USN			CMRIT

Internal Assessment Test II – June.2022

Sub	Design of Prestressed concrete					Sub Code:	18CV81/ 17CV82	Branch:	Civil Engg
Date:	04.06.2022	Duration:	90 min's	Max Marks:	50	Sem/Sec:	8th sem /All sections		OBE

		MARKS	CO	RBT
1.	What are the factors influencing the deflection of PSC beam? Obtain expression to calculate the deflection due to trapezoidal tendon due to eccentricity 'e' at mid span and concentric at supports.	[10]	CO2	L1

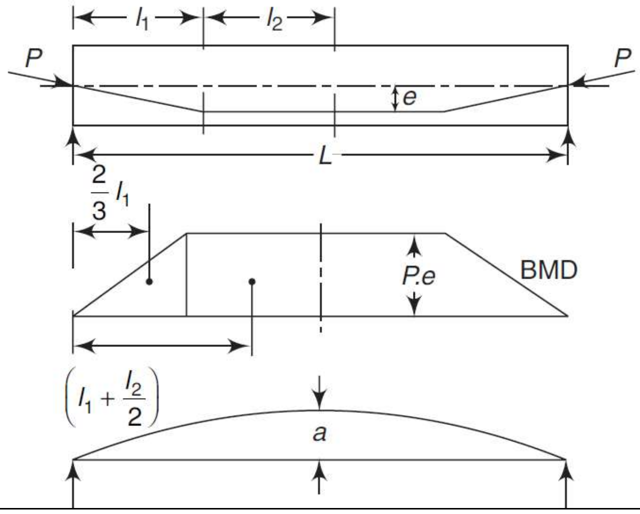
i. Factors influencing deflections

1. Imposed load and self-weight
2. Magnitude of prestressing force
3. Cable profile
4. Second moment of area of cross section
5. Modulus of elasticity of concrete
6. Shrinkage, creep, and relaxation of steel stress
7. Span of the members
8. Fixity conditions

Trapezoidal Tendons

A draped tendon with a trapezoidal profile is shown. Considering the BMD, the deflection at the centre of the beam is obtained by taking the moment of area of the BMD over one-half of the span.

$$a = -\frac{Pe}{EI}\left[l_2(l_1 + l_2/2) + (l_1/2)(2/3l_1)\right] = -\frac{Pe}{6EI}\left[2l_1^2 + 6l_1l_2 + 3l_2^2\right]$$



		MARKS	CO	RBT
2.	What are the different types of flexural failures observed in PSC members? List the factors which influences the flexural failures in PSC members	[10]	CO3	L1

Different types of flexural failures in PSC members

- Fracture of steel in tension
- Failure of under-reinforced sections
- Failure of over-reinforced sections
- Other modes of failure

Prestressed concrete members subjected to transverse loads may fail in shear before their full flexural strength is attained, if they are not adequately designed for shear

- failure of the bond between the steel and the surrounding concrete
- Anchorage failures

- Fracture of steel in tension
  The sudden failure of a prestressed member without any warning is due to the fracture of steel in the tension zone. This type of failure is imminent when the percentage of steel provided in the section is so low that when the concrete in the tension zone cracks, the steel is not in a position to bear up the additional tensile stress transferred to it by the cracked concrete. This type of failure can be prevented by providing a certain minimum percentage of steel in the cross-section.
  - ✓ The Indian Standard Code IS: 1343 prescribes a minimum longitudinal reinforcement of 0.2 per cent of the cross-sectional area in all cases except in the case of pretensioned units of small sections.
  - ✓ When a high-yield strength deformed reinforcement is used, the minimum steel percentage is reduced to 0.15 per cent.
- Failure of under-reinforced sections
  If the cross-section is provided with an amount of steel greater than the minimum prescribed in case 1, the failure is characterised by an excessive elongation of steel followed by the crushing of concrete. As bending loads are increased, excessive elongation of the steel raises the neutral axis closer to the compression face at the critical section.
  The member approaches failure due to the gradual reduction of the compression zone, exhibiting large deflections and cracks, which develop at the soffit and progress towards the compression face.
  When the area of concrete in the compression zone is insufficient to resist the resultant internal compressive force, the ultimate flexural failure of the member takes place through the crushing of concrete.
  Large deflections and wide cracks are the characteristic features of under-reinforced sections at failure

