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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APRIL / MAY 2024

CIVIL ENGINEERING

6th Semester

CE 5032 – PRESTRESSED CONCRETE STRUCTURES

(Regulation 2019)

Time:3hrs Max.Marks: 100

CO1	Design a prestressed concrete beam accounting for losses
CO2	Design for flexure and shear
CO3	Design the anchorage zone for post tensioned members and deflection in beams
CO4	Design composite members and continuous beams
CO5	Design pipes, water tanks and piles

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10x2 = 20 Marks)

(Answer all Questions)

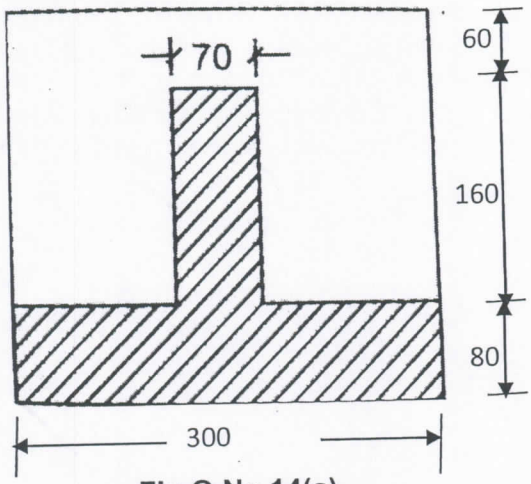
Q. No.	Questions	Marks	CO	BL
1	What are the principles of anchoring tendons in post tensioned systems.	2	1	L1
2	What do you mean by Pressure line or Thrust line?	2	1	L1
3	Enumerate the types of flexural failure modes observed in pre-stressed concrete members.	2	2	L1
4	Distinguish between web-shear crack and flexure-shear cracks in concrete beams.	2	2	L2
5	What are the factors influencing deflections?	2	3	L1
6	Define transmission zone?	2	3	L1
7	What are the assumptions made in stresses developed due to differential shrinkage?	2	4	L1
8	Sketch any two methods to achieve continuity in PSC continuous beams.	2	4	L6
9	Specify the design criteria for prestressed concrete poles.	2	5	L1
10	How are sleepers prestressed?	2	5	L1

PART- B (5x 13=65Marks)

(Restrict to a maximum of 2 subdivisions)

Q. No.	Questions	Marks	CO	BL
11 (a)	A rectangular concrete beam 250 mm wide and 300 mm deep is prestressed by a force of 550 kN at a constant eccentricity of 60 mm. The beam supports a concentrated load of 100 kN at the centre of a span of 3 m. Estimate the resultant stresses at the centre span. Also sketch the location of pressure line at the centre of the span.	13	1	L4
	OR			

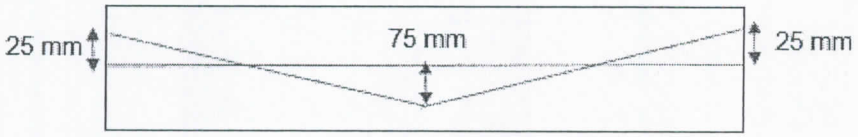
11 (b)	A post-tensioned prestressed concrete beam of span length of 8 m has a rectangular section 250 mm wide and 750 mm deep. The beam is prestressed by a parabolic cable concentric at the supports and with an eccentricity of 250 mm at the centre of the span. The beam is prestressed by 12 wires each of 7 mm diameter initially stressed to 1100 N/mm^2. Estimate the loss of prestress using IS 1343, given the following data: coefficient of friction for curvature effect = 0.55 Friction coefficient for wave effect = 0.003/m Anchorage slip at the jacking end = 3 mm Relaxation of steel stress = 4 % Es = 210 kN/mm^2; Ec= 35 kN/mm^2 Creep co-efficient = 2.2 Residual shrinkage strain = $2x10^{-4}$	**13**	1	L4
12 (a)	A post-tensioned bonded T-beam has a flange width of 1200 mm and thickness of 150 mm. The width of the rib is 300 mm. The high tensile steel tendons of cross-sectional area 4700 mm^2 are located at an effective depth of 1600 mm. If the characteristic strength of concrete and steel are 40 and 1600 N/mm^2 respectively, calculate the flexural strength of the T section using Indian standard code provisions.	**13**	2	L4
	OR			
12 (b)	A prestressed beam of rectangular section 120 mm wide and 250 mm deep is to be designed to support an ultimate sheer force of 60 kN. The uniform prestress across the section is 5 MPa. Given the characteristic cube strength of the concrete as 35 MPa, grade of steel as Fe 415, and effective cover to the reinforcement as 60 mm. Design suitable shear reinforcements according to IS 1343 recommendations.	**13**	2	L4
13 (a)	A simply supported beam spanning over 6 m is post-tensioned by two cables both of which have an eccentricity of 100 mm towards the soffit at mid-span. The first cable is parabolic and is anchored at an eccentricity of 100 mm towards the top of the beam at supports. The second cable is straight and is parallel to the longitudinal axis of the beam with constant eccentricity. Each of these cables carry a force of 140 kN. The cross-sectional area of the beam is $2x10^4$ mm^2 and the radius of gyration (k) is 120 mm. (Hint: Moment of inertia = Area x k^2). The beam supports a concentrated load of 50 kN at the mid-span. Modulus of elasticity = 38 kN/mm^2. Calculate the instantaneous deflection at mid span.	**13**	3	L4
	OR			
13 (b)	The end block of a post-tensioned beam 400 mm wide by 800 mm deep is prestressed by an effective force of 1200 kN. The anchorage plate is 400x400 mm. Estimate the bursting tension. Also, design the suitable end block reinforcements using IS1343. Adopt Fe415 grade HYSD bars.	**13**	3	L4

