Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 712007N **Date: 06-01-2014**

Subject Name: Prestressed Concrete

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of IS: 456 , IS:1343-1980, IS:3370-Part-III and IS:784-2001 is permitted.**

Q.1 **(a)** Define the terms: 1-) Concordant cable Profile. **02**
2-) Prestress Concrete

(b) State the difference between RCC beam and PSC beam with respect to its load resisting mechanism. **02**

(c) Draw a typical variation of Bursting Tensile Stress in the anchorage zone of a post tensioned beam and mention the region over which its effect is to be consider as per IS:1343-1980. **02**

(d) Justify the use of high strength steel in Prestressed Concrete. **02**

(e) Suggest different way of improving the shear resistance of a PSC beam. **02**

(f) What is the minimum grade of concrete recommended by IS:1343-1980 for pretension and posttensioned prestress concrete. **02**

(g) Suggest different ways of reducing the friction losses in PSC beam. **02**

Q.2 **(a)** Suggest suitable cable profile (draw sketch) w.r.t. Load Balancing Concept for a PSC beam of following cases. **07**
1-) simply supported beam subjected to point load at centre.
2-) Simply supported beam subjected to u.d.l.
3-) Simply supported beam with one side overhang subjected to u.d.l.
4-) Simply supported beam with two point load applied at equal distance.

(b) A simply supported rectangular concrete beam 250 mm wide by 300 mm deep is prestressed by a force of 540 KN at a constant eccentricity of 60 mm. The beam supports a concentrated load of 68 KN at the centre of a span of 3 m. Determine the location of a Pressure Line at centre, at quarter and at support section. Neglect the self wt. of the section. Also find the corresponding flexure stresses. **07**

OR

(b) A simply supported post-tensioned prestressed concrete beam of 30 m span is subjected to a transfer prestress force of 2500 KN at 28 days strength. The profile of the cable is parabolic with maximum eccentricity of 200 mm at mid span and concentric at support. **07**
The beam is 500 mm x 800 mm in cross-section and is prestressed wit 9 cables, each cable consisting of 12 wires of 5 mm diameter. Determine the total percentage loss of prestress, if jacking is done from one end and all the wires are tensioned at a time simultaneously.
Take Es = 2.1×10^5 N/mm^2,
Ec = 3.5×10^4 N/mm^2,
Co-efficient of friction $\mu = 0.3$,
Anchorage slip = 2 mm.
Wave co-efficient k = 15×10^{-4} per meter,
Ultimate tensile strength of 5 mm wire is 1600 N/mm^2.

Q.3 **(a)** Design a simply supported (Type-I) pretensioned prestressed concrete beam for flexure only as per IS:1343-1980 with total moment M_T=400 kN-m (including an estimated self-weight moment M_{sw} = 40 kN-m). Use concrete grade M40. The prestress at transfer is 1100 N/mm^2 and at service is 800 N/mm^2. Also **07**

The properties of the prestressing strands are given below:

- Type of prestressing tendon : 7 – wires strand
- Nominal diameter : 12.8 mm
- Nominal area : 99.3 mm^2

(b) A pre tensioned T-section has a flange 1200 mm wide and 150 mm thick. The width and depth of the rib are 300 mm and 1500 mm respectively. The high-tensile steel has an area of 4700 mm^2 and is located at an effective depth of 1600 mm. If the characteristic cube strength of the concrete and the tensile strength of steel are 40 N/mm^2 and 1600 N/mm^2 respectively, calculate the ultimate moment of T-section using IS:1343-1980 (Appendix- B) recommendations. **07**

OR

Q.3 **(a)** A Prestressed concrete beam of size 400mm x 800 mm is subjected to following service load conditions M = 300 KN-m(Moment), V = 120 KN (Shear) and T = 150 KN-m(Torsion). It is prestressed with an effective force of 1000 KN acting at an eccentricity of 220 mm. Area of prestressing steel is 940 mm2. Design the Longitudinal and transverse reinforcement necessary as per IS specification to resist the service load forces in the section using IS:1343-1980. Assume cover of 50 mm, fck = 40 N/mm2, fy = 415 N/mm2, fp=1600 N/mm2, fpe = 0.6fp (with usual notation). **09**

(b) 1-) State the difference between web shear crack and flexure Shear Crack. **05**
2-) Sketch a typical failure mode a beam under combine action of bending moment and Torsion.

Q.4 **(a)** Design a post-tensioned hanger to carry an axial tension of P_{DL}= 300 KN (including self wt.) and P_{LL} = 130 KN. The dimension of the hanger is 250 mm x 250 mm. Design the section of **Type -1** member as per IS: 1343-1980. **07**

- Grade of concrete = M35,
- Age at transfer : 28 days,
- Assumed loss in prestress : 15%,

The following properties of the prestressing strands are available from tests.

- Type of prestressing tendon = 7 wire strand,
- Nominal diameter = 12.8 mm,
- Nominal area = 99.3 mm^2,
- Ultimate tensile strength = 1860 N/mm^2,
- Modulus of Elasticity = 195 KN/mm^2.

(b) A rectangular cross section post-tensioned beam of size 300 mm x 800 mm is subjected to an effective prestressing force of 1500 kN at the centroid of the section. **07**

Take f_{ck} = 35 MPa

Permissible punching shear capacity in plate is 90 MPa.

The cables are placed symmetrically over a mild steel plate in an area of 200 mm x 350 mm. Design a bearing plate required to transfer the prestressing force. Also design and detail the reinforcement for bursting force as per IS:1343-1980.

OR

Q.4 **(a)** A Pretensioned beam of uniform rectangular section 0.15 x 0.30 m is subjected to an initial prestressing force of 337.5 KN at constant eccentricity of 0.05 m. Determine the short-time initial camber if only the self weight of the beam is effective at stress transfer. The beam is simply supported and has an effective span of 6 m. Also determine the net central deflection immediately on the application of a concentrated load of 22.5 KN at mid-span. Take Ec = 36050 Mpa. The prestressing force drops to 270 KN at the stage of load application. **08**

Also determine the long-time deflection at mid-span of the beam after 3 months and infinite times. The losses of prestress after 3 months and infinite time are 20% and 25% respectively and the corresponding value of creep co-efficient is 1.1 and 1.8 respectively. Sixty percent of the transverse load is permanent. Take density of concrete as 24 kN/m^3. Check all deflection for limiting value as per IS: 1343-1978.

(b) Answer the following w.r.t. end zone in pretensioned PSC beam. **06**

1-) Define the term: Transmission Length.

2-) State the importance of Transmission Length and the codal provision for the same.

3-) Draw typical variation of stresses in prestressing cable over a Transmission Length.

4-) Draw a typical variation of transverse tensile stresses in prestress concrete over a Transmission Length.

Q.5 **(a)** Draw typical sketches of various cable profiles used for continuous PSC beam in order to achieve continuity. **05**

(b) Explain the principle of linear transformation in PSC beam by giving suitable example. **09**

OR

Q.5 **(a)** A cylindrical prestressed water tank of internal diameter 27 m is required to store a water over a depth of 7 m. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and the minimum compressive strength under working pressure is 0.7 N/mm^2. The loss ratio is 0.8. Wires of 6 mm diameter with initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are to be used for vertical prestressing. Design the tank walls assuming the base as fixed. The cube strength of concrete is 40 N/mm^2. **14**

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