CBCS SCHEME

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15CV82

Eighth Semester B.E. Degree Examination, July/August 2022
Design of Prestressed Concrete Elements

Time: 3 hrs. Max. Marks: 80

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of IS1343 is permitted.***
3. ***Missing data if any may be assumed suitably.***

Module-1

1 a. Explain the concept of using high strength concrete and high strength steel in PSC structures. **(08 Marks)**

b. Explain with neat sketch, Magnel Blaton system of prestressing. **(08 Marks)**

OR

2 a. Define pre stressed concrete. Distinguish between Pretensioning and Post tensioning in PSC. **(06 Marks)**

b. A beam of symmetrical I – Section of span 8m flange with 250mm, Flange thickness 80mm Overall depth 450mm , Thickness of web 80mm. The beam is prestressed by parabolic cable with eccentricity of 150mm at midspan and zero at supports. L L on beam is 2.5 kN/m.
i) Determine the effective force in the cable for balancing the dead and live loads on the beam.
ii) Sketch the distribution of resultant stress distribution for mid span section , for the above case. **(10 Marks)**

Module-2

3 a. List out the various losses of prestress and explain briefly. **(06 Marks)**

b. A prestressed concrete beam 200mm wide and 300mm deep is prestressed with wires (area = 320mm^2) located at a constant eccentricity of 50mm and carrying an initial stress of 1000 MPa. The span of beam is 10m. Calculate the percentage loss of stress in wires if
i) Beam is pretensioned and ii) Beam is post tensioned using the following data :
E_S = 210 kN/mm^2 , E_C = 35 kN/mm^2 , Creep of concrete = 1.6 , Slip at anchorage = 1mm
Relaxation of steel stress = 5% of initial stress ,
Frictional coefficient for wave effect = 0.0015 per meter.
Shrinkage of concrete = 300×10^{-6} for pretensioning and 200×10^{-6} for post – tensioning. **(10 Marks)**

OR

4 a. List the factors influencing deflection of a PSC beam. **(06 Marks)**

b. A concrete beam with a cross sectional area of 32×10^3 mm^2 and radius of gyration of 72mm is prestressed by a parabolic cable carrying an effective stress of 1000 N/mm^2. The span of the beam is 3m. The cable is composed of 6 wires of 7mm diameter, has an eccentricity of 50mm at the centre of span and zero at the supports. Neglecting all losses, find the central deflection of the beam for the following cases.
i) Self weight + Prestress ii) Self weight + Prestress + Liveload of 2kN/m.
Assume E = 38kN/mm^2 and D_C = 24 kN/m^3. **(10 Marks)**

Module-3

5 a. Discuss the types of Flexural failure in PSC members with the help of neat sketches. **(06 Marks)**

b. A Pretensioned T section flange width of 300mm and thickness 200mm. The rib is 150mm wide by 350mm deep. The effective depth of the cross section is 500mm. Given $A_P = 200mm^2$, $f_{ck} = 50$ MPa and $f_p = 1600$ N/mm^2. Estimate the ultimate moment capacity of the T – section using the IS code regulations. **(10 Marks)**

OR

6 A prestressed girder has to be designed to cover a span of 12m, to support an uniformly distributed liveload of 15kN/m. M-45 grade concrete is used for casting the girder. The permissible stress in compression may be assumed as 14MPa and 1.4MPa in tension. Assume 15% losses in prestress. The preliminary section proposed for the girder consists of a symmetrical I – section with flanges 300mm wide and 150mm thick. The web is 120mm wide and 450mm deep.

i) Check the adequacy of the section provided to resist the service loads.

ii) Design the minimum prestressing force and the corresponding eccentricity for the section. **(16 Marks)**

Module-4

7 a. Discuss the various methods of improving the shear resistance of PSC members. **(03 Marks)**

b. A prestressed concrete beam span 10m of rectangular section, 120mm wide and 300mm deep is axially prestressed b a cable carrying an effective force of 180kN. The beam supports a total udℓ of 5kN/m which includes the self weight of the member. Compare the magnitude of the principal tension developed in the beam with and without the axial prestress. **(07 Marks)**

c. A prestressed girder of rectangular section 150mm wide by 300mm deep is to be designed to support an ultimate shear force of 130kN. The uniform prestress across the section is 5MPa. Given the characteristic cube strength of concrete as 40MPa and Fe-415 HYSD bars of 8mm diameter, design the suitable shear reinforcement as per IS – 1343 code recommendations. Assume cover to the reinforcement as 50mm. **(06 Marks)**

OR

8 a. List and explain the types of shear cracks in structural concrete. **(08 Marks)**

b. The support section of a prestressed concrete beam 100mm wide and 250mm deep is required to support an ultimate shear force of 60kN. The compressive prestress at the centroidal axis is 5MPa. The characteristic cube strength of concrete is 40N/mm^2. The cover to tension reinforcement is 50mm. If the characteristic tensile strength of steel in stirrups is 250MPa. Design suitable reinforcement at the section using IS – 1343 code provisions. **(08 Marks)**

Module-5

9 a. Explain the concept of stress distribution in End block. **(06 Marks)**

b. The end block of a post tensioned PSC member is 550mm wide and 550mm deep. Four cables each made up of 7 wires of 12mm diameter strands and carrying a force of 1000 kN are anchored by plate anchorages 150mm by 150mm , located with their centres at 125mm from the edges of the end block. The cable duct is 50mm diameter. The 28 day cube strength of concrete f_{cu} is 45 MPa. The cube strength of concrete at transfer f_{ci} is 25MPa. Permissible bearing stresses behind anchorages should conform with IS-1343. The characteristic yield stress in mild steel anchorage reinforcement is 260N/mm^2. Design suitable anchorages for the end block. **(10 Marks)**

OR

10 A precast pretensioned beam of rectangular section has an effective span of 5m. The beam has a breadth of 100mm and depth of 200mm. The beam is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150kN. The loss of prestress may be assumed to be 15%. The beam is incorporated in a composite T – beam by casting a top flange of breadth 400mm and thickness 40mm. If the composite beam supports a live load of $8kN/m^2$. Calculate the resultant stressed developed in the precast and insitu cast concrete assuming the pretensioned beam as :

i) unpropped and ii) propped during the casting of the slab.

Assume the same modular of elasticity for concrete in precast beam and insitu cast slab.

(16 Marks)

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