B. Sc. Engg. (CEE)/6th Semester — 5 March, 2024 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid semester Examination — **Summer Semester: 2022–2023**
Course Number: CEE 4613 — **Full Marks: 75**
Course Title: Design of Pre-Stressed Concrete Structures — **Time: 1.5 Hours**

There are 3 (Three) questions. Answer ALL the questions. The figures in the right margin indicate full marks. COs and POs are also specified in the right margin of the questions. The symbols have their usual meaning.

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1. (a) What is the basic difference between the behavior of a pre-stressed and reinforced concrete beam section in resisting external moment? Explain with sketches. [CO1, PO1: 5]

(b) A simply supported beam as shown in **Fig. 1**, is pre-stressed by 1600 kN force. Calculate the stresses in top and bottom fibers at a distance 2.5m from support. Consider self-weight of the beam. Unit weight of concrete 25 kN/m^3. Solve by [CO2, PO2: 20]

1. Combined loading concept
2. Internal couple concept
3. Load balancing concept

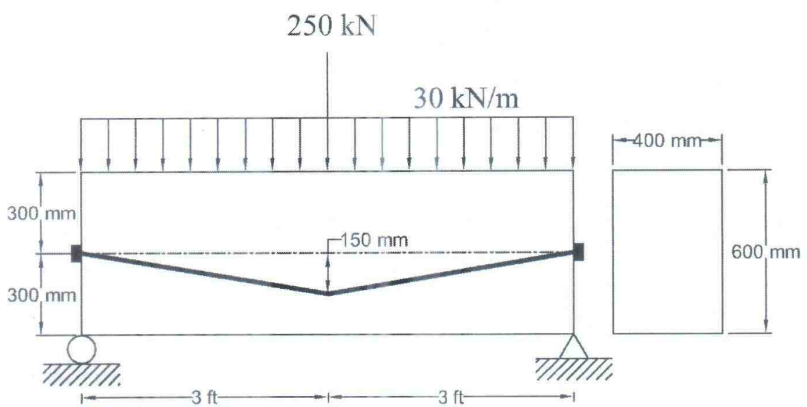


Fig. 1 for Question 1(b)

2. (a) Show mathematically that the elastic shortening loss computed using the transformed section and gross cross section is equivalent. [CO1, PO1:5]

(b) Determine the thrust force's location and magnitude for the section shown in **Fig. 2**, as well as the stress at mid span section that the thrust force has caused in the concrete. Find the amount of live load that is supported by the beam. Concrete has a unit weight of 25 kN/m^3. [CO2, PO2: 14]

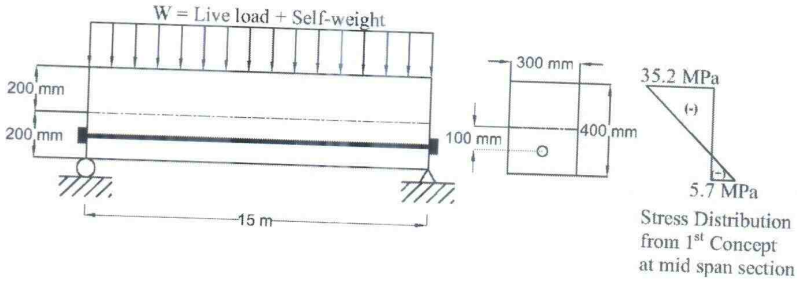


Fig. 2 for Question 2(b)

(c) A post tensioned concrete beam, 300mm wide and 600mm deep shown in **Fig. 3** is pre-stressed by a circular cable (total area = 1000 mm^2) with zero eccentricity at the ends and 200 mm at the center. The span of the beam is 8m. The cable is to be stressed from one side such that an initial stress of 840 MPa is available in the unjacked end immediately after anchoring. Determine the stress in the wires at the jacking end and the percentage of loss of stress due to friction. [CO2, PO2: 6]

