 4.5 Earthwork for plain and hill roads
- 4.6 RCC work in beams, slab, column and lintel, foundations
- 4.7 users septic tank - 25 users

**5. Calculation of quantities of materials for (10 periods)**

- 5.1 Cement mortars of different proportion
- 5.2 Cement concrete of different proportion
- 5.3 Brick/stone masonry in cement mortar
- 5.4 Plastering and pointing
- 5.5 White washing, painting
- 5.6 R.C.C. work in slab, beams

**6. Analysis of Rates (14 periods)**

- 6.1 Steps involved in the analysis of rates. Requirement of material, labour, sundries, contractor's profit and overheads
- 6.2 Analysis of rates for finished items when data regarding labour, rates of material and labour is given:
  - Earthwork in excavation in hard/ordinary soil and filling with a concept of lead and lift
  - RCC in roof slab/beam/lintels/columns
  - Brick masonry in cement mortar
  - Cement Plaster
  - White washing, painting
  - Stone masonry in cement mortar

**7 Contractorship (07 periods)**

- Meaning of contract
- Qualities of a good contractor and their qualifications
- Essentials of a contract
- Types of contracts, their advantages, dis-advantages and suitability, system of payment
- Single and two cover-bids; tender, tender forms and documents, tender notice, submission of tender and deposit of earnest money, security deposit, retention money, maintenance period
- Classification and types of contracting firms/construction companies

## **8 Preparation of Tender Document based on Common Schedule Rates (CSR/SOR) (08 periods)**

- Introduction to CSR and calculation of cost based on premium on CSR/SOR
  - Exercises on writing detailed specifications of different types of building works from excavation to foundations, superstructure and finishing operation
  - Exercises on preparing tender documents for the following
    - a) Earth work
    - b) Construction of a small house as per given drawing
    - c) RCC works
    - d) Pointing, plastering and flooring
    - e) White-washing, distempering and painting
    - f) Wood work including polishing
    - g) Sanitary and water supply installations
    - h) False ceiling, aluminum (glazed) partitioning
    - i) Tile flooring including base course
    - j) Construction of W.B.M/Concrete road
9. Exercises on preparation of comparative statements for item rate contract (02 periods)

## **10. Valuation (06 periods)**

- a) Purpose of valuation, principles of valuation
- b) Definition of various terms related to valuation like depreciation, sinking fund, salvage and scrap value, market value, fair rent, year's purchase etc.
- c) Methods of valuation (i) replacement cost method (ii) rental return method

### **INSTRUCTIONAL STRATEGY**

This is an applied engineering subject. Teachers are expected to provide working drawings for various Civil Engineering works and students be asked to calculate the quantities of materials required for execution of such works and use of relevant software for preparing estimates. Teachers should conceptualize making analysis of rates for different items of works. It will be advantageous if students are given valuation reports for reading.

### **RECOMMENDED BOOKS**

1. Pasrija, HD, Arora, CL and S. Inderjit Singh, "Estimating, Costing and Valuation (Civil)", New Asian Publishers, Delhi,

2. Rangwala, S.C, Estimating and Costing”, Anand, Charotar Book Stall
3. Chakraborti, M, “Estimating, Costing and Specification in Civil Engineering”, Calcutta
4. Dutta, BN, “Estimating and Costing
5. Mahajan Sanjay, “Estimating and Costing” Satya Parkashan, Delhi

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	02	02
2	03	04
3	03	04
4	25	31
5	10	12
6	14	18
7	07	09
8	08	10
9	02	02
10	06	08
<b>Total</b>	<b>80</b>	<b>100</b>



# GEOTECHNICAL ENGINEERING

L	T	P
5	-	6

Subject Code : 025002

## RATIONALE

Civil Engineering diploma engineers are required to supervise the construction of structural buildings, roads, pavements, dams, embankments, and other Civil Engineering structures. As such the knowledge of basic soil engineering is the pre-requisite for these engineers for effective discharge of their duties. This necessitates the introduction of Soil and Foundation Engineering subject in the curriculum for Diploma Course in Civil Engineering.

The subject covers only such topics which will enable the diploma engineers to identify and classify the different types of soils, their selection and proper use in the field for various types of engineering structures.

The emphasis will be more on teaching practical aspect rather than theory.

