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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST - 1

Even Semester: 2018-19 | **Date**: 06 March 2019

Course Code: CIV 307 | **Time**: 1 Hour

Course Name: Elements of Prestressed Concrete | **Max Marks**: 40

Programme & Sem: B.Tech (DE) & VIII Sem (Group-I) | **Weightage**: 20%

Instructions:

(i) Scientific and Non-programmable calculators are permitted

Part A

Answer **both** the Questions. **Each** question carries **five** marks. (2Qx5M=10)

1. Explain the terms:
   a. Moderate prestressing
   b. Hydrogen embrittlement
   c. Bonded and non-bonded prestressed concrete
2. What is the necessity for using high strength concrete and high strength steel in prestressed concrete?

Part B

Answer **both** the Questions. **Each** question carries **five** marks. (2Qx5M=10)

3. What is load balancing in prestressed concrete members?
4. Explain pre-tensioned and post tensioned concrete.

Part C

Answer **both** the Questions. **Each** question carries **ten** marks. (2Qx10M=20)

5. A concrete beam of rectangular section having a width of 250 mm and depth 500 mm, is prestressed by a cable carrying a force of 600 kN at an eccentricity of 100 mm. If the beam supports a live load of 20 kN/m over an effective span of 8m, estimate the resultant stress at the top and bottom fibers at mid-span section due to the effect of prestress, dead and live loads. Assume unit weight of concrete is 24 kN/m^3.
6. A concrete beam 150 mm wide and 300 mm deep is prestressed by a straight cable carrying an effective force of 200 kN at an eccentricity of 50 mm. The beam spanning over 7m supports a total uniformly distributed load of 4 kN/m, which includes self-weight of the beam. The initial stress in the tendons is 900 N/mm^2. Determine the percentage increase of stress in the tendons due to the loading of the beam. Take E_s = 210 kN/mm^2 and E_c = 35 kN/mm^2.

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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST - 2

Even Semester: 2018-19 | **Date**: 16 April 2019

Course Code: CIV 307 | **Time**: 1 Hour

Course Name: Elements of Prestressed Concrete Structures | **Max Marks**: 40

Program & Sem: B.Tech & VIII Sem(DE) Group-I | **Weightage**: 20%

Instructions:

(i) Scientific and Non-programmable calculators are permitted

(ii) IS 1343 code book is not required. Data provided in the questions.

Part A

Answer **both** the Questions. **Each** question carries **five** marks. (2Qx5M=10)

1. What are the different types of flexural failure modes observed in prestressed concrete beams? Explain briefly.

2. Differentiate between short-term and long-term deflections of prestressed concrete beams.

Part B

Answer **both** the Questions. **Each** question carries **six** marks. (2Qx6M=12)

3. A prestressed concrete girder is post-tensioned using a cable concentric at supports and having an eccentricity of 200 mm at the center of span. The effective span of the girder is 18m. The initial force in the cable is 300 kN at the jacking end. Determine the loss of force in the cable due to friction. Take μ = 0.30 and K = 0.0043/m. [$P_x = P_o e^{-(\mu\alpha+kx)}$]

4. A pre-tensioned prestressed concrete beam having a rectangular section with a width of 200 mm and overall depth of 400 mm is prestressed by tendons of effective area 400 mm^2 at an effective depth of 350 mm. Assuming the characteristic strength of concrete and steel as 30 and 1600 N/mm^2, estimate the ultimate flexural strength of the section using the provisions of the IS 1343 code: [$M = f_{pu} A_p (d-0.42 x_u)$] Refer table.11 in page 2.

Part C

Answer **both** the Questions. **Each** question carries **nine** marks. (2Qx9M=18)

5. A post-tensioned prestressed concrete beam of span 8m with a rectangular section 300 mm wide x 350 mm deep, is prestressed by high tensile wires of c/s area 2000 mm^2 and stressed to 1000 N/mm^2. Modulus of elasticity of concrete is 35 kN/mm^2 and its density is 24 kN/m^3. If the beam supports live load of 20 kN/m excluding its self-weight, compute the initial deflection due to prestress, self-weight and live loads, for a parabolic cable with an eccentricity of 100 mm at mid-span and concentric at supports:
[$a_p = -(5PeL^2) / (48EI)$; $a_{DL+LL} = (5\ W_{DL+LL}\ L^4) / (384\ E\ I)$]

