ENCE 355 – Introduction to Structural Design

SOLUTION to Homework Set No. 2

Fall 2002

PROB. 1-1

(a) $\frac{16(28)}{144}(150) = 467\ ^{\#}/_{FT}$

(b) $\frac{12(26-6)}{144}(150) + \frac{6(38)}{144}(150) = 488\ ^{\#}/_{FT}$

PROB 1-2

$E_c = w_c^{1.5}\, 33\sqrt{f_c'}$

SPREADSHEET PROBLEM:

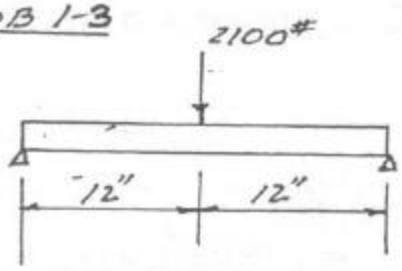
CHECK VALUE: FOR: $w_c = 145\ ^{\#}/_{FT^3}$

$f_c' = 4000\ ^{\#}/_{IN.^2}$

$E_c = 145^{1.5}(33)\sqrt{4000}$

$= 3{,}644{,}000\ ^{\#}/_{IN.^2}$

PROB 1-3



$f = \frac{Mc}{I} = f_r$

BEAM WEIGHT $= \frac{6(6)}{144}(0.145)$

$= 0.036\ ^{K}/_{I}$

$M = \frac{wL^2}{8} + \frac{PL}{4} = \frac{0.036(2)^2}{8} + \frac{2.1(2)}{4}$

$= 1.068\ ^{IK}$

$I = \frac{1}{12}(6)^4 = 108\ IN^4$

$f_r = \frac{1.068(12)(3)}{108} = 0.356\ Ksi$

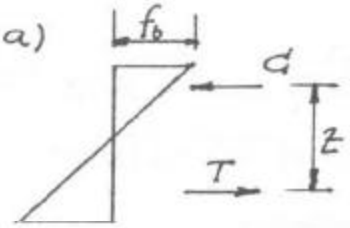
BY ACI FORMULA:

$f_r = 7.5\sqrt{f_c'} = 7.5\sqrt{3000} = 411\ psi$

PROB. 1-5

$$M = \frac{wL^2}{8} + \frac{PL}{4} = \frac{0.5(10)^2}{8} + \frac{2(10)}{4} = 11.25 \text{ ft-k}$$

(a)



$$C = \frac{1}{2} f_b (8)(8) = 32 f_b \text{ in.}^2$$

$$M = C z$$

$$11.25 \text{ ft-k} = 32 f_b (\text{in.}^2)\left(\frac{2}{3}\right)(16 \text{ in.})$$

$$f_b = \frac{11.25 \text{ ft-k } (12 \text{ in/ft})}{32 \text{ in}^2 \left(\frac{2}{3}\right)(16 \text{ in.})} = 0.396 \text{ ksi}$$

(b) $S_x = \frac{1}{6} bh^2 = \frac{1}{6}(8)(16)^2 = 341 \text{ in.}^3$

$$f_b = \frac{M}{S_x} = \frac{11.25(12)}{341} = 0.396 \text{ ksi} \quad \text{(OK)}$$

PROB 1-10

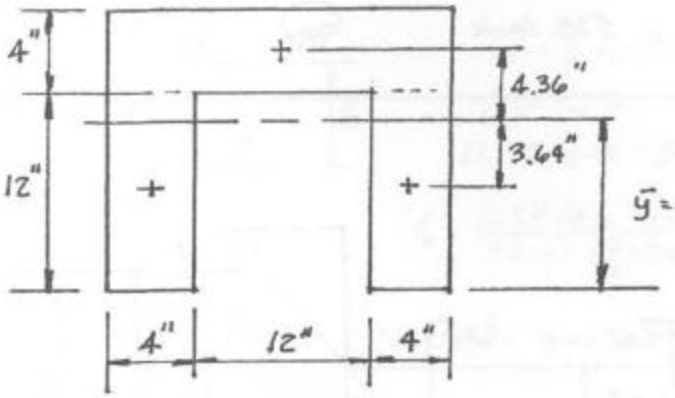
$f'_c = 3000$ psi

$f_r = \frac{7.5\sqrt{3000}}{1000} = 0.411$ ksi

$\bar{y} = \frac{\Sigma Ay}{\Sigma A}$

$= \frac{2(4)(12)(4) + 4(20)(14)}{2(4)(12) + 4(20)}$

$= 9.64''$



$I = 2\left(\frac{4(12)^3}{12}\right) + 2(4)(12)(3.64)^2 + \frac{20(4)^3}{12} + 4(20)(4.36)^2$

$= 4051$ in.^{4}

(a) $M_{CR} = \frac{f_r I}{c} = \frac{0.411(4051)}{9.64} = 172.7$ in.-k

(b) BEAM WT $= \frac{4(20) + 2(4)(12)}{144}(0.150) = 0.1833$ k/ft

BEAM WT MOMENT $= \frac{0.1833(12)^2}{8} = 3.30$ ft-k $= 39.6$ in.-k

$\frac{PL}{4} = M_{CR} - 39.6 = 172.7 - 39.6 = 133.1$ in.-k

$P = \frac{4(133.1 \text{ in.-k})}{12 \text{ ft}\ (12 \text{ in./ft})} = 3.70$ k