Dr. Amrit Kumar Roy 2/5/2023

National Institute of Technology, Hamirpur (HP)

Name of the Examination: B. Tech. (End Semester-May, 2023)

21

Branch: Civil Engineering
Course Name: **Prestressed Concrete**
Time: 3 Hours.

Semester: VIII
Course Code: CED - 421
Maximum Marks: 50

Note: Answer the questions as mentioned for each section (Assume any suitable data whenever required). Necessary IS codes are allowed and will be provided during examination.

Section – A (Answer all the questions)

1. Write down about the development of Building Materials with a flow-chart. Write short notes about the following topics. **(1+4×1=4)**

   i. Full, Limited or Partial Prestressing
   ii. Pre-tensioning & Post-tensioning
   iii. Source of Prestressing Force
   iv. External or Internal Prestressing

2. A concrete beam of dimension 100 mm × 300 mm (Fig. 1) is post-tensioned with 5 straight wires of 7mm diameter. The average prestress after short-term losses is 0.7fpk = 1200 N/mm^2 and the age of loading is given as 28 days. Given that E_p = 200 × 103 MPa, E_c = 35000 MPa, find out the losses of prestress due to creep, shrinkage and relaxation. Neglect the weight of the beam in the computation of the stresses. **(5)**

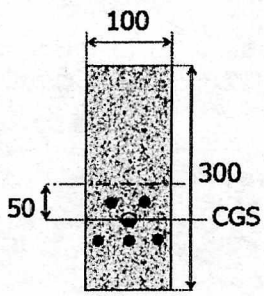


Fig. 1

Section – B (Answer all the questions)

3. Write short notes about the following topics. **(4×1=4)**

   i. Relaxation of Steel
   ii. Friction in PSC
   iii. Anchorage Slip
   iv. Force Variation Diagram

4. A concrete beam prestressed with a parabolic tendon is shown in the Fig. 2. The prestressing force applied is 1620 kN. The uniformly distributed load includes the self weight. Compute the extreme fibre stress at the mid-span by applying the three concepts. Draw the stress distribution across the section at mid-span. **(6)**

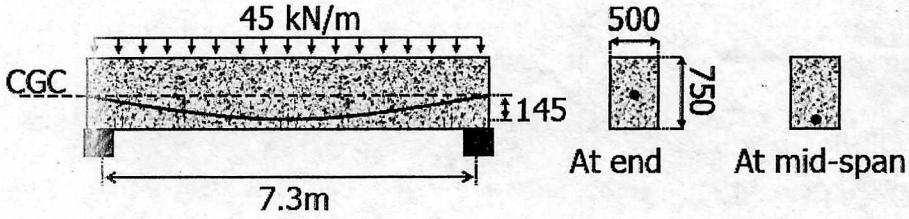


Fig. 2

Section – C (Answer all the questions)

5. Describe with suitable sketches about the following topics. **(3×1.5=4.5)**

   i. Cracking Moment ii. Kern Points iii. Pressure Line

6. What are the assumptions and Principles of Mechanics considered while analysis of members under flexure of prestressed concrete? Describe with neat sketches the analyses at transfer and at service based on stress concept. **(2+2=4)**

7. For the post-tensioned beam with a flanged section as shown in Fig. 3, the profile of the CGS is parabolic, with no eccentricity at the ends. The live load moment due to service loads at mid-span (M_{LL}) is 648 kNm. The prestress after transfer (P_0) is 1600 kN. Assume 15% loss at service. Grade of concrete is M30.

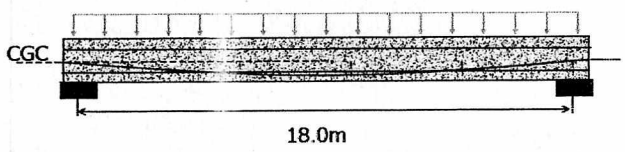
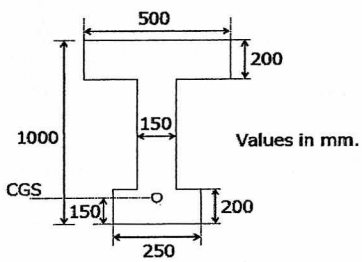


Fig. 3



Cross-section at mid-span

Evaluate the following quantities.
a) Kern levels, b) Cracking moment, c) Location of pressure line at mid-span at transfer and at service and d) The stresses at the top and bottom fibres at transfer and at service.

Compare the stresses with the following allowable stresses at transfer and at service.
For compression, $f_{cc,all}$ = – 18.0 N/mm^2, For tension, $f_{ct,all}$ = 1.5 N/mm^2. **(6.5)**

Section – D (Answer all the questions)

8. Write short notes about the following topics about tendons in PSC. **(4×1=4)**

   i. Minimum Cover Requirements ii. Minimum Side Face Reinforcement

   iii. Minimum Longitudinal Reinforcement iv. Tendon Profile

9. Design a simply supported Type 1 prestressed beam with M_T = 435 kNm (including an estimated M_{SW} = 55 kNm). The height of the beam is restricted to 920 mm. The prestress at transfer f_{p0} = 1035 N/mm^2 and the prestress at service f_{pe} = 860 N/mm^2.

   Based on the grade of concrete, the allowable compressive stresses are 12.5 N/mm^2 at transfer and 11.0 N/mm^2 at service. The properties of the prestressing strands are given below.

   Type of prestressing tendon: 7-wire strand
   Nominal diameter = 12.8 mm **(4×1=5)**
   Nominal area = 99.3 mm^2

10. Design a simply supported Type 2 prestressed beam with M_T = 435 kNm (including an estimated M_{SW} = 55 kNm). The height of the beam is restricted to 920 mm. The prestress at transfer fp0 = 1035 N/mm^2 and the prestress at service f_{pe} = 860 N/mm^2.

    Based on the grade of concrete, the allowable compressive stresses are 12.5 N/mm^2 at transfer and 11.0 N/mm^2 at service. The allowable tensile stresses are 2.1 N/mm^2 at transfer and 1.6 N/mm^2 at service. The properties of the prestressing strands are given below.

    Type of prestressing tendon: 7-wire strand
    Nominal diameter = 12.8 mm **(4×1=6)**
    Nominal area = 99.3 mm^2

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