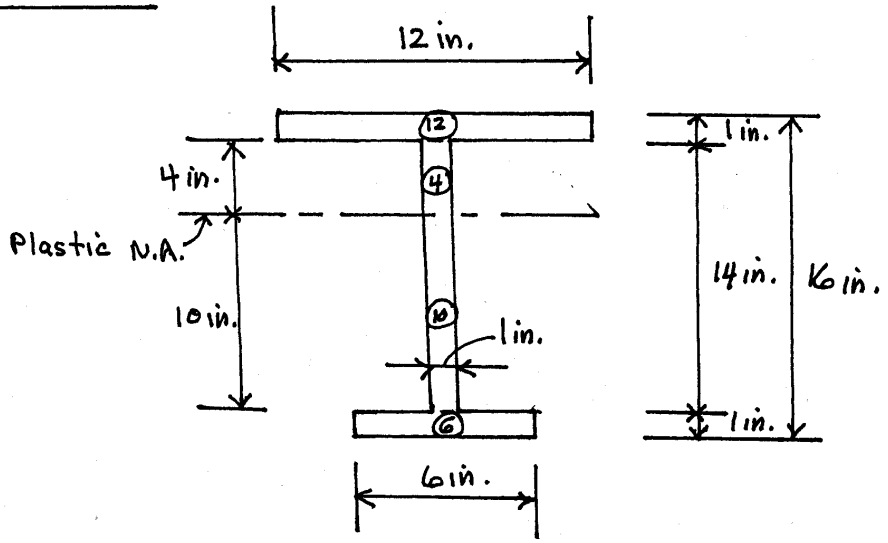
ENCE 355 – Introduction to Structural Design
SOLUTIONS to Homework Set No. 15
Fall 2002

PROB # 9-10



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

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

$Z_x = (12)(4.5) + (4)(2) + (10)(5) + (6)(10.5) = 175 \text{ in.}^3$

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

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

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

$1.2 w_D + 1.6 w_L = 5.833$

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

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

vgcmc

PROB #9-12

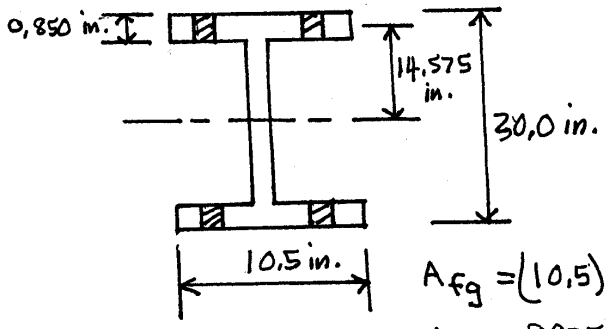
Assume beam wt = 116 lbs/ft

$w_u = (1.2)(2.616) + (1.6)(2) = 6.34$ k/ft

$M_u = \frac{(6.34)(36)^2}{8} = 1027$ ft-k

Net Z_x Reqd $= \frac{(12)(1027)}{(0.9)(50)} = 274$ in.^{3}

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



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

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

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

$\frac{A_{fn}}{A_{fg}} = \frac{5.10}{8.925} = 0.571 < 0.92$ ∴ flange area must be reduced

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

Reduced $Z_x = 378 - (8.925 - 5.52)(14.575)(2)$

$= 279$ in.^{3}

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

USE W30X116

210

PROB #9-16

Assume beam wt = 97 lbs/ft

$w_u = (1.2)(2.297) + (1.6)(3.0) = 7.56$ k/ft

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

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

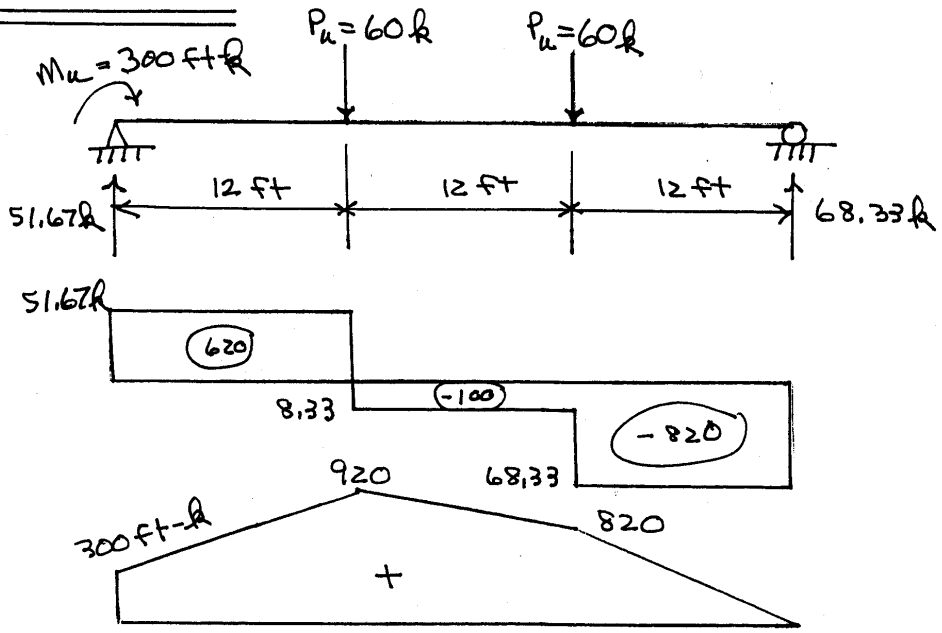
$M_{equiv} = \frac{591}{1.14} = 518$ ft-k

USE W18X97

$\phi_b M_n = 791$ ft-k > 591 ✓ JCM

from Beam Design Moment charts in LRFD Manual.

PROB #9-24



(a) with continuous lateral support

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

$\phi_b M_p = 2340$ ft-k > 920 ft-k ok

(b) with $L = 36$ ft and $C_b = 1.14$ from Figure 9-4 in text we find $\phi_b M_m$ is about 1012 ft-k. ok

$\phi_b M_m = (1012)(1.14) > 920$ ft-k ok