Code : 101501

B.Tech 5th Semester Exam., 2020
(New Course)

ANALYSIS AND DESIGN OF CONCRETE STRUCTURE

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct alternative from any *seven* of the following : 2×7=14

(a) Deflection can be controlled by using the appropriate

(i) aspect ratio

(ii) modular ratio

(iii) span/depth ratio

(iv) water/cement ratio

(b) **The probability of failure implied in limit state design is of the order of**

(i) 10^{-2}

(ii) 10^{-3}

(iii) 10^{-4}

(iv) 10^{-5}

(c) The main reinforcement of an RC slab consists of 10 mm bars @ 100 mm spacing. It is desired to replace 10 mm bars by 12 mm bars, then the spacing of 12 mm bars should be

(i) 120 mm

(ii) 140 mm

(iii) 144 mm

(iv) 160 mm

(d) **Flexural collapse in over-reinforced beam is due to**

(i) primary compression failure

(ii) secondary compression failure

(iii) primary tension failure

(iv) bond failure

(e) As per IS-456, side face reinforcement, not less than 0·05% of web area, is provided on each side when the depth of web is not less than

(i) 300 mm

(ii) 400 mm

(iii) 500 mm

(iv) 750 mm

(f) Shear span is defined as the zone, where

(i) bending moment is zero

(ii) shear force is zero

(iii) shear force is constant

(iv) bending moment is constant

(g) Lap length of reinforcement in compression shall not be less than

(i) 30 ϕ

(ii) 24 ϕ

(iii) 20 ϕ

(iv) 15 ϕ

where ϕ = diameter of the bar.

(h) The minimum clear cover (in mm) to the main steel bars in slab, beam, column and footing respectively are

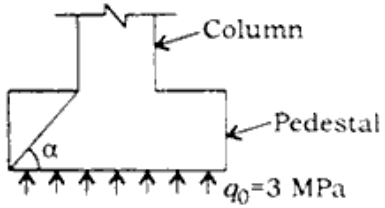
(i) 10, 15, 20, 25

(ii) 15, 25, 40, 40

(iii) 20, 25, 30, 40

(iv) 20, 35, 40, 75

(i) A concrete pedestal made of M-20 concrete is shown in the figure below :



The tanα value in this case will be

(i) not less than 3·5

(ii) less than or equal to 3·6

(iii) greater than 3·6

(iv) greater than or equal to 3·6

(j) A square column section of size 350 mm×350 mm is reinforced with four bars of 25 mmϕ and four bars of 16 mmϕ. Then the transverse steel should be

(i) 8 mmϕ @ 350 dl

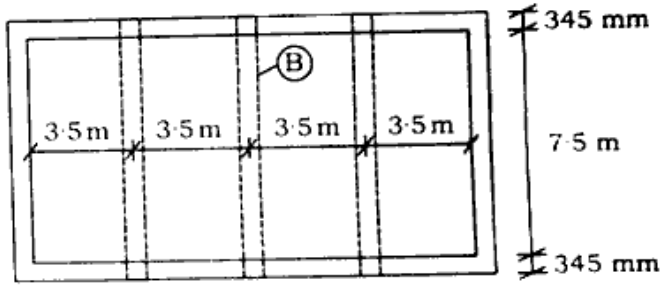
(ii) 8 mmϕ @ 250 dl

(iii) 6 mmϕ @ 250 dl

(iv) 5 mmϕ @ 240 dl

2. *(a)* What is principle of stability? Discuss. 3

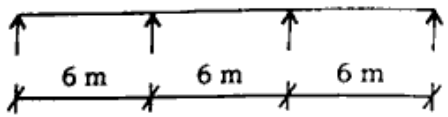
(b) A meeting hall is shown in the figure given below :



The slab is cast monolithically with beam. The beams are spaced at 3·5 m c/c. The slab is 130 mm thick and design for a superimposed working load of 6 kN/m^2. The web of the beam is 300 mm wide. Design beam—B using LSM. If M-25 concrete and Fe-500 grade steel is used, design for flexure as well as shear. 11