6. A prestressed concrete beam of rectangular section 150 mm wide and 300 mm deep spans over 7m. The beam is prestressed by a straight cable carrying an effective force of 200 kN at an eccentricity of 60 mm. If it supports an imposed load of 4 kN/m, E_c = 36 kN/mm^2, and density of 24 kN/m^3. Compute the final deflection under prestress + self-weight + LL, including creep and shrinkage. Assume creep coefficient to be 2. Compare with IS 1343 code provisions:
[*Span / 300; Span / 250, as applicable,* $a_p = -(PeL^2) / (8EI)$, $a_{DL+LL} = (5\ W_{DL+LL}\ L^4) / (384\ E\ I)$]

TABLE 11 CONDITIONS AT THE ULTIMATE LIMIT STATE FOR RECTANGULAR BEAMS WITH PRE-TENSIONED TENDONS OR WITH POST-TENSIONED TENDONS HAVING EFFECTIVE BOND

$\frac{A_p f_p}{b d f_{ck}}$	Stress in Tension as a Proportion of the Design Strength $\frac{f_{pu}}{0.87\ f_p}$		Ratio of the Depth of Neutral Axis to that of the Centroid of the Tendon in the Tension Zone x_u/d	
	Pre-tensioning	Post-tensioning with effective bond	Pre-tensioning	Post-tensioning with effective bond
(1)	(2)	(3)	(4)	(5)
0.025	1.0	1.0	0.054	0.054
0.05	1.0	1.0	0.109	0.109
0.10	1.0	1.0	0.217	0.217
0.15	1.0	1.0	0.326	0.316
0.20	1.0	0.95	0.435	0414
0.25	1.0	0.90	0.542	0.488
0.30	1.0	0.85	0.655	0.558
0.40	0.9	0.75	0.783	0.653

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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Even Semester: 2018-19 | **Date**: 23 May 2019

Course Code: CIV 307 | **Time**: 3 Hours

Course Name: Elements of Prestressed Concrete Structures (DE) | **Max Marks**: 80

Program & Sem: B.Tech & VIII Sem (Group-I) | **Weightage**: 40%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Scientific and Non-programmable calculators allowed.
(iii) IS 1343 Code book will be provided. Please return to invigilator after your exam.

Part A

Answer **all** the Questions. **Each** question carries **one** mark. Choose only **one**, most appropriate, option for each question. (20Qx1M=20M)

1.

i. In prestressed concrete members, the steel is under
(a) Compression (b) Tension (c) Bending (d) Torsion

ii. Prestressing is possible by using
(a) Mild Steel (b) High-strength steel
(c) High strength deformed bar (d) All of above

iii. Circular prestressing is advantageous in
(a) Beams (b) Columns (c) Pipes (d) Slabs

iv. Prestressing wires in electric poles are
(a) Concentric (b) Eccentric (c) Parabolic (d) None of above

v. In cable-stayed bridges, the cables supporting the deck of the bridge are under:
(a) Tension (b) Torsion (c) Bending (d) Compression

vi. In axially prestressed members, the concrete is under
(a) Compression (b) Torsion (c) Tension (d) Bending

vii. Shrinkage of concrete in a structural member is due to
(a) Lateral Load (b) Live Load (c) Loss of prestress (d) Loss of Moisture

viii. High-tensile steel is basically:
(a) Low Carbon Steel (b) High Carbon Steel
(c) High Manganese Steel (d) Mild Steel

ix. Curved cables can be used in:
(a) Pre-tensioned members (b) externally-prestressed member
(c) post-tensioned member (d) circular pipes

x. In long line method of pre-tensioning:
(a) Only one long member can be cast at a time (b) two members can be cast
(c) several members can be cast (d) Any of above

xi. In post-tensioning system:
(a) Member is prestressed by use of expansive cement
(b) Wires are first tensioned followed by concreting
(c) Tensioning of wires and concreting are done simultaneously
(d) The wires are tensioned against hardened concrete

xii. In prestressed members requiring very large forces, the tendons preferred are:
(a) Wires (b) Strands (c) MS Bars (d) HYSD Bars

xiii. Concentric tendons in a concrete beam section induces:
(a) Variable compressive stress (b) Uniform compressive stress
(c) Tensile stress (d) Bending stress

xiv. Eccentric tendons in a concrete beam section induces:
(a) Only direct stress (b) Direct and bending stress
(c) Compressive stress (d) Bending and shear stress

xv. Resultant stress in the cross section of a prestressed beam typically comprises of:
(a) Prestress + dead load stress + live load stress
(b) Prestress + dead load stress
(c) Prestress + live load stress
(d) Tensile + Compressive + Bending stresses

xvi. In a prestressed concrete beam subjected to prestress only:
(a) Pressure line coincides with the cable line
(b) Pressure line shifts from the cable line towards the bottom of beam
(c) Pressure line coincides with NA of the section
(d) Pressure line shifts from the cable line towards the top of beam

