University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2012
Program: B.Sc Engineering (Civil)

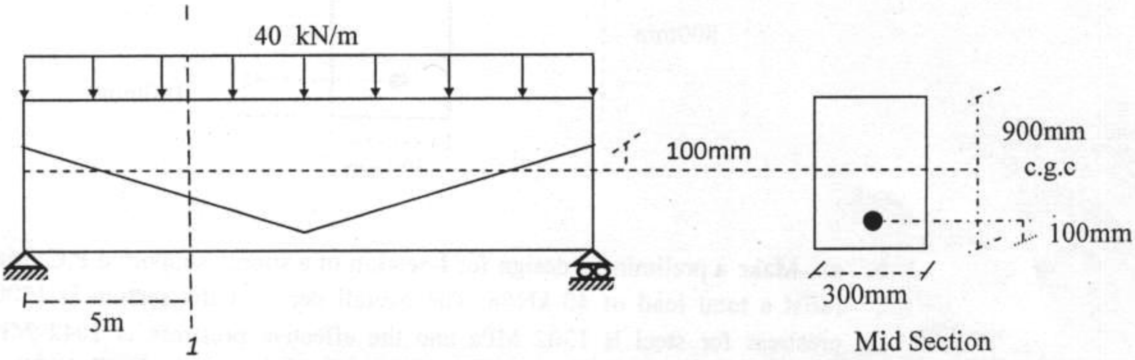
Course Title: Structural Engineering V — Course #: CE 415

Time : 2 Hr — Full Marks: 50

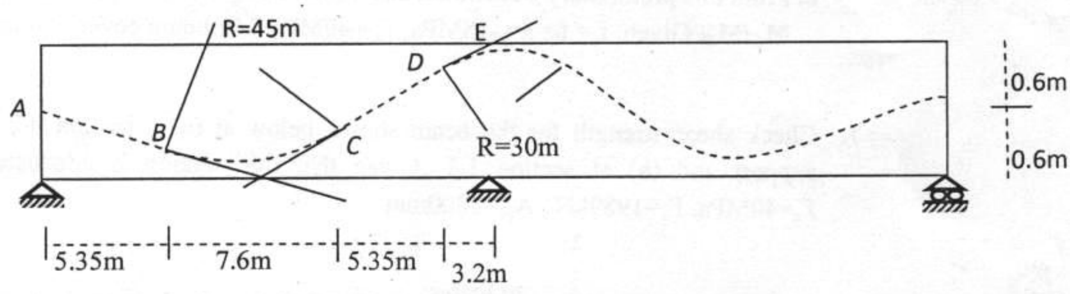
There are seven questions. Answer any **Five.** (5X10=50)

1. a. Draw a net sketch of the variation of steel stress with load in P.C. beam.

   b. A prestressed-concrete rectangular beam of 300 mm by 900 mm has a simple span of 15m and is loaded by a uniform load of 40 kN/m **excluding self-weight**. The effective prestress is 1620 kN. Compute the fiber stress in concrete at section 1-1 using **3rd concept**.

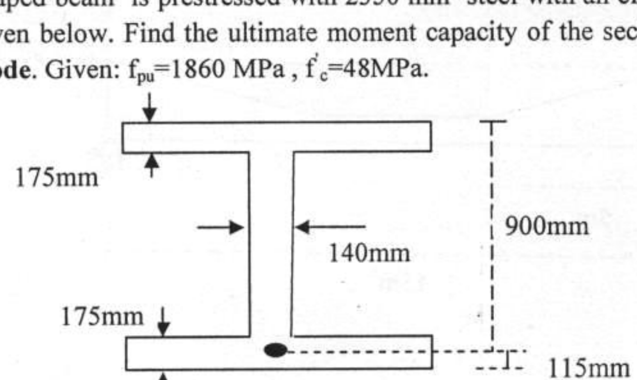


2. A prestressed concrete continuous beam with curved tendon is shown in figure below. Compute the percent of loss due to friction from A to E. Assume α=0.4 and K=0.0026 per meter. Use segmental approximate method.



