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Question Paper Code:U1104

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Professional Elective

Civil Engineering

21CEV104 – PRESTRESSED CONCRETE STRUCTURES

(Regulations 2021)

Code Book Permitted: IS 1343:2012 and IS 3370 (Part IV) – 1967

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. List the various types of tensioning devices used in prestressed concrete? CO1- U
2. A prestressed concrete rectangular beam of size 300mm X 900 mm is prestressed with an initial prestressing force of 700kN at an eccentricity of 350 mm at mid span, determine the stress at the top fiber at mid span due to prestress alone ? CO2-App
3. What are the different types of flexural modes observed in PSC beams? CO1- U
4. What are the assumptions made in strain compatibility method? CO1- U
5. What are the factors affecting deflection? CO1- U
6. What is meant by end block in Post tensioned member? CO1- U
7. Sketch some typical cross section of composite bridge deck with precast prestressed elements. CO1- U
8. Compare propped and unpropped construction methods. CO1- U
9. How are the tanks classified based on the joint? CO1- U
10. What are the forces considered in the calculation of deflection of prestressed concrete beams? CO1- U

PART – B (5 x 16= 80 Marks)

11. (a) A prestressed concrete beam of section 120mm wide by 300 mm deep is used over an effective span of 6 m to support a uniformly distributed load of 4 kN/m, which includes the self - weight of the beam. The beam is prestressed by a straight cable carrying a force of 180kN and located at an eccentricity of 50 mm. Determine the location of the thrust-line in the beam and plot its position at quarter and central span sections. CO2- App (16)

Or

- (b) A Post tensioned beam 250mm wide and 350mm deep is prestressed by 10wires of 8mm diameter initially stressed to 1100N/mm^2 with their centroids located 100mm from the soffit. Determine the maximum stress in concrete immediately after transfer allowing only for elastic shortening of concrete. If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of 6% of steel wires, estimate the final percentage loss of stress in the wire using IS code regulation and the following data. $E_s = 210\text{kN/mm}^2$, $E_c = 36.94\text{ kN/mm}^2$, creep coefficient = 1.6 total residual shrinkage strain = 3×10^{-4} . CO2- App (16)

12. (a) A pretension prestressed concrete beam having a rectangular section 200 mm wide and 450 mm deep has an effective cover of 50 mm. If $f_{ck} = 40\text{ N/mm}^2$, $f_p = 1600\text{ N/mm}^2$ and the area of prestressed steel $A_p = 461\text{ mm}^2$, Calculate the ultimate flexural strength of section using IS 1343 code provisions. CO2- App (16)

Or

- (b) A Pre tensioned T-section has a flange 180mm wide and 130mm thick. The width and depth of the rib are 280mm and 1480mm respectively. The high tensile steel has an area of 4650mm^2 and is located at an effective depth of 1580mm. If the characteristics cube strength of concrete and tensile strength of steel are 40 and 1550N/mm^2 respectively. Calculate the flexural strength of the T-Section. CO2- App (16)

13. (a) Using Guyons' method Calculate the position and magnitude of the maximum tensile stress and bursting tension for the end block with concentric prestressed anchor force of 150 kN. The end block of a concrete beam rectangular in section is 150 mm wide and 250 mm deep. Transmitted to concrete by a distribution plate 150 mm and 75 mm deep concentrically located at ends. CO3- App (16)
- Or
- (b) The end block of Post tensioned PSC beam 500X500 mm is subjected to a concentric anchorage force of 1200kN by a freyssinet anchorage system of area 12000mm^2 . Design and detail the average reinforcement for the end block. CO3- App (16)
14. (a) A composite beam of rectangular section is made up of a precast prestressed inverted T beam having a rib, 150 mm by 850 mm, and a slab, 400 mm wide and 250 mm thick. The in situ cast concrete has a thickness of 800 mm and a width of 400 mm. The precast T beam is reinforced with high tensile wires ($f_{pu} = 1600\text{ N/mm}^2$) having an area 800 mm^2 and located 100 mm from the soffit of the beam. If the cube strength of the concrete in the in-situ slab and prestressed beam is 20 and 40 N/mm^2 respectively, estimate the flexural strength of the composite section. CO4-Ana (16)
- Or
- (b) A precast pre – tensioned beam of rectangular section has a breadth of 150mm and depth of 300mm. The beam with an effective span of 5m is prestressed by the tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150kN. The loss of prestress is 15%. The top flange width is 400mm with the thickness of 40mm. If the composite beam supports a live load of 8 kN/m^2 . Calculate the resultant stresses developed if the section is propped and unpropped. Assume same modulus of elasticity in precast beam and in situ slab. CO4-Ana (16)
15. (a) A non-cylinder prestressed concrete pipe of 1.7m diameter of core thickness 100mm is required to withstand a working pressure of 1 N/mm^2 . Calculate the pitch of 6mm diameter wire winding if the high tensile initial stress in the wire is limited to 1100 N/mm^2 . The permissible maximum and minimum stresses in concrete are 14 N/mm^2 and zero (tension). The loss ratio is 0.8. If the direct tensile strength of concrete is 2.5 N/mm^2 . Calculate the load factor against cracking. CO3-App (16)

Or

- (b) A prestressed concrete pipes is to be designed to withstand a fluid pressure of 1.6 N/mm^2 . The diameter of the pipe is 1200mm and shell thickness is 100 mm. The max compressive stress in concrete at transfer is 16 N/mm^2 . A residual compression of 1 N/mm^2 is expected to be maintained at service loads. Loss ratio is 0.8 high tensile wires of 5mm diameter. Analyse the spacing of wire winding for various initial stress CO3-App (16)
- i) The number of turns of wires per meter length.
 - ii) The pitch of wire winding for initially stressed to 1 kN/mm^2 & 5 kN/mm^2 .