University Of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011

Subject : Concrete Design — Class: Third Year
Branch : Highways and Bridges — Time : 3 Hours
Examiner : Dr. Dhiyaa H. — Date : 8 / 6 / 2011

Note: Answer <u>Four</u> Questions Only.

Apply the ACI 318M-05 Specification, $f_c' = 24\ N/mm^2$, $f_y = 350\ N/mm^2$.

Q1) the simply supported beam shown in the figure (1) carries a service distributed dead load of (10kN/m) (without including beam self weight) and concentrated live loads (P_L). By using the Working Stress Design Method find the maximum values of (P_L) that the beam can carry.

Q2) By using the Ultimate Strength Design Method, determine the ultimate moment capacity for the beam section shown in figure (2).

Q3) The continuous beam ABC shown in figure (3) carries a service uniformly distributed dead load of (29 kN/m) (including beam self weight) and a service uniformly distributed live load of (33 kN/m). By using the Ultimate Strength Design Method, determine the longitudinal steel reinforcement required at section B and section D (Draw sections with full details).

Q4) The cantilever beam shown in the figure (4) carries a service uniformly distributed dead load of (12 kN/m) (without including beam self weight) and a service concentrated live load (P_L=17 kN) at free end (B). Find:

a) Immediate deflection at the free end (B) caused by dead and live loads.
b) Long-time deflections suppose that 25% of live load is sustained load.

Q5) The beam shown in figure (5) is subjected to a pure torsional moment of (T_U=24 kN.m). Design the necessary torsional reinforcement required for this beam. (use stirrups $\Phi 10^{mm}$ and clear cover of 40^{mm}) (draw full section details).

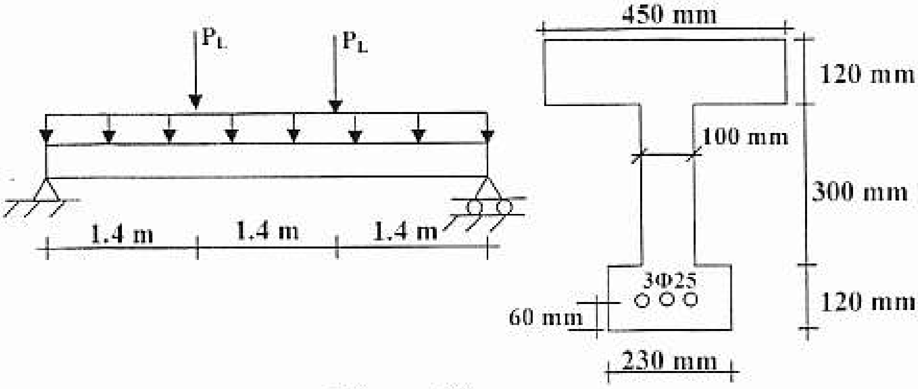

Figure (1)

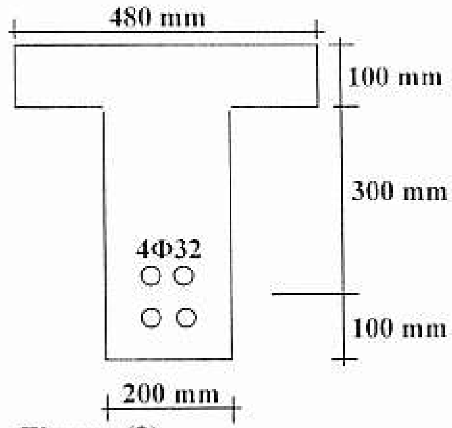

Figure (2)

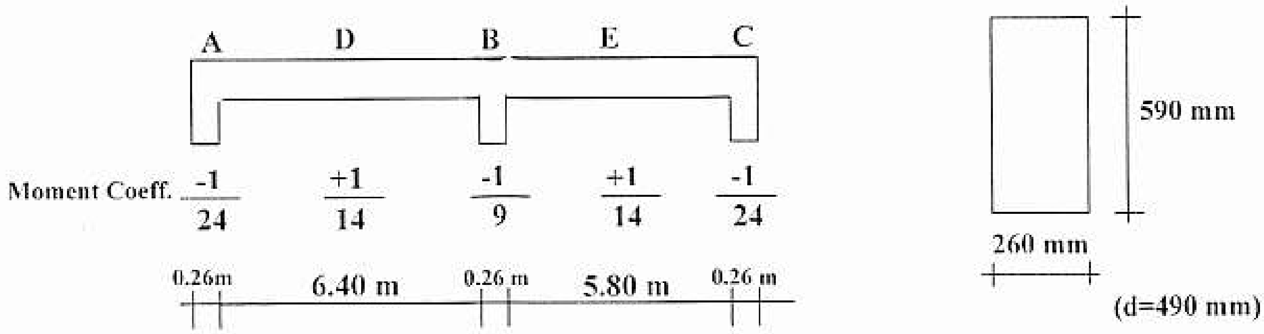

Figure (3)

