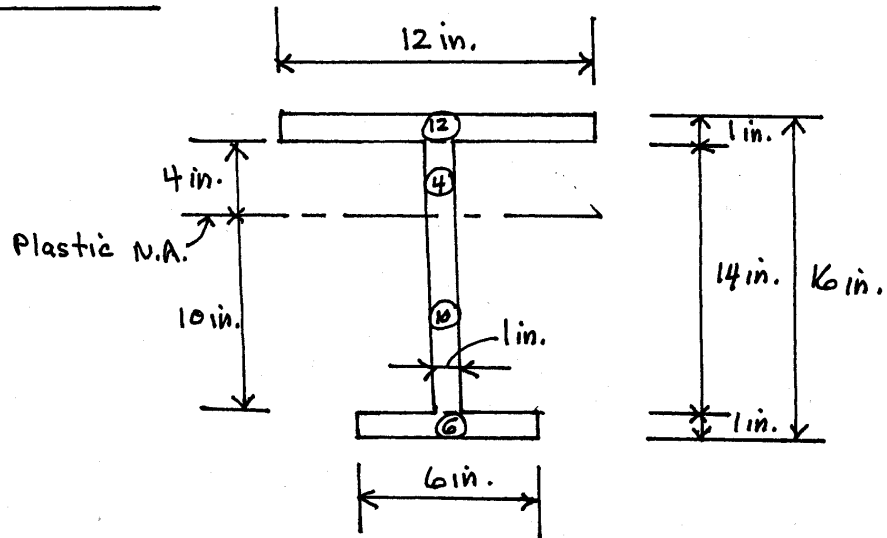


ENCE 355 – Introduction to Structural Design
 SOLUTIONS to Homework Set No. 15
 Fall 2002

PROB # 9-10



$$A = (12)(1) + (14)(1) + (6)(1) = 32 \text{ in.}^2$$

$$w_t = \left(\frac{32}{144}\right)(490) = 108.9 \text{ lbs/ft}$$

$$Z_x = (12)(4.5) + (14)(2) + (10)(5) + (6)(10.5) = 175 \text{ in.}^3$$

$$\phi M_m = \frac{(0.9)(50)(175)}{12} = 656.2 \text{ ft-k}$$

$$\frac{w_u L^2}{8} = 656.2$$

$$w_u = \frac{(8)(656.2)}{(30)^2} = 5.833 \text{ k/ft}$$

$$1.2 w_D + 1.6 w_L = 5.833$$

$$(1.2)(1 + 0.1089) + 1.6 w_L = 5.833$$

$$w_L = \boxed{2.81 \text{ k/ft}}$$

v g CMC

PROB#9-12

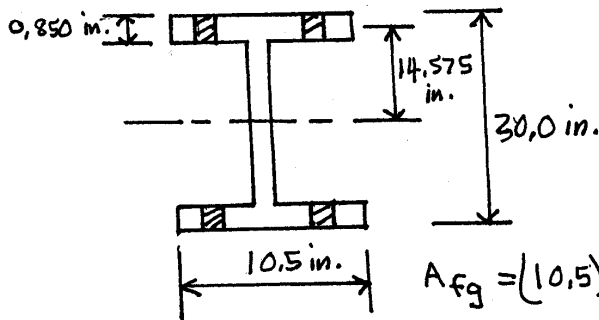
Assume beam $w_t = 116 \text{ lbs/ft}$

$$w_u = (1.2)(2.416) + (1.6)(2) = 6.34 \text{ k/ft}$$

$$M_u = \frac{(6.34)(36)^2}{8} = 10.27 \text{ ft-k}$$

$$\text{Net } Z_x \text{ Req'd} = \frac{(12)(10.27)}{(0.9)(50)} = 274 \text{ in.}^3$$

