CBCS SCHEME

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17CV82

Eighth Semester B.E. Degree Examination, July/August 2021
Design of Prestressed Concrete Elements

Time: 3 hrs. Max. Marks: 100

Note: ***1. Answer any FIVE full questions.***
2. Use of IS-1343 is permitted.

1 a. Distinguish between pretensioning and post-tensioning. **(06 Marks)**
b. List the advantages of PSC over RCC. **(04 Marks)**
c. Explain with sketch Hoyer's long line systems of pre-tensioning. **(10 Marks)**

2 a. Explain the concept of load balancing in prestressed concrete design. **(06 Marks)**
b. A prestressed concrete beam made of T-section has flange (1000mm and 150mm) and web 200mm × 800mm. Beam supports super imposed load of 180kN/m over a simply supported span of 8m. If the prestressing force in the tendon is 6200kN at mid span and is located at a distance of 500mm from soffit, determine the resultant stresses at mid span for the following cases:
i) Prestress + self weight
ii) Prestress + self weight + super imposed load
Take unit weight of concrete = 24kN/m^3. **(14 Marks)**

3 a. List the different types of losses in pretensioning and post tensioning separately. **(06 Marks)**
b. A prestressed concrete beam 300mm × 600mm is prestressed by tendons of area 800mm^2 at a constant eccentricity of 100mm with an initial stress of 1050N/mm^2. Span of the beam is 10.5m. With the following additional data, calculate losses for both pre and post-tensioning cases:
ES = 210kN/mm^2
EC = 35kN/mm^2
Anchorage slip = 1.5mm
K = 0.0015m
Ultimate keep strain = 40×10^{-6} per 1N/mm^2 stress for pretensioning and 20×10^{-6} per 1N/mm^2 for post tensioning
Shrinkage strain = 300×10^{-6} for pretensioning
= 200×10^{-6} for post-tensioning
Relaxation steel = 2.5% **(14 Marks)**

4 a. What are the factors influencing deflections of PSC beams? Indicate how long term deflection is calculated? **(07 Marks)**
b. A concrete beam having a rectangular section 150mm × 300mm is prestressed by a parabolic cable at an eccentricity of 75mm at mid span towards bottom soffit and at an eccentricity of 25mm towards top at support sections. The effective prestressing force is 350kN. The beam supports a concentrated live load of 20kN at centre of span in addition to the self weight with a span 8m. Find the short term deflection at the centre of span under prestress, self weight, and live load. Find also the long term deflection if the loss ratio is 0.8 and the creep coefficient is 1.6. Take E_C = 38kN/mm^2. **(13 Marks)**

5 a. Discuss the IS code method of determining the ultimate moment of resistance of rectangular and flanged sections PSC members. **(08 Marks)**

b. A post-tensioned bonded prestressed concrete beam of T-section has a flange width of 1500mm and thickness of flange is 200mm. Thickness of the rib is 300mm. The area of high tensile steel is 5000mm^2, located at an effective depth of 1800mm. If the characteristic strength of concrete and steel are 40N/mm^2 and 1600N/mm^2 respectively. Calculate the flexural strength of T-section. **(12 Marks)**

6 Design a pretensioned roof purlin to suit the data given below:
Effective span = 6m, udl = 5kN/m, f_{ck} = 50N/mm^2, loss ratio = 0.8 permissible stresses at transfer are σ_{ct} = 15N/mm^2, σ_{tt} = -1.0N/mm^2. At service load permissible stresses are, σ_{cw} = 17N/mm^2, σtw = 0, 7mm high tensile steel wires having an ultimate strength f_{pu} = 1600N/mm^2 are available for use. **(20 Marks)**

7 a. Explain the mechanism of shear failure in PSC beam. **(04 Marks)**

b. A concrete beam of rectangular section 200mm wide and 650mm deep is prestressed by a parabolic cable located at an eccentricity of 120mm at mid span and zero at the supports. If the beam has a span of 12m and carries a udl of 4.5kN/m. Find the effective force necessary in the cable for zero shear stress at the support section. For this condition calculate the principal stresses. The density of concrete is 24kN/m^3. **(08 Marks)**

c. The support section of a PSC beam (150 × 300mm) is to resist a shear of 100kN. The prestress at centroidal axis is 5N/mm^2, fck = 40N/mm^2. The cover to tension reinforcement is 45mm. Check the section for shear and design suitable shear reinforcement, ft = 1.5N/mm^2. **(08 Marks)**

8 A post tensioned beam of size 400mm width and 600m depth is subjected to the following ultimate load conditions at service loads:
M = 350kN-m
T = 100kN-m
V = 100kN
If the area of prestressing tendons is 70mm^2 and effective prestressing force at service load condition is 800kN at an eccentricity of 200mm using provisions of IS:1343, design suitable transverse reinforcement. Take
f_{ck} = 40N/mm^2
f_y = 415N/mm^2
f_{pu} = 1600N/mm^2 and cover = 50mm. **(20 Marks)**

9 a. What is meant by composite construction in PSC? What are the advantages of composite construction? **(08 Marks)**

b. The precast prestressed unit has dimension 120mm × 200mm while cast-in-situ slab has 400mm × 40mm. The effective span is 6m and is prestressed with a force of 250kN with its centroid coinciding with bottom kern point. Determine the final stresses developed, if live load on slab is 10kN/m^2. Assume loss of prestress as 15 percent and modular ratio between pre cast and cast in concrete same. The beam was not propped while casting slab. **(12 Marks)**

10 A composite beam is made up of a precast rib of size 120mm × 200mm and a cast-in-situ slab of size 400mm × 40mm. It was prestressed with a force of 250kN with straight cables at an eccentricity of 35mm. Determine the deflection of the beam, if it is unsupported at the time of casting slab. Assume 15% loss.
Given : span = 6m,
Live load = 4kN/m
Modulus of elasticity for precast and cast-in-situ concrete = 30kN/mm^2. **(20 Marks)**

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