

5.2 REINFORCED CEMENT CONCRETE DESIGN AND DRAWING

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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 and Thus one should be able to read and interpret drawings of RC structures. The competence to read and interpret structural drawings is best learnt by being able to draw these drawings. Hence there is a need to have a subject devoted to preparation of structural drawings.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

- CO1: Explain methods of RCC design i.e. Working stress and Limit state methods
- CO2: Design singly, doubly reinforced rectangular and T&L beams as per IS Code
- CO3: Design one way and two way slab
- CO4: Design axially loaded column and their isolated footing
- CO5 Draw the reinforcement details for various structural elements from the given data
- CO6: Read and interpret R.C.C. drawings

DETAILED CONTENTS

PART-A: RCC Design

UNIT-I

1.1 Introduction

- 1.1.1 Concept of RCC and PCC.
- 1.1.2 Difference between RCC and PCC

- 1.1.3 Reinforcement Materials: Suitability of steel as reinforcing material
- 1.1.4 Properties of mild steel and HYSD steel
- 1.1.5 Loading on structures as per IS: 875

1.2 Introduction to following methods of RCC design

- 1.2.1 Working stress method: Definition and basic assumptions.
- 1.2.2 Limit state method: Definition and basic assumptions
- 1.2.3 Difference between W.S.M and L.S.M.

UNIT-II

2.1 Shear and Development Length

- 2.1.1 Shear as per IS: 456 by working stress method
- 2.1.2 Shear strength of concrete without shear reinforcement, nominal shear stress, maximum shear stress and shear reinforcement, functions of vertical stirrups.
- 2.1.3 Conditions and different forms of providing shear reinforcement
- 2.1.4 Concept, purpose and methods for achieving development length
- 2.1.5 Concept of bond and bond stress.

2.2 Concept of Limit State Method

- 2.2.1 Definitions, methods and assumptions made in limit state of collapse (flexure)
- 2.2.2 Characteristics strength of materials
- 2.2.3 Characteristics loads
- 2.3.4 Design value for material & loads
- 2.3.5 Stress blocks parameters.

UNIT-III

3.1 Singly Reinforced beam

- 3.1.1 Concept of singly R/F beam, neutral axis, depth of Neutral axis, maximum depth of neutral axis, limiting percentage of steel, limiting moment of resistance, value of limiting moment of resistance.
- 3.1.2 Types of beam sections- Balanced, under and over R/F sections.
- 3.1.3 Details of reinforced in beam as per IS: 456
- 3.1.4 Design of singly reinforced beam by limit state method and types of problems.

3.2 Doubly Reinforced Beams

- 3.2.1 Concept of doubly reinforced beam, difference between doubly and singly R/F beam.
 - 3.2.2 Circumstances under which doubly R/F beam are provided.
 - 3.2.3 Concept depth of neutral axis of doubly R/F beam, area of tensile steel and compression steel, ultimate moment of resistance, maximum design stress in compression.
 - 3.2.4 Design of simply supported doubly reinforced rectangular beam by limit state method and types of problems
- 3.3 Behaviour of T beam,** Concept of isolated T-beam and L-beam

UNIT-IV

4.1 One Way Slab-

- 4.1.1 Concept of one way slab
- 4.1.2 General considerations of design of slabs as per IS: 456
- 4.1.3 Design steps of simply supported one way slab including sketches showing enforcement details (plan and section) by Limit State Method.

4.2 Two Way Slab-

- 4.2.1 Concept of two way slab
- 4.2.2 Difference between one-way slab and two way slab
- 4.2.3 Design steps of two-way simply supported slab with corners free to lift, no provisions for Torsional reinforcement by Limit State Method including sketches showing R/F details (plan and two sections)

UNIT-V

5.1 Axially Loaded Column

- 5.1.1 Definition and classification of columns
- 5.1.2 Effective length of column,
- 5.1.3 Specifications for longitudinal and lateral reinforcement as per IS: 456
- 5.1.4 Design of axially loaded square, rectangular and circular short columns by Limit State Method including sketching of reinforcement (sectional elevation and plan)

5.2 Pre-stressed Concrete

- 5.2.1 Concept of pre-stressed concrete
- 5.2.2 Methods of pre-stressing: pre-tensioning and post-tensioning
- 5.2.3 Advantages and disadvantages of pre-stressing
- 5.2.4 Losses in pre-stress

PRACTICAL EXERCISES

PART-B: RCC Drawing

Reinforcement details from the given data for the following structural elements with barbending schedules

- (i) Drawing No. 1: RC Slabs - One way slab, Two way slab and Cantilever Slab.
- (ii) Drawing No.2 : Beams - Singly and doubly reinforced rectangular beams and Cantilever beam (All beams with vertical stirrups)
- (iii) Drawing No.3 : Columns and Footings – Square, Rectangular and Circular Columns with lateral ties and their isolated sloped column footings.
- (iv) Drawing No. 4 : Portal Frame – Three bay two storey RC portal frame with blow up of column beam junctions.
- (v) Drawing No. 5 : Draw at least two sheet using AutoCAD software

Important Note:

- i. Use of IS: 456 is permitted in the examination.
- ii. 60 Marks external paper should be set for Part-A RCC Design and 60 Marks external paper should be set for Part-B RCC Drawing.

RECOMMENDED BOOKS

1. "Reinforced Concrete Structure Vol I" by Punmia, BC; Standard Publishers, Delhi
2. "Design and Testing of Reinforced Structures" by Ramamurtham, S; Dhanpat Rai and Sons, Delhi
3. "RCC Design and Drawing" by Singh, Birinder ; Kaption Publishing House, New Delhi
4. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

RCC DRAWING:

5. “Civil Engineering Drawing” by Layal JS; Satya Parkashan, New Delhi
6. “Civil Engineering Drawing by Kumar NS; IPH, New Delhi
7. “RCC Design and Drawing” by Singh, Birinder; Kaption Publishing House, New Delhi.
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

RECOMMENDED WEBSITES

1. <https://swayam.gov.in/>
2. <https://www.udemy.com/>
3. <https://www.upgrad.com/>

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. This subject contains five units of equal weightage.