## DETAILED CONTENTS THEORY

- 1. Introduction (03 periods)**
  - 1.1 Importance of soil studies in Civil Engineering
  - 1.2 Geological origin of soils with special reference to soil profiles in India: residual and transported soil, alluvial deposits, lake deposits, local soil found in J&K, dunes and loess, glacial deposits, black cotton soils, conditions in which above deposits are formed and their engineering characteristics.
  - 1.3 Names of organizations dealing with soil engineering work in India, soil map of India
  
- 2. Physical Properties of Soils (10 periods)**
  - 2.1 Constituents of soil and representation by a phase diagram
  - 2.2 Definitions of void ratio, porosity, water content, degree of saturation, specific gravity, unit weight, bulk density/bulk unit weight, dry unit weight, saturated unit weight and submerged unit weight of soil grains and correlation between them
  - 2.3 Simple numerical problems with the help of phase diagrams
  
- 3. Classification and Identification of Soils (06 periods)**
  - 3.1 Particle size, shape and their effect on engineering properties of soil, particle size classification of soils

- 3.2 Gradation and its influence on engineering properties
- 3.3 Relative density and its use in describing cohesionless soils
- 3.4 Behaviour of cohesive soils with change in water content, Atterberg's limit - definitions, use and practical significance
- 3.5 Field identification tests for soils
- 3.6 Soil classification system as per BIS 1498; basis, symbols, major divisions and sub divisions, groups, plasticity chart; procedure for classification of a given soil.

**4. Flow of Water Through Soils (05 periods)**

- 4.1 Concept of permeability and its importance
- 4.2 Darcy's law, coefficient of permeability, seepage velocity and factors affecting permeability
- 4.3 Comparison of permeability of different soils as per BIS
- 4.4 Measurement of permeability in the laboratory

**5. Effective Stress: (Concept only) (04 periods)**

- 5.1 Stresses in subsoil
- 5.2 Definition and meaning of total stress, effective stress and neutral stress
- 5.3 Principle of effective stress
- 5.4 Importance of effective stress in engineering problems

**6. Deformation of Soils (06 periods)**

- 6.1 Meaning, conditions/situations of occurrence with emphasis on practical significance of:
  - a) Consolidation and settlement
  - b) Creep
  - c) Plastic flow
  - d) Heaving
  - e) Lateral movement
  - f) Freeze and thaw of soil
- 6.2 Definition and practical significance of compression index, coefficient of consolidation, degree of consolidation.
- 6.3 Meaning of total settlement, uniform settlement and differential settlement; rate of settlement and their effects
- 6.4 Settlement due to construction operations and lowering of water table
- 6.5 Tolerable settlement for different structures as per BIS

- 7. Shear Strength Characteristics of Soils (10 periods)**
- 7.1 Concept and Significance of shear strength
  - 7.2 Factors contributing to shear strength of cohesive and cohesion less soils, Coulomb's law
  - 7.3 Examples of shear failure in soils
- 8. Compaction (06 periods)**
- 8.1 Definition and necessity of compaction
  - 8.2 Laboratory compaction test (standard and modified proctor test as per BIS) definition and importance of optimum water content, maximum dry density; moisture dry density relationship for typical soils with different compactive efforts
  - 8.3. Compaction control; Density control, measurement of field density by core cutter method and sand replacement method, moisture control, Proctor's needle and its use, thickness control, jobs of an embankment supervisor in relation to compaction
- 9. Soil Exploration (08 periods)**
- 9.1 Purpose and necessity of soil exploration
  - 9.2 Reconnaissance, methods of soil exploration, Trial pits, borings (auger, wash, rotary, percussion to be briefly dealt)
  - 9.3 Sampling; undisturbed, disturbed and representative samples; selection of type of sample; thin wall and piston samples; area ratio, recovery ratio of samples and their significance, number and quantity of samples, resetting, sealing and preservation of samples.
  - 9.4 Presentation of soil investigation results
- 10 Bearing Capacity of soil (10 periods)**
- 10.1 Concept of bearing capacity
  - 10.2 Definition and significance of ultimate bearing capacity, net safe bearing capacity and allowable bearing pressure
  - 10.3 Guidelines of BIS (IS 6403) for estimation of bearing capacity of soil
  - 10.4 Factors affecting bearing capacity
  - 10.5 Concept of vertical stress distribution in soils due to foundation loads, pressure bulb
  - 10.6 Applications of SPT, unconfined compression test and direct shear test in estimation of bearing capacity
  - 10.7 Plate load test (no procedure details) and its limitations
  - 10.8 Improvement of bearing capacity by sand drain method, compaction, use of geo-synthetics.

## 11. Foundation Engineering

(12 periods)

Concept of shallow and deep foundation; types of shallow foundations: isolated, combined, strip, mat, and their suitability. Factors affecting the depth of shallow foundations, deep foundations, types of well foundation and their suitability, type of piles and their suitability; pile classification on the basis of material, pile group and pile cap.

