Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (CE)/SEPARATE SUPPLE/SEM-7/CE-704/2011

2011
STRUCTURAL DESIGN - III

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.

Use IS : 456, 800, 1893, 1343, 3370, SP 16, SP 6 and other relevant Codes and steel tables permitted.

Assume reasonable data wherever necessary

GROUP – A

(Multiple Choice Type Questions)

1. Tick the correct or most appropriate answer for the following questions : $10 \times 1 = 10$

   i) Prestressed Concrete essentially requires a combination of

      a) mild steel and high strength concrete

      b) ordinary concrete and high tensile steel

      c) high strength concrete and high tensile steel

      d) mild steel and ordinary concrete.

ii) Minimum number of plastic hinges required to render the structure a Mechanism is

a) i + 2

b) i + 1

c) i – 1,

d) i where 'i' is the degree of statical indeterminacy.

iii) The wall of a circular tank may be designed for only cantilever action when H^2/Dt is

a) more than 12

b) less than 6

c) between 6 and 12

d) between 12 and 30 where 'H', 'D' and 't' are the height, diameter and thickness of the tank wall.

iv) The shape factor of a rolled steel I-section is

a) 1.0 b) 1.5

c) 1.24 d) 1.14.

v) The impact factor for live load on a bridge is

a) directly proportional to the span

b) inversely proportional to the span

c) directly proportional to the square of the span

d) constant.

vi) Friction coefficient between cable and the duct in a post-tensioned prestressed beam is minimum generally when

a) grease b) paraffin

c) machine oil d) kerosene.

vii) The seismic zones in India, as per IS : 1893-2002, are divided into

a) two b) three

c) four d) five parts.

viii) Loss due to elastic shortening in a post-tensioned prestressed member is

a) always zero

b) equal to half that of the corresponding pre-tensioned case

c) zero when all the cables are stressed simultaneously

d) equal to that for the pre-tensioned case.

ix) For the design of sleepers in railway bridges, the impact factor should be taken as

a) 0.9 b) 1.0

c) 1.1 d) 1.2.

x) The economical span of a bridge can be assessed using the principle of

a) $C_s = C_t$

b) $C_s < C_t$

c) $C_s > C_t$

d) $C_s = 2 \times C_t$ — where C_s and C_t are the cost of superstructure of one span and cost of substructure of one pier including foundations respectively.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Define and explain 'Plastic Hinge' and 'Shape Factor' with reference to the plastic design of steel structures.
3. Discuss the advantages and disadvantages of Prestressed Concrete w.r.t. Reinforced Concrete.
4. Detail the design loads and steps for the design of a typical stringer beam of a through type steel truss railway bridge.
5. For a RCC rectangular beam section of overall depth 'D', width 'b' and percentage of steel = 1.0%, compute the Moment of Resistance for uncracked section if M20 concrete and Fe415 grade steel are used. Use σ_{cbt} = 1.8 N/mm^2, σ_{cdt} = 1.3 N/mm^2, σ_{st} = 150 N/mm^2 for steel at outer face and σ_{st} = 120 N/mm^2 for steel at liquid face. 5
6. Detail the superstructure and substructure components of a typical RCC bridge.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. Design a typical RCC Slab Culvert for the following data :

   a) Carriageway Width – 7.5 m, b) Wearing Coat – 80 mm average thickness, c) Clear Span – 6.0m, d) Width of bearing – 300 mm, and e) Loading Case – IRC Class AA tracked vehicle only.

8. Design and detail the reinforcements of the wall and base slab of a RCC circular water tank of diameter 12.0m resting on ground and having wall free to slide at the base. The height of the tank is 4.5m. Use M20 concrete and Fe415 grade steel with the permissible stresses given in Q.5.

9. A post-tensioned prestressed concrete beam is prestressed by three sets of cables each with 10 nos. 7mm dia high tensile wires and initial prestress of 1200 N/mm^2. Two of the cables are placed at uniform eccentricity of 180 mm while the third one has zero eccentricity at the supports and 180 mm at the midspan following a parabolic profile.

   a) Calculate the extreme fibre stresses at the midspan.

   b) Calculate the actual effective prestress in the cables after computation of all losses assuming that all cables are stressed simultaneously. Use the following data :

      i) span of the beam – 8.0m, ii) superimposed live load – 20 kN/m, iii) beam section – 300 mm (width) × 500 mm (depth) uniform, iv) E_s = 210 kN/mm^2, v) E_c = 35 kN/mm^2, vi) relaxation loss of steel – 80 N/mm^2, vii) age of transfer = 30 days, viii) coefficient of friction between cable and duct – 0.40 ix) coefficient of friction for wave effect – 0.0015 per metre.

10. Determine the required value of M_p for a single bay single storey portal frame ABCD with the following data :

    a) Column AB – hinged at A – height 4.0 m – section with 1.5 M_p.

    b) Beam BC – span 4.5 m – section with 2.0 M_p.

    c) Column CD – fixed at D – height 4.0 m – section with 3.0 M_p.

    d) Design Loads – W concentrated vertical on beam BC at 1.5 m from end B. And W concentrated horizontal at the joint B from left to right.

    e) Load Factor – 1.7.

    Show calculations for all possible mechanisms.

11. Design the wall of a R.C.C. rectangular water tank when the maximum moment is 30kN.m/m and maximum tension is 50kN/m. Use M-20 Concrete and Fe-415 grade steel. Check for interaction as per I.S. Code.

12. The grid plan of a RCC 4-storied office building at Kolkata is shown in the figure given. The building has only outer walls 250 mm thick at all levels. Use the following data to

determine the base shear and seismic forces at all floor and roof levels as per IS Code :

a) Floor to floor height – 3.3 m.

b) LL intensity at each floor – 4.0 kN/m^2.

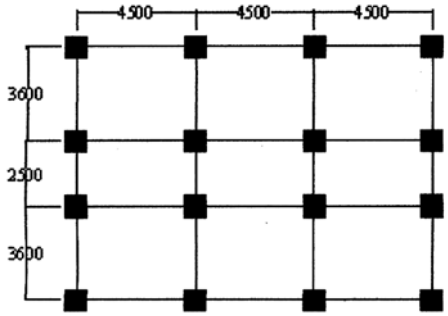
c) L.L intensity at roof – 1.5kN/m^2.

d) D.L. intensity including slabs & beams at each floor & roof – 6.5 kN/m^2.

e) Columns – 400mm × 400mm uniform for all columns.

f) Damping coefficient – 5%.

g) Building designed as Special Moment Resistant Frame.



ALL DIMENSIONS ARE IN mm.