DESIGN OF RCC STRUCTURES
(CIVL 3102)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) If nominal shear stress τ_v exceeds design shear strength of concrete τ_c, nominal shear reinforcement as per IS 456-1978 shall be provided forcarrying shear stress equal to
(a) τ_v (b) τ_c (c) τ_v-τ_c (d) τ_v+ τ_c

(ii) If the depth of actual neutral axis in a beam is more than the depth of critical neutral axis, then the beam is called
(a) balanced beam (b) under-reinforced beam
(c) over reinforced beam (d) doubly reinforced beam

(iii) The modular ratio m in terms of permissible compressive stress due to bending in concrete σ_{cbc} (in N/mm^2) is given by
(a) $^{280}/_{\sigma_{cbc}}$ (b) $^{2800}/_{\sigma_{cbc}}$
(c) $^{280}/_{3\sigma_{cbc}}$ (d) $^{2800}/_{\sigma_{cbc}}$

(iv) A slab panel with an effective depth of 250 mm is reinforced with 0.2% main reinforcement using 8 mm diameter steel bars. The uniform centre to centre spacing (in mm) at which the 8 mm diameter bars are placed in the slab panel is (rounded off to the nearest integer).
(a) 90 mm (b) 100 mm
(c) 110 mm (d) 75 mm

(v) An R.C.C. beam not provided with shear reinforcement may develop cracks in its bottom inclined roughly to the horizontal at
(a) 25° (b) 35° (c) 45° (d) 55°

(vi) In a R.C. beam shear reinforcement should be always in the form of
(a) vertical stirrups (b) inclined stirrups
(c) bent up bars with stirrups (d) any one of the above

(vii) Eccentric tendons in a concrete beam section induce
(a) only direct stress (b) only bending stress
(c) direct and bending stress (d) none of the above

(viii) If the foundations of all the columns of structure are designed on the total live and dead load basis, then
(a) there will be no settlement of column
(b) there will be no differential settlement
(c) the settlement of exterior column will be more than interior columns
(d) the settlement of interior columns will be more than exterior columns

(ix) The spacing of transverse reinforcement of column is decided by the following consideration.
(a) The least lateral dimension of the column
(b) Sixteen times the diameter of the smallest longitudinal reinforcing rods in the column
(c) Forty-eight times the diameter of transverse reinforcement
(d) All the above

(x) The minimum clear cover for the RCC columns shall be
(a) greater of 40 mm or diameter (b) smaller of 40 mm or diameter
(c) greater of 25 mm or diameter (d) smaller of 25 mm or diameter.

Fill in the blanks with the correct word

(xi) When the amount of steel is kept more than that in the balanced condition, the neutral axis tends to move_____.

(xii) A strut is a compression member, the effective length of which exceeds _____ times the least lateral dimension.

(xiii) The maximum spacing of vertical shear reinforcement for a beam of size 250 × 360 mm is_____.

(xiv) To satisfy deflection criteria, the span l to depth d ratio in a simply supported slab shall be not less than_____.

(xv) In axially prestressed members, concrete is under _____.

Group - B

2. (a) Determine the depth of neutral axis of a beam 250 mm × 400 mm, reinforced with 3 bars of 20 mm diameter. Also check for the type of section. Use M20 concrete and Fe 415 steel. *[(CO1, CO4)(Evaluate/HOCQ)]*

(b) Determine the moment of resistance of a beam of dimension 250 mm × 350 mm. The area of steel consists of 3 bars of 12 mm diameter placed at a distance of 40 mm from bottom of beam. Use M20 concrete and Fe 415 steel.
[(CO1,CO4)(Evaluate/HOCQ)]
6 + 6 = 12

3. (a) A rectangular section of effective size 300 mm × 500 mm is used as a simply supported beam of effective span 7m. Determine maximum u.d.l. that can be applied on the beam if maximum percentage of steel is provided only on tension

side. Use M20 concrete and Fe 415 steel. Determine the amount of steel to be provided. *[(CO1, CO4)(Evaluate/HOCQ)]*