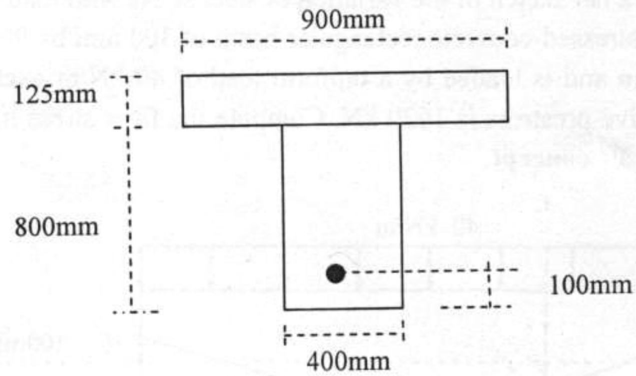
3. **a.** Write down the name of different types of loss that occur in P.C. beam.

   b. An I-shaped beam is prestressed with 2350 mm² steel with an effective prestress of 1100 MPa is given below. Find the ultimate moment capacity of the section for design following the **ACI code**. Given: f_{pu}=1860 MPa , f'_c=48MPa.



4. Find the ultimate moment capacity of the I-section of previous problem for design following **Strain Compatibility method.** Given: f_{pu}=1860 MPa , f'_c=48MPa, A_{ps}= 2350mm^2, f_{pe}= 1100 MPa,E_c=27000 MPa, E_p=190000 MPa .Use annexture-2.

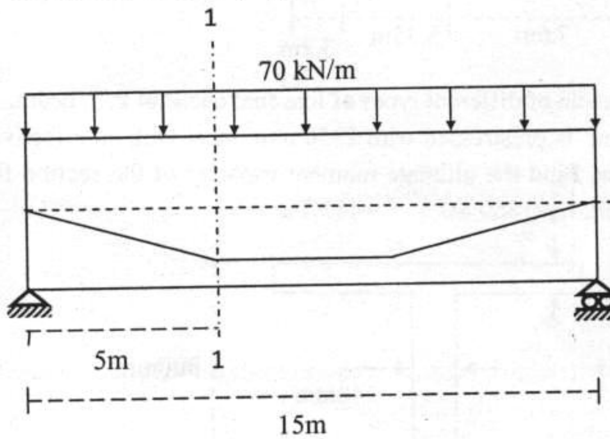
5. Mid span section of simply supported composite beam of 10m span is shown below. The precast stem (W_G=7.68 KN/m) is post-tensioned with an initial prestress force of 984 kN. The effective prestress after loss is 861 KN. The top slab (W_s=2.7 kN/m) is cast-in place above the stem. The composite section is to carry a live load moment of 450 kN-m. Compute the stresses in the section at various stages.

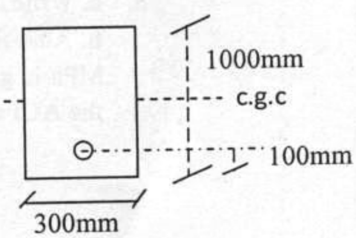


6. **a.** Make a preliminary design for **I-section** of a simply supported P.C. beam of 25m span to resist a total load of 40 kN/m. The overall depth of the section is 1300 mm. The Initial prestress for steel is 1302 MPa and the effective prestress is 1042 MPa. **Assume large M_G/M_T** ratio and thickness of web and flange=100mm. Given: allowable stress for concrete under working load ,f_c = -18 MPa

   b. From this preliminary **I-section** make a final design allowing **no tension and large M_G/M_T**. Given: f_c= f_b=f_t= -18MPa, f'_c= 40MPa. Minimum cover 75mm.

7. Check shear strength for the beam shown below at (a) a section h/2 distance apart from support and (b) at section 1-1 .Given that this section is adequate for w_u=70 kN/m, f'_c=40MPa. F_e=1989kN , A_{ps}=1800mm^2





Mid Section

Annexture-1

$$\rho = \frac{A_s}{bd}$$

$$\omega_p = \rho_p \cdot \frac{f_{ps}}{f'_c} \leq 0.3$$

$$a = \frac{A_{sp} \cdot f_{ps}}{0.85 f'_c b}$$

$$f_{ps} = f_{pu}\left(1 - \frac{1}{2}\beta \cdot \frac{f_{pu}}{f'_c}\right)$$

$$M_u = \phi A_{ps} \cdot f_{ps}\,(d_p - a/2)$$

$$A_{pf} = \frac{0.85 f'_c (b - b_w) h_f}{f_{ps}}$$

$$M_{uf} = \phi A_{pf} \cdot f_{ps}\,(d_p - h_f/2)$$

$$a = \frac{A_{pw} \cdot f_{ps}}{0.85 f'_c\, c\, b_w}$$

$$M_{uw} = \phi A_{pw} \cdot f_{ps}\,(d_p - a/2)$$

$$\epsilon_{pu} = \frac{f_{pe}}{E_p} + \frac{f_{pe} \cdot A_{ps}}{E_c}\left[\frac{e^2}{I_g} + \frac{1}{A_g}\right] + \epsilon_u \frac{d_p - c}{c}$$

