CBCS SCHEME

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15CV82

Eighth Semester B.E. Degree Examination, Aug./Sept.2020
Design of Prestressed Concrete Structural Elements

Time: 3 hrs. Max. Marks: 80

Note: i) For Regular Students: Answer any FIVE full questions irrespective of modules.
ii) For Arrear Students : Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Distinguish between pretensioning and post tensioning. **(05 Marks)**

b. Explain why high strength steel and high strength concrete are used in prestressed concrete. **(06 Marks)**

c. Explain with a neat sketch "Hoyer's long line" system of pre-tensioning. **(05 Marks)**

2 A pretensioned concrete beam having an unsymmetrical I-section having overall depth 1300mm, top flange 600mm wide and 250mm thick, bottom flange 350mm wide and 300mm thick and thickness of web is 150mm is used to support live load of 11kN/m over a span of 30m. The prestressing force of 3200kN is located at an eccentricity of 580mm at the centre of span section. Determine the extreme fibre stresses at mid span section when the beam supports dead and live loads assuming the loss of prestress is 15 percent. **(16 Marks)**

Module-2

3 a. How do you estimate the loss of prestress due to
i) Elastic deformation
ii) Shrinkage of concrete
iii) Creep of concrete. **(06 Marks)**

b. A pretensioned beam 250mm wide and 360mm deep is prestressed by 10 wires of 8mm diameter initially stressed to 1000N/mm^2. The centroid of the steel wires is located at 105mm from the soffit. Determine the maximum stress in concrete immediately after transfer allowing elastic shortening of concrete only at the level of the centroid of steel.
If however the concrete is subjected to additional shortening due to creep and shrinkage and the steel is subjected to a relaxation of stress of 5 percent. Find the final percentage of loss of prestress in the steel wires.
Take E_s = 210kN/mm^2, E_c = 36.85kN/mm^2, Creep coefficient = 1.60. Total residual shrinkage strain = 3×10^{-4}. **(10 Marks)**

4 a. What are the factors affecting deflection of a PSC beam? **(06 Marks)**

b. A prestressed concrete beam of rectangular section 120mm wide and 300mm deep, span over 6m. The beam is prestressed by a straight cable carrying an effective force of 200kN at an essentricity of 50mm. The modulus of elasticity of concrete is 38kN/mm^2.
Compute the deflection at centre of span for the following cases:
i) Deflection under prestress + self weight
ii) Find the magnitude of uniformly distributed live load which will nullify the deflection due to prestress and self weight. **(10 Marks)**

Module-3

5 a. What are the different flexural failure modes observed in prestressed concrete beam? Explain with sketches. **(06 Marks)**

b. A post tensioned bridge girder with unbounded tendons is of box section of overall dimensions 1200mm wide × 1800mm deep with wall thickness 150mm. The high tensile steel has an area of 4000mm^2 and is located at an effective depth of 1600mm. The effective prestress in steel after all losses is 1000N/mm^2 and the effective span of the girder is 24m. If f_{ck} = 40N/mm^2 and f_p = 1600N/mm^2, estimate the ultimate flexural strength of the section. **(10 Marks)**

6 Design a post tensioned prestressed concrete roof girder to suit the following data:

Effective span = 20m

Live load = 12kN/m

f_{ck} = 50N/mm^2

f_{ct} = 41N/mm^2

lose ratio = 0.85

Cable containing 12 wires of 7mm diameter (f_p = 1500N/mm^2) are available for use. Design the girder as Type-1 member to confirm IS1343. **(16 Marks)**

Module-4

7 a. Explain different methods of improving shear resistance of PSC members. **(06 Marks)**

b. A prestressed girder of rectangular section 150mm wide shear force of 130kN. The uniform prestress across the section is 5N/mm^2. Given the characteristic strength (cube) strength of concrete is 40N/mm^2 and Fe-415 HYSD bars of 8mm diameter, design suitable spacing for the stirrups confirming to Indian standard code IS-1343 recommendations. Assume cover to the reinforcement as 50mm. **(10 Marks)**

8 a. Explain mechanism of shear failure in PSC beams. **(06 Marks)**

b. The horizontal prestress at the centroid of a concrete beam of rectangular section 120mm × 250mm is 7N/mm^2 and the maximum shearing force on the beam is 70kN. Calculate the maximum principal tensile stress, what is the maximum vertical stress required to eliminate this principal stress? **(10 Marks)**

Module-5

9 a. Write a note on zone stresses. **(06 Marks)**

b. The end block of a prestressed concrete girder is 200mm wide × 300mm deep. The beam is post tensioned by two Freyssinet anchorage each of 100mm diameter with their centres located at 75mm from top and bottom of beam. The force transmitted by each anchorage being 2000kN. Compute the bursting force and design suitable reinforcements according to IS1343, sketch the arrangement of anchorage zone reinforcement. **(10 Marks)**

10 The mid section of a composite T beam comprises a pretensioned beam 300mm wide and 900mm deep and an in-situ cast slab 900mm wide and 150mm deep. The effective prestressing located 200mm from the soffit of the beam is 2180kN. The moment due to the weight of the precast section is 273kN-m at mid span. After this is erected in place, the top slab is cast producing a moment of 136.5kN-m at midspan.

After the slab concrete is hardened, the composite section is to carry a maximum live load moment of 750kN-m. Compute the resultant final stresses at

i) The top of slab

ii) The top and bottom of precast section. **(16 Marks)**

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