(b) A singly reinforced beam section 250 mm × 550 mm is reinforced in tension side with 1256 mm^2 Fe 415 steel with effective cover of 50 mm. Determine the uniformly distributed load it can carry if span of the beam is 5.5 m. Use M25 concrete. *[(CO1,CO4)(Evaluate/HOCQ)]*

6 + 6 = 12

Group - C

4. A doubly reinforced beam section is 250 mm wide and 450 mm deep to the centre of the tensile reinforcement. It is reinforced with 2 bars of 16 mm diameter as compression reinforcement at an effective cover of 50 mm and 4 bars of 25 mm diameter as tensile steel. Using M20 concrete and Fe 415 steel, calculate the ultimate moment of resistance of the beam section. *[(CO1, CO3, CO4)(Analyse/IOCQ)]*

12

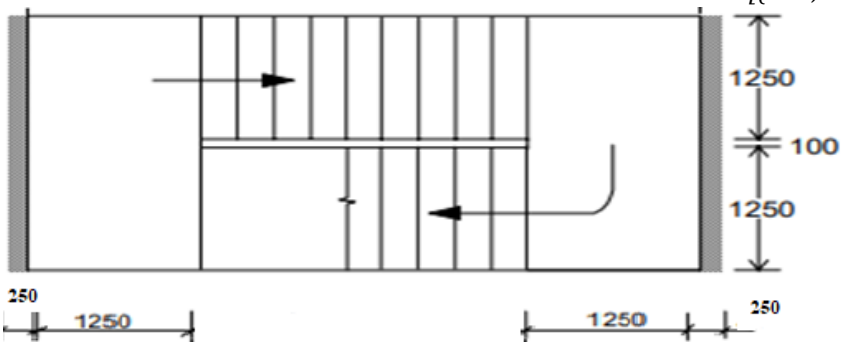
5. Design and detail a one way slab for the following data:
Clear span = 4 m
Wall thickness = 250 mm
Live load intensity= 3kN/sqm
Floor finish = 0.6 kN/sqm
Use M20 concrete and Fe 415 steel. *[(CO1, CO3, CO4, CO6) (Create/HOCQ)]*

12

Group - D

6. Design a ('waist slab' type) dog-legged staircase for an office building, given the following data:
- height between floor = 3.2 m;
- riser = 160 mm, tread = 270 mm;
- width of flight = landing width = 1.25 m
- live load = 5.0 kN/m^2
- finishes load = 0.6 kN/m^2

Assume the stairs to be supported on 250 mm thick masonry walls at the outer edges of the landing, parallel to the risers. Use M 20 concrete and Fe 415 steel. Assume mild exposure conditions. *[(CO1,CO3,CO4,CO6)(Create/HOCQ)]*



12

7. A short rectangular R.C.C. column carries an axial load of 1170 kN accompanied by moments M_x = 120 kNm and M_y= 30 kNm about the major and the minor axes.
Effective length about *x* -axis = l_{ex} = 5.25 m
Effective length about *y*-axis = l_{ey} = 4 m.
Unsupported length of column about both axes = 4.75 m.
Design the column using M 20 concrete and Fe 415 steel.
Reinforcement shall be arranged equally on four sides. *[(CO1, CO3, CO4, C06)(Create/HOCQ)]*
12

Group - E

8. Design a rectangular footing of uniform thickness for an axially loaded column of size 300 mm × 600 mm load on column is 1150 kN. Safe bearing capacity of the soil is 200 kN/m^2. Use M20 concrete and Fe 415 steel. *[(CO1,CO4)(Create/HOCQ)]*
12

9. A rectangular concrete beam of cross-section 30 cm deep and 20 cm wide is prestressed by means of 15 wires of 5 mm diameter located 6.5 cm from the bottom of the beam and 3 wires of diameter 5 mm, 2.5 cm from the top. Assuming the prestress in the steel as 840 N/mm^2, calculate the stresses at the extreme fibres of the mid-span section when the beam is supporting its own weight over a span of 6m. If a uniformly distributed live load of 6 kN/m is imposed, evaluate the maximum working stress in concrete. The density of concrete is 24 kN/m^3. *[(CO5)(Create/HOCQ)]*
12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	0	12.5	87.5