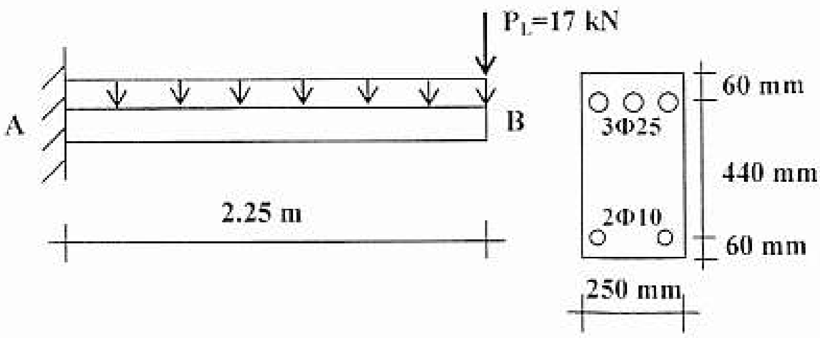

Figure (4)

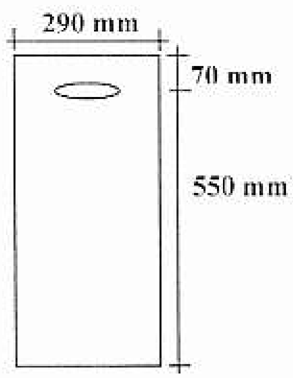

Figure (5)

$$f_{c_{all}} = 0.45 f'_c \qquad f_{s\,all} = 140 \quad N/mm^2 \qquad E_s = 200000 \quad N/mm^2$$

$$\phi = \left[\frac{7}{30} + \frac{0.2125\beta_1 f'_c}{\rho \quad f_y}\right] \leq \quad 0.9 \qquad S = \frac{A_v f_y d}{V_s} \qquad \rho_{\max} = \frac{51\beta_1 f'_c}{140 \quad f_y}$$

$$M_u = \phi\left[A_{sf} f_y (d - \frac{h_f}{2}) + (A_s - A_{sf}) f_y (d - \frac{a}{2})\right] \qquad V_c = 0.17\sqrt{f'_c} \quad b_w d$$

$$I_{eff} = \left(\frac{M_{cr}}{M_a}\right)^3 I_g + \left[1 - \left(\frac{M_{cr}}{M_a}\right)^3\right] I_{cr} \leq I_g \qquad \rho_f = \frac{A_{sf}}{bd} \qquad f_r = 0.62\sqrt{f'_c}$$

$$M_u = \phi\rho b d^2 f_y \left[1 - 0.59\,\rho \frac{f_y}{f'_c}\right] \qquad M_{cr} = \frac{f_r I_g}{y_t} \qquad \gamma_{conc.} = 24 \quad kN/m^3$$

$$T_u \leq \phi \quad 0.083\sqrt{f'_c}\,\frac{A_{cp}^2}{p_{cp}} \qquad \frac{A_t}{S} = \frac{T_n}{1.7 A_{oh} f_{yt}} \qquad \rho_{w_{\max}} = \rho_{\max} + \rho_f$$

$$M_u = Coeff. \times W_u \times l_n^2 \qquad \lambda = \frac{\xi}{1 + 50\rho'} \qquad \Delta_B = \frac{wL^4}{8EI} \qquad \Delta_B = \frac{PL^3}{3EI}$$

$$\varepsilon'_s = 0.003\left(\frac{c - d'}{c}\right) \qquad \rho_{\min} = \frac{1.4}{f_y} \qquad A_l = \frac{A_t}{S} P_h \qquad E_c = 4700\sqrt{f'_c}$$

$$\sqrt{\left(\frac{V_u}{b_w d}\right)^2 + \left(\frac{T_u P_h}{1.7 A_{oh}^2}\right)^2} \leq \phi \left(\frac{V_c}{b_w d} + 0.66\sqrt{f'_c}\right) \qquad S_{\max} = \frac{P_h}{8} \quad or \quad 300mm$$

$$\frac{A_v + 2A_t}{S} \geq 0.062\sqrt{f'_c}\,\frac{b_w}{f_{yt}} \qquad \frac{A_v + 2A_t}{S} \geq \frac{0.35 b_w}{f_{yt}} \qquad M_u = \phi \quad A_s f_y (d - \frac{a}{2})$$

$$A_{l,\min} = \frac{0.42\sqrt{f'_c}\,A_{cp}}{f_{yl}} - \frac{A_t}{S} P_h \frac{f_{yt}}{f_{yl}} \quad where \frac{A_t}{S} \rangle \frac{0.175 b_w}{f_{yt}} \qquad bar \quad dia. \geq \begin{matrix} 0.042 * S \\ 10 \quad mm \end{matrix}$$