### PRACTICAL EXERCISES

- a) To determine the moisture content of a given sample of soil
- b) Auger Boring and Standard Penetration Test
  - a. Identifying the equipment and accessories
  - b. Conducting boring and SPT at a given location
  - c. Collecting soil samples and their identification
  - d. Preparation of boring log and SPT graphs
  - e. Interpretation of test results
- c) Extraction of Disturbed and Undisturbed Samples Extracting a block sample
  - a. Extracting a tube sample
  - b. Extracting disturbed samples for mechanical analysis.
  - c. Field identification of samples
- d) Field Density Measurement (Sand Replacement and Core Cutter Method)
  - a. Calibration of sand
  - b. Conducting field density test at a given location
  - c. Determination of water content
  - d. Computation and interpretation of results
- e) Liquid Limit and Plastic Limit Determination:
  - a. Identifying various grooving tools
  - b. Preparation of sample
  - c. Conducting the test
  - d. Observing soil behaviour during tests
  - e. Computation, plotting and interpretation of results
- f) Mechanical Analysis
  - a. Preparation of sample
  - b. Conducting sieve analysis
  - c. Computation of results
  - d. Plotting the grain size distribution curve
  - e. Interpretation of the curve

- g) Laboratory Compaction Tests (Standard Proctor Test)
  - a. Preparation of sample
  - b. Conducting the test
  - c. Observing soil behaviour during test
  - d. Computation of results and plotting
  - e. Determination of optimum moisture content and maximum dry density
  
- h) Demonstration of Unconfined Compression Test
  - a. Specimen preparation
  - b. Conducting the test
  - c. Plotting the graph
  - d. Interpretation of results and finding/bearing capacity
  
- i) Demonstration of:
  - a. Direct Shear and Vane Shear Test on sandy soil samples
  - b. Permeability test apparatus

### **INSTRUCTIONAL STRATEGY**

The teacher while imparting instructions are expected to lay greater emphasis on the practical aspects rather than theory and mathematical treatment. To bring clarity regarding concepts and principles involved, teachers should organize demonstrations in the laboratories and fields. It is necessary to create understanding that soils fail either under shear or settlement due to heavy loads. This can be shown by making use of photographs on working models of such failures. Efforts should be made in the practical classes that students perform practical exercises individually. Conduct of viva examination at the end of each practical work will develop clear understanding about the concepts and principles related to this subject.

### **RECOMMENDED BOOKS**

1. Punmia, BC, "Soil Mechanics and Foundations"; Standard Publishers, Delhi
2. Bharat Singh and Shamsher Prakash; "Soil Mechanics and Foundations Engineering", Nem Chand and Bros, Roorkee,
3. Sehgal, SB, "A Text Book of Soil Mechanics"; CBS Publishers and Distributors, Delhi,
4. Gulati, SK and Manoj Dutta, "Geotechnical Engineering ", Tata McGraw Hill, Delhi,
5. Ranjan Gopal and Rao ASR "Basic and Applied Soil Mechanics", New Age Publication (P) Ltd., New Delhi
6. Singh Harbhajan "Soil and Foundation Engineering", Abhishek Publishers, Chandigarh

7. S Mittal and JP Shukla, “Soil Testing for Engineers”, Khanna Publishers Ltd., Delhi
8. BIS Codes IS 6403 (latest edition) and IS 1498 (latest edition)
9. Jagroop Singh, “Soil and Foundation Engineering”, Eagle Parkashan, Jalandhar
10. Rabinder Singh, “Soil and Foundation Engg.” SK Kataria and Sons, Ludhiana
11. NITTTR, Chandigarh, “Shallow Foundations”
12. Video films on Geo-technical Laboratory Practices by NITTTR, Chandigarh

#### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	03	04
2	10	12
3	06	08
4	05	06
5	04	05
6	06	08
7	10	12
8	06	08
9	08	10
10	10	12
11	12	15
<b>Total</b>	<b>80</b>	<b>100</b>

# COMPUTER APPLICATION IN CIVIL ENGINEERING

L	T	P
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Subject Code : 025004

## RATIONALE

Computer applications plays a very vital role in present day life and more so, in the professional life of diploma engineer. In order to enable the students use the computers effectively in problem solving, this course offers applications of various computer softwares in civil engineering.

## DETAILED CONTENTS

### PRACTICALEXERCISES

1. Introduction and use of AutoCAD for making 2D Drawings and develop plan, section and elevation of 2 rooms building.
2. Demonstration of various civil engineering softwares like STAAD-Pro, MS Project or Primavera Project Planner, Auto Civil, MX Road or any other equivalent software for above mentioned software.

### Note:

- i) The polytechnics may use any other software available with them for performing these exercises
- ii) If the above softwares are not available in the institution, the demonstration of the above said software should be arranged outside the institute.