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15CV82

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

Time: 3 hrs. Max. Marks: 80

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

1 a. Define Prestressed Concrete. Explain briefly Pretensioned and Post tensioned members. **(03 Marks)**

b. A PSC unsummetrical I section beam span 8m support a load 20kN/m , Top flange 300 × 60mm ; Bottom flange 100 × 60mm ; Web 80 × 280mm ; P = 100kN located at 50mm from bottom. Find stress at mid span. Given A = 46.4×10^3mm^2 , NA 156mm from top $I_{xx} = 760.45 \times 10^6$ mm^4. **(05 Marks)**

c. A PSC inverted T section web 300 × 900mm , Flange 300 × 600mm , Simply supported over a span of 15m. It is tensioned by 3 cable each containing 12 wires of 7mm diameter placed at 150mm from Soffit. Calculate Max UDL the beam can carry if Max tension and compression is limited to 1MPa and 15Mpa. Loss of pre stress 15%. **(08 Marks)**

2 a. Explain Load Balancing Concept. **(03 Marks)**

b. A PSC section 400 × 600mm is prestressed by 1920kN by a parabolic cable having max eccentricity 200mm at mid span 100mm at support. Find stress at mid span only by load balancing concept. **(07 Marks)**

c. A PSC beam with single overhanging is simply supported at A, Continuous over B span AB 8m and over hanging BC 2m , C/S of beam 300 × 900mm , Live load at 3.52kN/m. Suggest a suitable cable profile. Take prestressing force 500kN. **(06 Marks)**

3 a. Define Loss of Pre-stress. Briefly explain different loss with suitable formula. **(05 Marks)**

b. A post tensioned PSC beam 250 × 400mm is prestressed by 12 wires of 7mm diameter stressed to 1200N/mm^2. The cable is parabolic with eccentricity 120mm at centre and zero at support span 10m. Calculate loss of pre-stress and % loss of pre-stress. Take $\mu = 0.55$, K = 0.0015/m , $\varepsilon_{cs} = 1.354 \times 10^{-4}$, $\phi = 1.6$, $E_s = 2 \times 10^5$N/mm^2 , $E_c = 31.6 \times 10^3$ N/mm^2. , Relaxation 5% , Slip 2mm. **(06 Marks)**

c. A post tensioned PSC member 400 × 400mm span 12m is pre-stressed by 4 – cable each having area 200mm^2 initial pre-stress 1000N/mm^2. Find the loss of pre-stress when cable is tensioned one by one. Take $\varepsilon_{cs} = 0.003$, $\phi = 2.5$, m = 6 , Δ = 3mm , $E_s = 2.1 \times 10^5$N.mm^2. Eccentricity of cable is zero. **(05 Marks)**

4 a. A simply supported 6m beam post tensioned by two cable having 100mm eccentricity below NA at centre. The first cable is parabolic with an eccentricity 100mm above NA at support. The second cable is straight. C/s of each cable is 100mm^2 , Initial pre-stress is 1200N/mm^2 , A = 2×10^4mm^2 , Radius of gyration 120mm. The beam support a load of 20kN each at middle third point E_c = 38kN/mm^2. Calculate Short term and Long term deflection. Take ϕ = 2. Loss of pre-stress 20%. **(10 Marks)**

b. A PSC beam 200 × 400mm span 10m is pre-stressed by a parabolic cable at 80mm from bottom at mid span and 125mm from top at support force in the cable 400kN , E_c = 35 kN/mm^2. Calculate i) Deflection at mid span to support its self weight.
ii) Point load to be applied at centre for zero deflection. **(06 Marks)**

5 a. A pretensioned T – section flange 1200mm × 150mm , Web 300mm × 1500mm , Steel area 4700mm^2 , located at a depth 1600mm M40 conc. Find Ultimate moment tensile strength of steel 1600N/mm^2. **(10 Marks)**

b. A post tension unbounded rectangular beam 400mm × 800mm effective depth cross sectional area of cable 2840mm^2 , Effective pre-stress 900N/mm^2 , Span 16m. Find Ultimate moment. Take M40 conc. **(06 Marks)**

6 Design a PSC beam E-span 15m live load 20kN/m , Loss of pre-stress 20% , Permissible comp stress in conc at transfer and at working load 15N/mm^2 and 12N/mm^2. No tensioned is allowed. Take b = 400mm. **(16 Marks)**

7 a. Explain Shear failure is PSC member. **(04 Marks)**

b. A post tensioned beam 200 × 400mm span 10m , Load 8kN/m , P = 500kN. The cable is parabolic with 140mm eccentricity at mid span and zero at support. Calculate
i) Principal stress at support ii) Find principal stress in absence of pre-stress. **(12 Marks)**

8 a. The cross section of a bridge girder T beam, top flange 600mm × 230mm , Web 150mm , NA is at 545mm from top of area 328500mm^2 , MI = 665 × 10^{8}mm^4 , Second moment of area , $a\bar{y}$ = 665 × 10^8 mm^3 , Span 25m , Cable area 2300mm^2 , Parabolic cable with e = 650mm at mid span and 285 at support effective pre stress 900N/mm^2 , Tensile stress is concrete 1.6N/mm^2. Find Max UDL the beam can support if load factor is 2.0. Assume no loss of pre-stress. **(08 Marks)**

b. A PSC beam 250mm × 1500mm carries an effective pre-stress 1362kN , Shear force 771kN Slope of cable at support $\theta = \frac{1}{6}$, Extreme fiber stress 7N/mm^2 at top and zero at bottom principal tensile stress 0.7N/mm^2. Design Shear reinforcement. **(08 Marks)**

9 a. Explain Anchorage Zone stresses and stress distribution in end block with suitable figure. **(04 Marks)**

b. What are the methods available for calculating Anchorage Zero stress? Explain Indian Code provision. **(04 Marks)**

c. The end block of a post tensioned beam 300 × 300mm subjected to a anchorage force of 32.8kN by a Freyssinet anchorage area 11720mm^2. Design Anchorage reinforcement. **(08 Marks)**

10 a. Explain Composite Construction in PSC. Mention the advantages of precast PSC member. **(04 Marks)**

b. A precast pre-tensioned beam 100mm × 200mm E-span 5m is pre-stressed by a force of 150kN. Loss of pre-stress 15%. The beam is incorporated in a composite T beam by casting a top flange of breadth 400mm thickness 40mm. Live load 8kN/m^2. Assuming unproved condition. Find the stress developed. **(12 Marks)**

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