xvii. In a prestressed concrete beam subjected to prestress, dead and live loads:
(a) The pressure line shifts more at centre of span and zero at supports
(b) The pressure line shifts uniformly towards the top of the beam as load increases
(c) Pressure line coincides with neutral axis of the section
(d) Pressure line coincides with the cable line

xviii. In a prestressed concrete beam the applied loads are resisted by:
(a) Shift in the pressure line from cable line depending upon the moment
(b) Increase in the tensile stress in concrete
(c) Concrete cross-section
(d) Increase in the stress in tendons

xix. A concentrated live load at center of span of a prestressed concrete beam can be counter balanced by selecting:
(a) Linearly varying cable profile (b) Parabolic cable profile
(c) Concentric cable profile (d) Straight cable profile

xx. Uniformly distributed load on a concrete beam can be effectively counter balanced by selecting:
(a) Concentric cable profile (b) Eccentric cable profile
(c) Parabolic cable profile (d) Linearly varying cable profile

Part B

Answer **both** the Questions. **Each** question carries **five** marks. (2Qx5M=10M)

2. Explain transmission length and IS1343 codal provisions for the same
3. Explain end zone reinforcement

Part C

Answer **all** the Questions. **Each** question carries **ten** marks. (5Qx10M=50M)

4. A prestressed concrete beam of 12 m span and rectangular cross-section, 150 mm wide and 300 mm deep, is axially prestressed by a cable carrying an effective force of 200 kN.

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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

SUMMER TERM / MAKE UP END TERM EXAMINATION

Summer Term: 2018-19 | **Date**: 24 July 2019

Course Code: CIV 307 | **Time**: 2 Hours

Course Name: Elements of Prestressed Concrete Structures | **Max Marks**: 80

Program & Sem: B.Tech (Civil) & VII Sem (2015 Batch) | **Weightage**: 40%

Instructions:

(i) Read the question properly and answer accordingly.

(ii) Scientific and Non-programmable calculators allowed.

(iii) IS 1343 Code book will be provided. Please return to invigilator after your exam.

Part A

Answer **all** the Questions. **Each** question carries **one** marks. Choose only **one**, most appropriate, option for each question. (20Qx1M=20M)

1.

I. Hoop tension developed in circular water tanks is best resisted by using
(a) Parabolic tendons (b) Circular or hoop tendons
(c) Straight tendons (d) Linearly varying tendon profile

II. For resisting concentrated live loads at quarter span points in a prestressed concrete beam, the ideal shape of tendon profile to be used is
(a) Trapezoidal (b) Linear (c) Parabolic (d) Concentric

III. In a pre-tensioned beam, there will be loss of stress due to
(a) Friction (b) Anchorage Slip
(c) Elastic deformation of concrete (d) All of the above

IV. In a post-tensioned beam there will be loss of stress due to
(a) Shrinkage of concrete (b) Creep of concrete
(c) Relaxation of steel (d) Any of above

V. Loss of stress due to elastic deformation of concrete depends upon
(a) Relaxation of steel (b) Modular ratio (c) Friction (d) Anchorage Slip

VI. Loss of stress due to creep of concrete is influenced by
(a) Relaxation of steel b) Creep coefficient (c) Anchorage Slip (d) Friction

VII. Loss of stress in steel due to creep of concrete is proportional to
(a) Modulus of elasticity of steel (b) Anchorage Slip
(c) Elastic deformation of concrete (d) Relaxation of steel

VIII. Loss of stress due to relaxation of steel is influenced by:
(a) Friction between steel and concrete (b) Creep of concrete
(c) Shrinkage of concrete (d) Initial stress in steel

IX. Loss of stress due to friction is dependent on:
(a) Modulus of elasticity of concrete (b) Relaxation of steel
(c) Modulus of elasticity of steel (d) Coefficient of friction

X. The loss of stress due to friction is maximum in the case of:
(a) Linear members b) Circular members
(c) Inclined members (d) Curved members

XI. Maximum permissible final deflection of a beam should not exceed:
(a) span/350 b) span/480 (c) span/200 (d) span/250

XII. Suitable control of deflections is essential to:
(a) Prevent failure of the member
(b) Avoid damage to partitions and finishes
(c) Prevent shear failure
(d) All of above

XIII. Deflection of prestressed concrete beam is excessive in the:
(a) Pre-cracking stage (b) Elastic stage
(c) Post-cracking stage (d) None of the above

XIV. Short-term deflection of a prestressed beam can be computed using:
(a) Mohr's circle (b) Bending moment diagram
(c) Mohr's theorem (d) shear force diagram