- Coefficient of friction for curvature effect = 0.6
- Coefficient of friction for curvature effect = 0.003/m

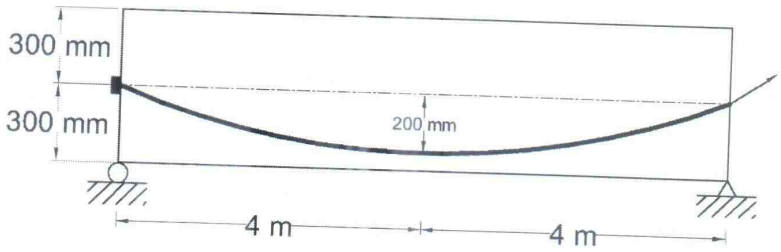


Fig. 3 for Question 2(c)

3. (a) List the factors affecting creep strain and illustrate the time-dependent strain variations graphically due to the uploading effect. [CO1, PO1: 5]

(b) Estimate the change of prestress force with time for the pretensioned-prestreesed concrete beam shown in **Fig. 4**. The normal weight concrete beam has only its own weight w_G= 6.75 kN/m acting at transfer of prestress which occurs approximately 48 h. after initial stressing of the tendons to 75% of f_{pu} in the prestressing bed. For 30 days the beam carries only w_G = 6.75 kN/m on a simply supported 22 m span. Additionally superimposed load w_s = 14.6 kN/m is added to the beam when erected at 30 days and is sustained for three years or more on the simple beam spanning 22 m. Assume the following material properties f_{pu}= 1862 MPa, f'_{ci} = 31 MPa, f_c = 41 MPa, RH = 75%, V/S = 3, K_{re} = 138, J = 0.15 and C = 1.45, K_{cr} = 2.0. [CO2, PO2: 20]

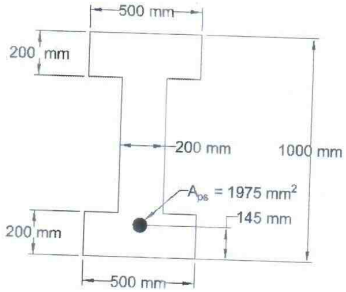
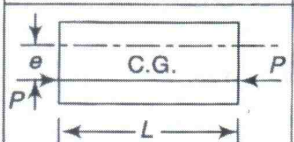
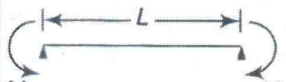
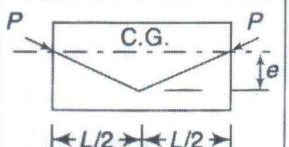
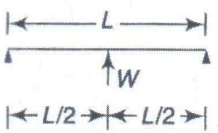
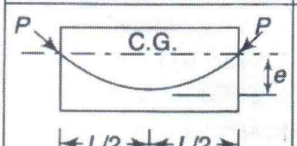
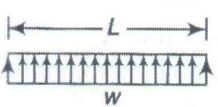
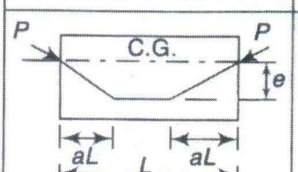
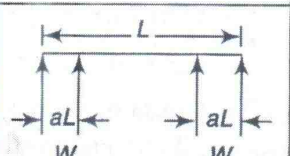


Fig. 4 for Question 3(b)

Table 4.1 *Tendon Profiles and Equivalent Loads in Prestressed Concrete Beams*

Tendon profile	*Equivalent moment or Load*	*Equivalent loading*	*Camber*
	$M = Pe$		$\frac{ML^2}{8\,EI}$
	$W = \frac{4\,Pe}{L}$		$\frac{WL^3}{48\,EI}$
	$W = \frac{8\,Pe}{L^2}$		$\frac{5WL^4}{384\,EI}$
	$W = \frac{Pe}{aL}$		$\frac{a(3-4a^2)WL^3}{24\,EI}$