$$\beta_1 = 0.85 - 0.00725\,(f'_c - 28)$$

$$C = 0.85 \beta_1 f'_c\, b\, c$$

$$= 0.85 f'_c b h_f + 0.85 f'_c b_w (\beta_1 c - h_f)$$

$$T = f_{pu} \cdot A_{sp}$$

$$F_e = \frac{M_T}{0.65h}$$

$$A_{ps} = F_e / f_{se}$$

$$A_c = \frac{A_{ps} \cdot f_{se}}{0.5 f_c}$$

$$k_t = r^2 / c_b \; ; \; k_b = \frac{r^2}{c_t}$$

$$e - k_b = M_G / F_O$$

$$F_e = M_T / e + k_t$$

$A_e =$ [illegible] $= F_e h / f_t \cdot c_b$

$$A_c = \frac{F_o}{f_b}\left(1 + \frac{e - (M_G/F_o)}{k_t}\right)$$

$$A_c = F_o h / f_b c_t$$

$$V_{cw} = (0.29\sqrt{f'_c} + 0.3 f_{pc})\, b_w d + V_p$$

$$V_{ci} = 0.05\, b_w d \sqrt{f'_c} + V_d + \frac{V_i \cdot M_{cr}}{M} \geq 0.14\sqrt{f'_c}\, b_w d$$

$$M_{cr} = \frac{I}{y_t}\left(0.5\sqrt{f'_c} + f_{pe} - f_d\right)$$

$$\frac{M}{V} = \frac{lx - x^2}{l - 2x}$$

Annexture-2

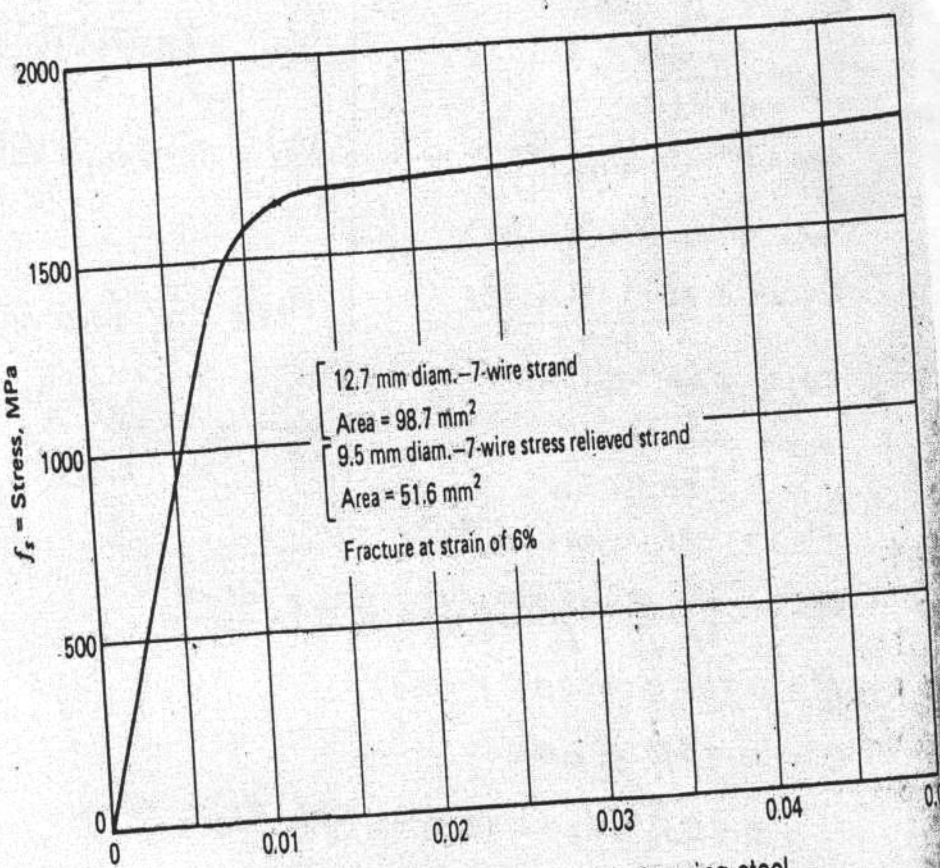


Fig. B-1. Stress strain curve for prestressing steel.