XV. A parabolic cable profile with maximum eccentricity at mid-span and concentric at supports when stressed results in:
(a) Zero deflection (b) Downward deflection
(c) Upward deflection (d) Sagging deflection

XVI. Long-term deflection of a prestressed member depends on:
(a) Relative humidity (b) Tendon profile
(c) Type of tendons (d) Modulus of rigidity

XVII. Prestressed concrete beam fails suddenly without warning due to:
(a) Failure of steel in compression (b) Failure of steel in tension
(c) Failure of concrete in compression zone (d) Failure of concrete in tension zone

XVIII. Failure of over reinforced prestressed concrete beam is characterized by:
(a) Large cracks (b) Sudden failure due to fracture of steel in tension
(c) Balanced failure (d) Explosive failure due to crushing of concrete in compression

XIX. The maximum effective reinforcement ratio of a bonded prestressed concrete beam at failure according to IS 1343 is limited to a value of:
(a) 0.15 (b) 0.3 (c) 0.4 (d) 0.25

XX. The main reason for not recommending the use of unbonded tendons in prestressed concrete elements is to prevent:
(a) Excessive deflections (b) Sudden failure
(c) Impairment of flexural strength (d) Loss of prestress

Part B

Answer **both** the Questions. **Each** question carries **five** marks. (2Qx5M=10M)

2. Explain bond stresses in pre-tensioned beams with neat sketch.
3. List the assumptions of strain compatibility method.

Part C

Answer **all** the Questions. **Each** question carries **ten** marks. (5Qx10M=50M)

4. A prestressed concrete beam of 12m span and rectangular cross-section, 200 mm wide and 400 mm deep. It is prestressed by a curved cable having an eccentricity of 100 mm at the centre of span and reducing to 0 at the supports. The effective force in the cable is 200 kN.

   The maximum shear force on the beam is 45 kN. Estimate the principal stresses at the support section.

   $$f_{max,min} = \left[\frac{f_x + f_y}{2} \pm \frac{1}{2}\sqrt{(f_x - f_y)^2 + 4\zeta_v{}^2}\right]$$

5. A prestressed beam of rectangular section 100 mm x 200 mm deep, is to be designed to support an ultimate shear force of 75 kN. The uniform prestress across section is 7 N/mm^2. Given the characteristic cube strength of concrete as 45 N/mm^2 and Fe-415 HYSD bars of 8mm diameter, design suitable spacing for the stirrups conforming to the Indian standard code IS: 1343 recommendations. Assume cover to the reinforcement as 50 mm.

6. A post tensioned prestressed concrete beam, 200 mm wide and 500 mm depth is grouted before the application of live loads. The steel consists of three tendons, each made up of 10 number of 7 mm diameter wires encased in a thin metallic hose of 25 mm diameter with an effective cover of 50 mm. The modular ratio is 6. The beam spans 10 m and is subjected to maximum shear force of 200 kN. Compute the unit bond stress:
   (a) Between each wire and grout
   (b) Between the hose and the concrete.
   [$\zeta_b = V y \alpha_c A_s / \Sigma u I$; $\zeta_b = V y \alpha_c \Phi / 4I$, $\zeta_b = V/(z^* \Sigma u)$]

7. A prestressed beam of rectangular section, 150 mm wide and 300 mm deep is pre-tensioned by five high-tensile wires of 5mm diameter located at an eccentricity of 100 mm. The maximum shear force is 125 kN. If the modular ratio is 6, compute the bond stress developed assuming (a) The section is uncracked
   (b) The section is cracked (Take z = 7/8th of effective depth).
   [$\zeta_b = V y \alpha_c A_s / \Sigma u I$; $\zeta_b = V y \alpha_c \Phi / 4I$, $\zeta_b = V/(z^* \Sigma u)$]

8. A pre-tensioned beam of 12 m span has a symmetrical I section. The flanges are 200 mm wide and 50 mm thick. The web thickness is 75 mm and the overall depth of girder is 400mm. The member is prestressed by 8 strands of 7 mm diameter located on the tension side such that the effective eccentricity is 100 mm. The initial stress in the strand is 1200 N/mm^2 and the cube strength of concrete at transfer is 35 N/mm^2. Section properties are as follows: A = 45500 mm^2, I = 7.25x10^8 mm^4, Z = 4.55x10^6 mm^3.
   a) Determine the maximum vertical tensile stress developed in the transfer zone
   b) Design suitable mild steel reinforcement using 6 mm diameter stirrups. Take the permissible stress in steel as 125 N/mm^2

   [$f_{v(max)} = 10M / (b_w h L_t)$ and $A_{sv} = 2.5M/(f_s h)$]