3. *(a)* What are different design philosophies for RCC structures. Discuss the merits and demerits of each. 4

(b) A continuous beam is shown in the figure below :



It is supporting a DL of 20 kN/m and LL of 25 kN/m at working loads. Design the end span of the beam for shear and flexure. The width of the beam is 300 mm. Use M-25 concrete and Fe-415 steel. 10

4. *(a)* Discuss how wind and earthquake loads are calculated on structure taking suitable examples. 4

(b) Design a two-flight staircase with steps on waist slab for floor-to-floor height of 3·6 m. Width of flight is equal to 1·5 m and LL is 4 kN/m^2. The waist slab is simply supported on landing slabs which spans transversely to the flight. Landing slabs are 1·5 m wide. Use M-25 concrete and Fe-415 bars. 10

5. *(a)* Draw the P_V-M_V interaction curve for a column and mark all salient points on it. Discuss all points. 4

(b) Calculate the load carrying capacity of a short axially loaded column 350 mmϕ reinforced with 6 bars of 22 mmϕ of Fe-415 grade. The helical reinforcement consists of 8 mmϕ bars of Fe-415 grade steel at 40 mm pitch. Assume clear cover of 40 mm and grade of concrete M-25. 6

(c) Design a short axially loaded column carrying an axial working load of 1100 kN and size of column is 400 mm×450 mm. Use M-25 concrete and Fe-415 steel. 4

6. (a) A 1·0 m wide cantilever chajja (small balcony) is constructed monolithically with a lintel over an opening 2·0 m wide garage door in a 230 mm thick brick wall (inclusive of plaster). The height of the door is 3·5 m and that of roof is 6·0 m. The weight of brick masonry is 19·5 kN/m^3. The LL on chajja is 1·5 kN/m^2 and the finish load may be taken as 0·6 kN/m^2. Design the chajja and lintel. The materials used are M-20 concrete and Fe-415 steel. 10

(b) Discuss the behaviour of concrete and HYSD steel under compression and tension. 4

7. Design a rectangular column for the following data : 14

Ultimate axial load = 1000 kN

Ultimate moment (about *X*-axis) at top bisecting depth of column = 30 kN-m

Ultimate moment (about *Y*-axis) at top bisecting width of column = 10 kN-m

Ultimate moment at bottom about *X*-axis = 20 kN-m

Ultimate moment at bottom about *Y*-axis = 10 kN-m

Unsupported length about *X*-axis = 6 m

Effective length about *X*-axis = 4·8 m

Unsupported length about *Y*-axis = 6 m

Effective length about *Y*-axis = 4·8 m

Width of column = 300 mm

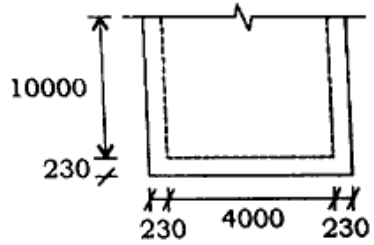
Effective cover = 50 mm

Use M-25 concrete and Fe-415 steel.

The column is braced and bends into single curvature.

(Sp-16 graphs shall be provided.)

8. *(a)* Design a simply supported one-way slab as shown in the figure below :



It is subjected to an LL of 4 kN/m^2 and surface finish of 1 kN/m^2. Consider M-25 concrete and Fe-500 steel. 10

(b) Discuss the role of engineer, architects, user and builder in building planning design and construction. 4

9. *(a)* Design a reinforced concrete square footing for a column of section 400 mm×400 mm which is subjected to a load of 1200 kN at service state. Consider :

Weight to soil = 18 kN/m^3

Angle of repose = 30°

Allowable BC of soil = 120 kN/m^2

Use M-25 concrete and Fe-500 steel. 10

(b) Determine moment of resistance of a beam section 300 mm width and 500 mm effective depth, if it is reinforced by 4–16 mmϕ bars. Consider M-25 concrete and Fe-415 steel. 4

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