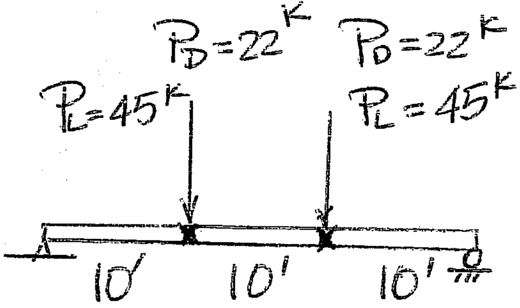
(1)

Select the Lightest steel Beam. $F_y = 50$ ksi.

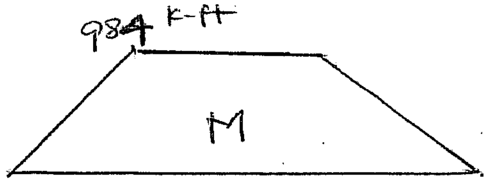
The Lateral Bracing is provided at the both ends and two mid-points 10 ft each from both ends.

Needs to verify (a) Moment (b) Shear (c) and Deflection.

Assume the total allowable deflection for total Load is 3/4" (4...



$P_u = 1.2 P_D + 1.6 P_L = 98.4$ kips



$C_b = 1.0 \quad L_b = 10'$

Assume Self-weight = 100 lb/ft

$\therefore W_u = 1.2 \times .1 = .12$ K/ft

$M_u = \frac{1}{8} \times .12 \times 30^2 = 13.5$ k-ft self-weight

$M_u = P_u \times 10 = 984$ k-ft from P_u

$\therefore \Sigma M_u = 984 + 13.5 = 997.5$ k-ft.

$Z = \frac{997.5 \times 12}{.9 F_y} = 266$ IN^3 TRY W30x90

$L_b = 7.38$. BF = 27.1 $\phi M_p = 1060$ $\therefore \phi M_n = [1060 - 27.1(10 - 7.38)]$

$\phi M_n = 989$ k-ft $< M_u = 998$ k-ft N.G. $= 989 < 1060$ (ok)

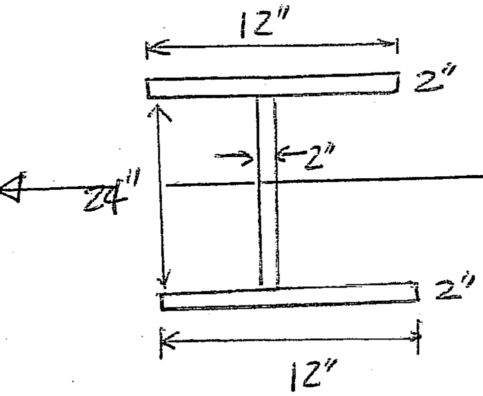
TRY W30x99. $\phi V_n = 417^k > V_u = 98.4^k$ (ok)

$\Delta_{max} = \frac{P \times a}{24EI}(3l^2 - 4a^2)$ [see manual 5-165 for eq.]

$= \frac{67 \times 10 \times (3 \times 30^2 - 4 \times 10^2) \times 12^3}{24 \times 29000 \times 3990} = .959'' > \Delta_{allow} = .75''$ N.G.

TRY $I = 3990 \times \left(\frac{.959}{.75}\right) = 5101$ IN^4 TRY W33x118 $I_x = 5900$ IN^4 (OK)

(2) Determine the built-up section's



ⓐ $\phi M_p = \phi Z F_y$

ⓑ $\phi M_r = \phi (F_y - F_r) S$

Given: $F_y = 50$ ksi , : (30

$$I_x = \frac{1}{12} \times 2 \times 24^3 + \left[\frac{1}{12} \times 12 \times 2^3 + 12 \times 2 \times \left(\frac{24}{2} + \frac{2}{2}\right)^2\right] \times 2$$

$$= 2304 + 8128 = 10432 \text{ IN}^4$$

$$S_x = \frac{10432}{\frac{24}{2} + 2} = 745.1 \text{ IN}^3$$

$$Z_x = 2\left[2 \times 12 \times 6 + 2 \times 12 \times 13\right] = 912 \text{ IN}^3$$

$$\therefore \phi M_p = 0.9 \times 912 \text{ IN}^3 \times \frac{50 \text{ ksi}}{12} = 3420 \text{ Kip-ft.}$$

$$\phi M_r = 0.9(50 - 16.5) \times \frac{745.1}{12} = 1872 \text{ Kip-ft.}$$

(3) Select a 12'-6" W14 beam-column member with $K_x = K_y = 1.2$ $F_y = 50$ ksi in a braced fra[me]

The member is braced in a single curvature. with the bottom moments equal to 3/4 of the top moments. Its ends are rotationally restrained and it is not subjected to intermediate transverse loads. Given: $P_u = 600$ kips Compression.

$M_{ux} = 200^{k\text{-}ft}$, $M_{uy} = 160^{k\text{-}ft}$ (30%)

$K_x L_y = 1.2 \times 12.5 = 14^{ft}$ TRY W14x132

$\phi P_n = 1430^{kips}$ $\frac{P_u}{\phi P_n} = \frac{600}{1430} = .419 > 0.2$

$C_m = 0.6 - 0.4(-\frac{3}{4}) = 0.9$

$P_{ex} = \frac{\pi^2 \times 29000 \times 1530}{(14 \times 12)^2} = 15516^{k}$

$P_{ey} = \frac{\pi^2 \times 29000 \times 548}{(14 \times 12)^2} = 5557^{k}$

$B_{1x} = \frac{0.9}{1 - \frac{600}{15516}} = .936 < 1$ $\therefore B_1 = 1$

$B_{1y} = \frac{0.9}{1 - \frac{600}{5557}} = 1.01$

$\phi M_{px} = 878$

$\phi M_{py} = .9 \times 5[0] \times 113/12$

$= 423.75$

$\phi \times 1.5 S_y F_y$

$= .9 \times 1.5 \times 74.5 \times$ [...]

$= 419$

$\therefore .419 + \frac{8}{9}\left(\frac{200}{828} + \frac{1.01 \times 160}{419}\right)$

$= 0.96$ (OK)

OR TRY W14x132 $KL_y = 14^{ft}$

$b = 0.702 \times 10^{-3}$

$m = 1.02 \times 10^{-3}$

$n = 2.12 \times 10^{-3}$

$\therefore \quad 0.702 \times 10^{-3} \times 600 + 1.02 \times 10^{-3} \times 200 + 2.12 \times 10^{-3} \times 1.01 \times 16\ldots$

$= .967 < 1$ OK