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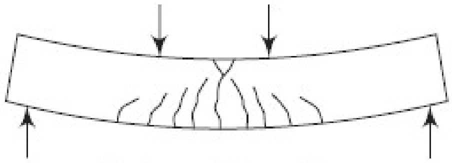
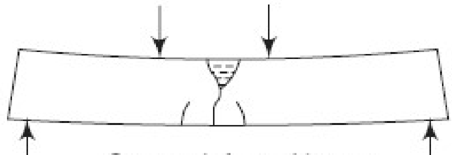
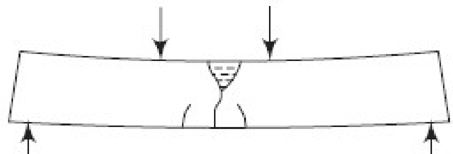

Under–reinforced beam

Over–reinforced beam

- Failure of over-reinforced sections

When the effective reinforcement index, which is expressed in terms of the percentage of reinforcement, the compressive strength of concrete and the tensile strength of steel exceed a certain range of values, the section is said to be over-reinforced. Generally, over-reinforced members fail by the sudden crushing of concrete, the failure being characterised by small deflections and narrow cracks (Figure).


Over–reinforced beam

Factors Influencing the flexural failures in PSC members

- percentage of reinforcement in the section
- degree of bond between tendons and concrete
- compressive strength of concrete
- ultimate tensile strength of the tendons
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<tr><td>3.</td><td>A concrete beam with a rectangular section 300 mm wide and 500 mm deep is prestressed by 2 post tensioned cables of area 650 mm^2 each. Initially stressed to 1650N/mm^2 . The cables are located at a constant eccentricity of 100 mm throughout the length of beam having a span of 10.5 m. The modulus of elasticity of steel and concrete is 210 and 38 kN/mm^2 a) Neglecting all losses, the deflection at the centre of span when it is supporting its own weight. b) Allowing for 20% loss in prestress, find the final deflection at the centre of span when it carries an imposed load of 20kN/m. Density of concrete = 24 kN/m^3</td><td>[10]</td><td>CO2</td><td>L2</td></tr>
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	Self-weight of beam = w = 0.3 × 0.5 ×1 × 24 = 3.6 kN/m $I = \frac{bD^3}{12} = \frac{300 \times 500^3}{12} = 3.125 \times 10^9$ mm^4 As = 2 × 650 = 1300 mm^2 f_{si} = 1650 N/mm^2, e = 100 mm , l = 10.5 m, Es = 210 kN/mm^2 Ec = 38 kN/mm^2 Po = As f_{si} = 1300 × 1650 = 2145 kN Downward deflection due to self-weight = $\frac{5}{384\,Ec\,I} wl^4 = \frac{5}{384 \times 38 \times 10^3 \times 3.125 \times 10^9} \times 3.6 \times 10500^4$ = 4.798 mm Upward deflection due to prestressing force = $\frac{P e l^2}{8 E_c I} = \frac{2145\ 000 \times 100 \times 10500^2}{8 \times 38 \times 10^3 \times 3.125 \times 10^9}$ = 24.89 mm Net upward deflection of the beam when it supports its own weight = 24. 89 – 4.798 = 20.092 mm Downward deflection due to live load = $\frac{5}{384\,Ec\,I} ql^4 = \frac{5}{384 \times 38 \times 10^3 \times 3.125 \times 10^9} \times 20 \times 10500^4$ = 26.65 mm Upward deflection of the beam due to prestress after loss = 80 % × −29. 56 = - 23.64 mm Final downward deflection of the beam due to self-weight +prestress +live load = 4+4.79 – 23.64 + 26.65 = +7.8 mm			

4	A pretensioned prestressed concrete beam having a rectangular section with a width of 150 mm and overall depth of 350 mm is prestressed by tendons of effective area 461 mm2 at an effective depth of 300 mm. Assuming the characteristic strength of concrete and steel as 40 and 1600 N/mm^2 , estimate the ultimate flexural strength of the section using the provisions of the Indian Standard Code.	[10]	CO3	L2

5.

A PSC beam 210 mm wide and 350mm deep is prestressed with wires of area 400 mm^2 located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/mm^2. Span of the beam is 12m. Calculate the percentage loss of stress in wires if a) the beam is pretensioned b) the beam is post tensioned, Using the following data Es = 210kN/mm^2 , Ec = 34.5 kN/mm^2

Relaxation of steel = 5% of intial stress

Shrinkage of concrete = 300 × 10^{-6} for pretensioning

= 200 × 10^{-6} for post

tensioningCreep coefficient Cc = 1.6

Slip at anchorage = 1 mm

Frictional coefficient for wave effects k = 0.0015/m

A = 300 × 200 = 60000 mm^2

P = 1000 × 400 /1000 = 400 kN, A = 240 × 600 = 144000mm^2