DESIGN OF RCC STRUCTURES
(CIV3102)

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) The maximum area of tension reinforcement in beams shall not exceed
(a) 0.15% (b) 1.5% (c) 4% (d) 1%

(ii) If the depth of neutral axis for a singly reinforced rectangular section is represented by k_d in working stress design, then the value of k for balanced section
(a) depends on σ_{st} only (b) depends on σ_{cbc} only
(c) depends on both σ_{st} and σ_{cbc} (d) is independent of both σ_{st} and σ_{cbc}
Where d is the effective depth of section.

(iii) If a beam fails in bond, then its bond strength can be increased most economically by
(a) increasing the depth of beam
(b) using thinner bars but more in number
(c) using thicker bars but less in number
(d) providing vertical stirrups

(iv) 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°

(v) The centre to centre distance of main bars in a slab shall not exceed
(a) 200 mm (b) 500 mm (c) 300 mm (d) 400 mm

(vi) The maximum moment, reinforcement is provided in
(a) Middle strip (b) Edge strip
(c) Side strip (d) None of the above

(vii) The number of treads in a flight is equal to
(a) risers in the flight (b) risers plus one
(c) risers minus one (d) none of these

(viii) The depth of footing for an isolated column is governed by
(a) maximum bending moment (b) shear force
(c) punching shear (d) (*a*), (*b*) and (*c*)

(ix) In a prestressed concrete beam, an eccentric tendon is used to
(a) Induce uniform compressive stress across the section
(b) Produce additional tensile stress in the top fiber
(c) Counteract bending moments by inducing a restoring moment
(d) Eliminate shear forces in the beam

(x) Critical section for shear in case of flat slab at a distance of
(a) effective depth of slab from periphery of column/drop panel
(b) $d/2$ from periphery of column/capital/drop panel
(c) at the drop panel of slab
(d) at the periphery of column

Fill in the blanks with the correct word

(xi) The vertical deflection limit for a cantilever beam for spans up to 10m is generally assumed to be satisfied provided that the span to depth ratios are not greater _____.

(xii) The maximum diameter of reinforcement bars in RCC slab shall not exceed _____ of the total thickness of the slab.

(xiii) In a concrete beam subjected to prestress, dead and live loads the pressure line shifts uniformly towards the _____ of beam as load increases.

(xiv) The deflections and bending moments in a two-way slab are considerably _____ as compared to those in a one way slab.

(xv) A dog-legged staircase consists of two flights running in opposite directions with a _____ between them.

Group - B

2. (a) Determine the moment of resistance of the beam having dimension as 300×550 mm (effective). The beam is reinforced with 1963 mm^2 of steel in the tension zone. Use M20 concrete and Fe 415 steel. Also comment on the design of beam. *[(CO4)(Evaluate/HOCQ)]*

(b) A R.C.C. beam 200 mm × 400 mm (effective) is reinforced with 3-16 mm diameter bars of Fe 415 steel. Find the ultimate uniformly distributed load which the beam can carry safely over a span of 5m. Take M20 concrete. *[(CO4)(Evaluate/HOCQ)]*

6 + 6 = 12

3. (a) Estimate the safe load that an R.C.C. cantilever beam of size 300mm× 500mm effective depth reinforced with 2 bars of 16 mm diameter and span of 4m can safely carry. Use working stress method of design. Assume Fe 415 steel and M20 concrete. *[(CO4)(Evaluate/HOCQ)]*

(b) An R.C.C. beam of width 300mm× 650 mm overall depth is reinforced with 4 bars of 20 mm diameter. The beam is simply supported and has to carry a superimposed load of 60kN/m, including self weight of the beam over an effective

span of 4.5 m. Evaluate the actual stresses developed in steel and concrete. Use M25 and Fe 415 steel and working stress method of design. *[(CO4)(Evaluate/HOCQ)]*

6 + 6 = 12

Group - C

4. A T-beam having an effective flange width of 1525 mm is required to resist an ultimate moment of 500 kNm. The thickness of the flange is 120 mm, the width of the rib is 300 mm and the effective depth is 750 mm. Using M20 concrete and Fe 500 steel, determine the area of reinforcement required. *[(CO3, CO4)(Analyse/IOCQ)]*

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5. Design a continuous reinforced concrete beam of rectangular section to support a dead load of 10kN/m and live load of 12 kN/m over 3 spans of 6 m each. The ends are simply supported. Adopt M 20 grade concrete and Fe 415 HYSD bars. Sketch the details of the reinforcement in the beam. *[(CO3, CO4, CO6)(Create /HOCQ)]*

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Group - D

6. Design and detail a two way slab for office floor to suit the following data:
   Size of the office floor = 4 m× 6m
   Edge conditions = two adjacent edges discontinuous
   Live load intensity= 4kN/sqm
   Floor finish = 1.5 kN/sqm
   Use M20 concrete and Fe 415 steel. *[(CO3, CO4, CO6)(Create/HOCQ)]*

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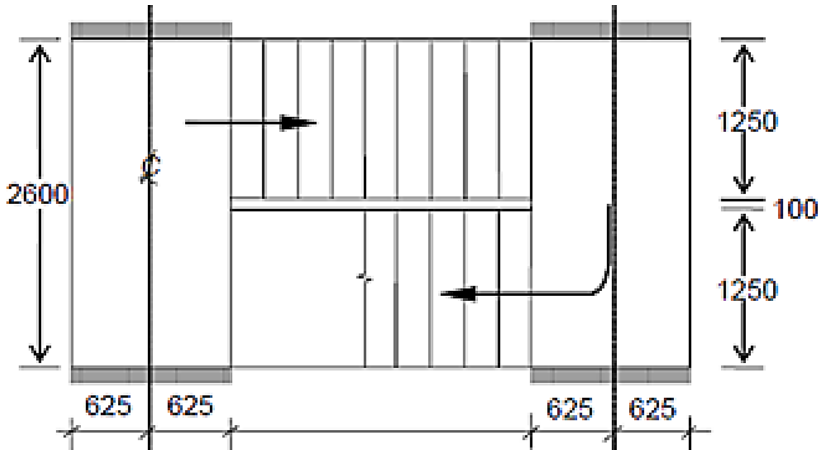
7. Design and detail a ('waist slab' type) dog-legged staircase for an office building, given the following data:
   - height between floor = 3.2 m;
   - riser = 160 mm, tread = 270 mm;
   - width of flight = landing width = 1.25 m
   - live load = 4.0 kN/m^2
   - finishes load = 0.6 kN/m^2

   Assume the landings to be supported only on two edges perpendicular to the risers. Use M 25 concrete and Fe 500 steel. Assume mild exposure conditions.



[(CO1, CO3, CO4, CO6)(Create/HOCQ)]

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Group - E

8. Design a short column subjected to biaxial bending to the following particulars:
Size of the column: 450 mm × 450 mm
Factored load P_u : 1150 kN
Factored moment M_{ux} : 80 kNm
Factored moment M_{uy}: 40 kNm
Use M 20 concrete and Fe 415 steel. *[(CO3, CO4)(Create/HOCQ)]*

12

9. 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. *[(CO4)(Create/HOCQ)]*

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	0	12.5	87.5