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Paper Code : CE-502

PUID : 05155 (To be mentioned in the main answer script)

DESIGN OF RC STRUCTURES

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own

words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :   10 × 1 = 10

   i) Which one of the following sections performs better in ductility condition ?

   a) Balanced section

   b) Under-reinforced section

   c) Over-reinforced section

   d) Non-prismatic section.

   ii) The minimum number of bars in a circular column should be

   a) 4   b) 6

   c) 8   d) 2.

   iii) If a column has an unsupported length l, and it is effectively held in position at both ends, but restrained against rotation at both end, then the relation between its length l and its effective length l_e as per IS 456:2000 is

   a) $l_e = 1$ b) $l_e = 0.7$

   c) $l_e = 0.51$ d) $l_e = 21$.

   iv) Maximum percentage reinforcement in case of slab is limited to

   a) 2   b) 4

   c) 6   d) 8

   v) In an under-reinforced section

   a) Concrete is fully stressed

   b) Steel is fully stressed

   c) Both (a) and (b)

   d) None of these.

vi) The developed shear stress in slab in working stress method of design using M20 concrete shall never exceed

a) 0.9 N/mm^2 b) 1.8 N/mm^2

c) 1.9 N/mm^2 d) 2.2 N/mm^2

vii) The Permissible stress for Fe415 Steel is

a) 250N/mm^2 b) 150N/mm^2

c) 230N/mm^2 d) 200N/mm^2.

viii) Lever arm distance j depends on

a) area of steel   b) grade of concrete

c) grade of steel   d) none of these.

ix) The value of partial safety factor for D.L. + L.L. is

a) 1.0   b) 1.5

c) 1.2   d) 1.3.

x) The spacing of nominal shear reinforcement is given by

a) $\dfrac{0 \cdot 87 f_y A_{sv}}{0 \cdot 25b}$ b) $\dfrac{0 \cdot 87 f_y A_{sv}}{0 \cdot 4d}$

c) $\dfrac{0 \cdot 87 f_y A_{sv}}{0 \cdot 4b}$ d) $\dfrac{0 \cdot 87 f_y A_{sv}}{0 \cdot 25d}$.

xi) Shear reinforcement is provided to resist

a) Diagonal Compression

b) Diagonal bending

c) Diagonal tension

d) None of these.

xii) Development length in tension is given by

a) $\dfrac{\phi \cdot \sigma_{st}}{6 T_{bd}}$ b) $\dfrac{\phi \cdot \sigma_{st}}{4 T_{bd}}$

c) $\dfrac{\phi \cdot \sigma_{st}}{5 T_{bd}}$ d) $\dfrac{\phi \cdot \sigma_{st}}{3 T_{bd}}$.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following. $3 \times 5 = 15$

2. Differentiate between Balanced, Under- and Over-reinforced section with the help of stress diagram.

3. Derive expression for neutral axis depth for balanced section in working stress method of design and limit state method of design. http://www.makaut.com

4. Determine the moment of resistance of a singly reinforced RCC beam of size 300 × 600 mm. reinforced with 4 bars of 20 mm dia at bottom with effective cover of 40 mm. Consider concrete of grade M25 and steel of Fe500 grade. Apply working stress method.

5. Find the moment of resistance of the T-beam with following sectional properties:

   Width of flange: 1300 mm, thickness of flange: 150 mm, width of web : 250 mm, effective depth : 700 mm, area of steel : 2500 mm^2. Assuming M20 grade of concrete and Fe415 grade of steel.

6. Determine the anchorage lengths of bars at the simply supported end of RCC beam with a flexural reinforcement of 2 nos. of 25 HYSD bars and ultimate shear force is 400 kN at the centre of support. Consider concrete of grade M20 and steel of Fe415 grade.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following.   3 × 15 = 45

7. Design one of the flights of stairs of an office building spanning between landing beams to suit the following data. Use limit state method of design.

   a) Type of staircase: Waist slab type

   b) Number of steps in flight : 12

   c) Tread : 300 mm

   d) Riser : 160 mm

   e) Width of the landing beams : 500 mm

   Materials: M25 grade of concrete and Fe500 grade of steel.

8. The moment of resistance of a rectangular reinforced concrete beam, of breadth *b* cm and effective depth *d* cm is 0.9 bd^2. If the stresses in the outside fibre of the concrete and in the steel do not exceed 5 N/mm^2 & 140 N/mm^2 respectively and the modular ratio equals 18, determine the ratio of the depth of neutral axis from the outside compression fibre to the effective depth of the beam and the ratio of area of tension steel to the effective area of the beam. The beam is reinforced for tension only.

9. a) What are the basic difference between "Limit state method" and "Working stress method" of design ?

   b) Design the lateral ties required for a RCC column of dimension 250 × 400, reinforced with 12 mm dia HYSD bars of Fe415 grade.

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c) What is meant by a "singly reinforced section" and a "doubly reinforced section"? 4 + 7 + 4

10. A reinforced concrete column 500 × 500 mm supports an axial vertical load of 1000 kN. The safe bearing capacity of the soil in the site is 200 kN/m². Adopting M20 grade of concrete and Fe415 HYSD bars design a suitable footing for the column and sketch the details of reinforcements. Use limit state method of design.

11. A three span continuous RC slab of clear span 3 metre each supported on 250 mm thick masonry wall. This slab is subjected to a live load of intensity 4 kN/m² and a dead load due to floor finish ceiling plaster partitions of 1.5 kN/m² in addition to its self-weight. Using suitable coefficients determine critical bending moment and design the slab in Flexure. Consider mild exposure condition and M20 grade of concrete and Fe500 grade of steel. Show the details of reinforcement. Use limit state method of design.