Try a W30x116 ($Z_x = 378 \text{ in.}^3$, $d = 30.0 \text{ in.}$,
 $t_f = 0.850 \text{ in.}$, $b_f = 10.5 \text{ in.}$)



$$A_{fg} = (10.5)(0.850) = 8.925 \text{ in.}^2$$

$$A_{fm} = 8.925 - (4)(\frac{1}{8})(0.850) = 5.10 \text{ in.}^2$$

For no reduction in flange area $A_{fm} \geq 0.92 A_{fg}$

$$\frac{A_{fm}}{A_{fg}} = \frac{5.10}{8.925} = 0.571 < 0.92 \therefore \text{flange area must be reduced}$$

$$A_{fe} = (\frac{5}{6})(\frac{F_u}{F_y})(A_{fm}) = (\frac{5}{6})(\frac{65}{50})(5.10) = 5.52 \text{ in.}^2$$

$$\text{Reduced } Z_x = 378 - (8.925 - 5.52)(14.575)(2) = 279 \text{ in.}^3$$

$$\phi_b M_m = \frac{(0.9)(50)(279)}{12} = 1046 \text{ ft-k} > 1027 \text{ ft-k}$$

USE W30X116

210

L 9 CMC

PROB#9-16

Assume beam wt = 97 lbs/ft

$$w_u = (1.2)(2.297) + (1.6)(3.0) = 7.56 \text{ k/ft}$$

$$M_u = \frac{(7.56)(25)^2}{8} = 591 \text{ ft-k}$$

$C_b = 1.14$ from Figure 9-9 in text

$$M_{equiv} = \frac{591}{1.14} = 518 \text{ ft-k}$$

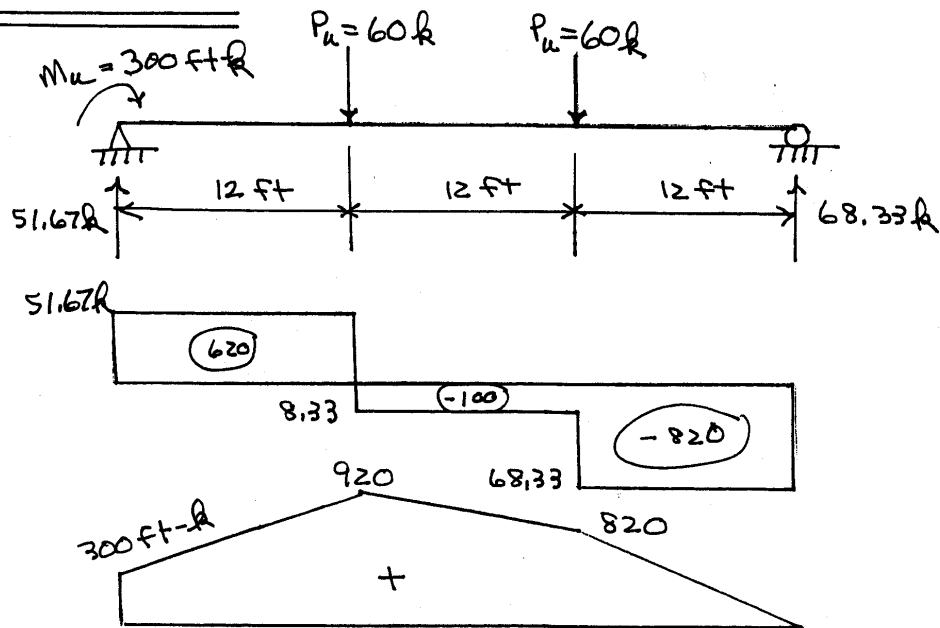
USE W18X97

$$\phi_b M_m = 791 \text{ ft-k} > 591$$

✓ JCLM₂

from Beam Design
Moment charts in
LRFD Manual.

PROB #9-24



(a) with continuous lateral support

Using a W36X160 ($\phi_b M_p = 2340 \text{ ft-k}$, $L_p = 8.83 \text{ ft}$, $L_r = 23.8 \text{ ft}$)

$$\phi_b M_p = 2340 \text{ ft-k} > 920 \text{ ft-k} \quad \underline{\underline{\text{OK}}}$$

(b) with $L = 36 \text{ ft}$ and $C_b = 1.14$ from Figure 9.4 in text we find $\phi_b M_m$ is about 1012 ft-k . OK

$$\phi_b M_m = (1012)(1.14) > 920 \text{ ft-k} \quad \underline{\underline{\text{OK}}}$$

✓ $\phi_b M_c$