14 (a)	The deck of a prestressed concrete bridge with an overall depth of 300 mm is made up of an inverted T- section, with an insitu concrete laid over it as shown in Fig.14(a).Given the following data; Height of centroid from soffit = 80 mm Prestress at bottom = 11 N/mm^2 (compression) $I=1472x10^5 N/mm^2$. Prestress at top = 1 N/mm^2 (tension) Ec= 35 kN/mm^2. The bridge has a span of 6 m and the precast beams are required to support the weight of the web concrete infill without any propping. When the infill which may be assumed a modulus of elasticity of 28 kN/mm^2, has hardened, a uniformly distributed load of 13 kN/m^2 is applied. Calculate the resultant final stresses at (a) top and bottom of the precast beam (b) highest point in the concrete infill.  **Fig.Q.No.14(a)**	**13**	4	L4
	OR			
14 (b)	A continuous PSC beam ABC (AB=BC=15m) has a uniform rectangular cross section 100 x 300 mm. The cable carries an effective prestressing force of 350 kN is parallel to the axis of the beam and located at 100 mm from the soffit. Determine (a) secondary and the resultant moment at the central support B (b) resultant stress at the top and bottom of the beam at B if the live load of 1.5 kN/m is acting. Given the density of concrete as 24 kN/m^3.	**13**	4	L4
15 (a)	A cylindrical prestressed concrete water tank of internal diameter 30 m is required to store water over a depth of 7.5 m ; maximum compressive stress in concrete at transfer is 13 N/mm^2(compression); minimum compressive stress at working load = 1 N/mm^2. The prestress is to be provided by the circumferential winding of 5mm diameter wires with an initial stress of 1000 N/mm^2. Fressynet cxables made of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are used for vertical prestressing; Loss ratio is 0.75. Design the tank walls if the joint conditions at the base are fixed. The cube strength of concrete is 40 N/mm^2.	**13**	5	L4

	OR			
15 (b)	A pre-tensioned prestressed concrete pole of rectangular section 150 mm wide by 400 mm deep at the base is proposed for a pole of height 10 m. The analysis of wind loads on pile face and wires, indicate a maximum design moment of 25 kNm at the base section. The permissible compressive stress in concrete is 14 N/mm² and no tension is permitted under working loads. The loss of prestress may be taken as 30%. 5 mm high tensile wires initially stressed to 1500 N/mm² are available for use. Check the adequacy.	**13**	5	L4

PART- C (1x 15=15Marks)

(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16.	A concrete beam of 8 m span is prestressed by a linearly varying cable having eccentricities as shown in Fig.Q.No.16. The force in the cable is 350 kN. The beam supports a concentrated load of 20 kN at the centre of the span. If E = 38 kN/mm^2. Loss ratio =0.8 and creep coefficient =1.6. Compute the short-term and long-term deflections. The cross-section of the beam is 150 mm x 300 mm.  Fig.Q.No.16	15	3	L4