B. Sc. Engg. (CEE)/6th Semester — 15 February 2023 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid-Semester Examination — **Summer Semester: 2021–2022**
Course Number: CEE 4613 — **Full Marks: 75**
Course Title: Design of Pre-Stressed Concrete Structures — **Time: 1.5 Hours**

There are **4 (four)** questions. Answer **3 (three)** of them. Question *1* and *2* are ***compulsory***. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

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1. (a) What are the methods of prestressing? Describe briefly. CO1, PO1: [4]

   (b) Compare prestressed concrete beam with reinforced and plain concrete beam in terms of cracking moment. CO1, PO1: [6]

   (c) Compute the concrete stresses at the top and bottom fibers at section 1-1 of the cantilever beam shown in Fig. 1. The beam has a cross-section of 800 mm by 300 mm and carries a live load of 150 kN in addition to its own weight. Use the force in tendon concept for analyzing the beam. CO1, PO1: [15]

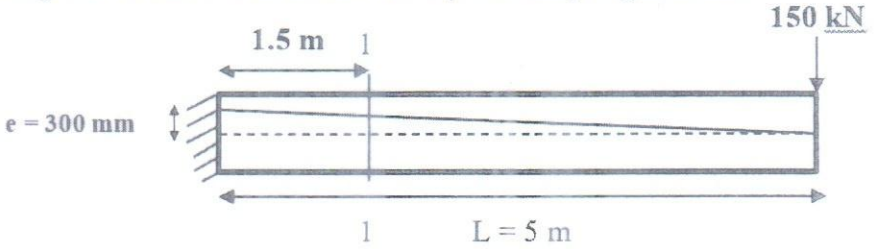

Fig. 1 for Question 1(c)

2. The following figure shows an unreinforced T-beam made of normal-weight concrete with f'_c= 40 MPa. Given that, the unit weight of the normal weight concrete is 240 kN/m^3.

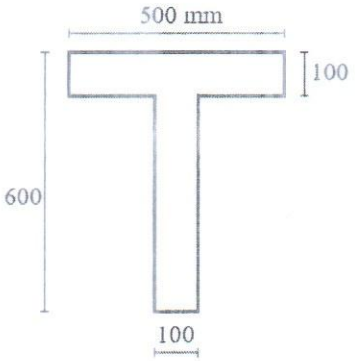

Fig. 2 for Question 2: (All dimensions are in mm)

(a) If the beam is simply supported, what is the maximum span length possible if the beam is not to undergo flexural cracking under its own weight? Given that the flexural cracking stress is 10% of f'_c. CO1, PO1: [2.5]

(b) At mid-span, what is the flexural stress at a point 350 mm from the top of the beam? CO1, PO1: [2.5]

(c) For the span length computed in part (a), what is the minimum prestressing force, applied at an eccentricity of 60 mm, that would be required to prevent tension in the beam at the mid-span section? CO2, PO2: [10]

(d) For the span length computed in part (a) and considering that the beam will carry additional load equal to its self-weight, what is the minimum prestressing force, applied at an eccentricity of 60 mm, that would be required to prevent concrete cracking in the beam at the mid-span section? Given that the cracking stress is 10% of f'_c. CO2, PO2: [10]

3. A prestressed concrete beam is continuous over two spans and is curved tendon is to be tensioned from both ends as shown in Fig. 3. Compute the percentage loss of pressure due to friction, from one end to the center of the beam (A to E) following simple approximate, approximate, and exact solution method. The coefficient of friction between the cable and the duct is taken as 0.4 and the average "wobble" or length effect is represented by K=0.0026 per meter. CO2, PO2: [25]

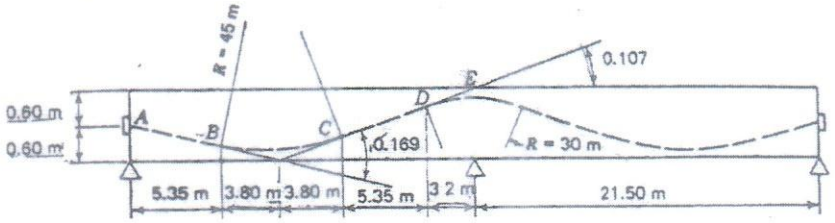

Fig. 3 for Question 3

4. Find out the losses of prestress due to elastic shortening, creep, shrinkage and relaxation for the pretensioned-prestressed concrete beam as shown in Fig. 1. The normal weight concrete beam has only its own weight w_G= 0.47 k/ft acting at transfer of prestress which occurs approximately 48 hr after initially stressing the tendons to 0.75 of f_{pu} ksi in the prestressing bed. Additional superimposed load w_s= 1 k/ft is added on the simple beam spanning 65 ft. Assume the following material properties: f'_{ci} =4500 psi, f'_c = 6000 psi, diameter of the strands= 0.5 inch, f_{pu}=270 ksi, E_s = 27.5 × 10^3 ksi, E_{ci} = 3.824 x 10^3 ksi, E_c = 4.415 x 10^3 ksi, K_{re} = 20, J = 0.15 and C= 1.45. CO2, PO2: [25]

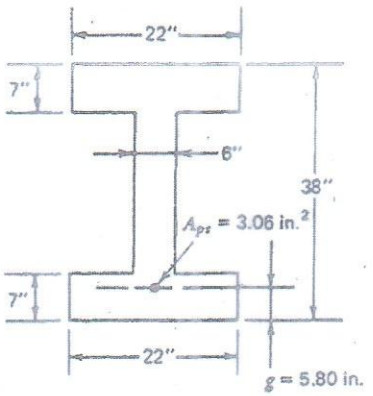

Fig. 4 for Question 4