6.2-1

$P_d = 1/4\ 250\ k = 62.5\ k$

$P_l = 3/4\ 250\ k = 187.5\ k$

$M_d = 1/4\ 240\ k\text{-}ft = 60\ k\text{-}ft$

$M_l = 3/4\ 240\ k\text{-}ft = 180\ k\text{-}ft$

The ~~moment~~ amplification not considered.

$P_r = 1.2D + 1.6L = 62.5 \cdot 1.2 + 187.5 \cdot 1.6 = 375\ k$

$M_r = 1.2D + 1.6L = 60 \cdot 1.2 + 180 \cdot 1.6 = 360\ k\text{-}ft$

From table 4-1

$KL = 14'$

$\phi_c P_n = 1130\ k$

From table 3-10

$L_b = 14'$

$\phi_b M_n = 597\ k\text{-}ft$

Interaction Check

$$\frac{P_r}{P_c} = \frac{375\ k}{\phi_c P_n = 1130\ k} = 0.331 \geq 0.2 \rightarrow \text{Use H1-1a}$$

$$\frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right)$$

$$= 0.331 + \frac{8}{9}\left(\frac{360\ k\text{-}ft}{597\ k\text{-}ft}\right) = 0.868 \leq 1.0 \quad \text{O.K}$$

The given member satisfies the AISC interaction equation

6.5-1 Find B_1

$$B_1 = \frac{C_m}{1 - \alpha P_r/P_{e1}} = \frac{1}{1 - (1.0)\,375\ k/9461.5\ k} = 1.041 \geq 1.0$$

where $C_m = 0.6 - 0.4\frac{M_1}{M_2}$

$= 0.6 - 0.4\left(-\frac{360\ k\text{-}ft}{360\ k\text{-}ft}\right) = 1.0$

$\alpha = 1$

$P_r = 375\ k$

$$P_{e1} = \frac{\pi^2 E I_x}{(K_1 L)^2} = \frac{\pi^2 (29000\ ksi)(933\ in^4)}{(14 \cdot 12)^2}$$

$= 9461.5\ k$

$B_1 = 1.041$

6.5-4 $P_d = 120\,k\,(0.3) = 40\,k$

$P_l = 120\,k - 40\,k = 80\,k$

$M_{d,Top} = 135\,k\text{-}ft\,(0.3) = 40.5\,k\text{-}ft$

$M_{l,Top} = 135\,k\text{-}ft - 40.5\,k\text{-}ft = 94.5\,k\text{-}ft$

$M_{d,Bot} = 67\,k\text{-}ft\,(0.3) = 20.1\,k\text{-}ft$

$M_{l,Bot} = 67\,k\text{-}ft - 20.1\,k\text{-}ft = 46.9\,k\text{-}ft$

Braced frame assumed

$P_{nt} = 1.2D + 1.6L = 40 \cdot 1.2 + 80 \cdot 1.6 = 176\,k$

$M_{nt,Top} = 1.2D + 1.6L = 40.5 \cdot 1.2 + 94.5 \cdot 1.6 = 199.8\,k\text{-}ft$

$M_{nt,Bot} = 1.2D + 1.6L = 20.1 \cdot 1.2 + 46.9 \cdot 1.6 = 99.16\,k\text{-}ft$

Find B_1

$$B_1 = \frac{C_m}{1 - \alpha P_r / P_{el}} = \frac{0.4}{1 - (1.0)\,176k/3687.98k} = 0.42 \not\geq 1.0 \quad \text{Use } B_1 = 1.0$$

where $C_m = 0.6 - 0.4\left(\frac{99.16\,k\text{-}ft}{199.8\,k\text{-}ft}\right) = 0.40$

$P_r = P_{nt} = 176\,k$

$\alpha = 1.0$

$$P_{el} = \frac{\pi^2 E I_x}{(K_1 L)^2} = \frac{\pi^2 (29000\,ksi)(495\,in^4)}{(16 \cdot 12)^2} = 3687.98\,k$$

$P_r = P_{nt} = 176\,k$

$M_r = B_1 M_{nt} = 199.8\,k\text{-}ft$

Find $\phi_c P_n$, $\phi_b M_n$

W 12 x 58

From Table 4-1

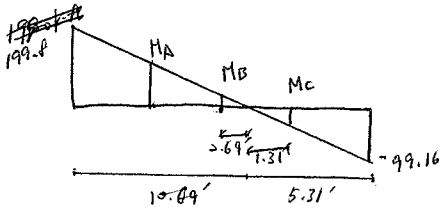
$\phi_c P_n = 500\,k$

From Table 3-10

$\phi_b M_n = 284\,k\text{-}ft$ when $C_b = 1.0$

$\phi_b M_p = 304\,k\text{-}ft$

Find C_b



$M_{max} = 199.8\,k\text{-}ft$

$M_A = 199.8 \cdot \frac{6.69}{10.69} = 125.03\,k\text{-}ft$

$M_B = 199.8 \cdot \frac{2.69}{10.69} = 50.28\,k\text{-}ft$

$M_C = 99.16 \cdot \frac{1.31}{5.31} = +24.46\,k\text{-}ft$

$$C_b = \frac{12.5\, M_{max}}{2.5 M_{max} + 3M_A + 4M_B + 3M_C} = \frac{12.5\,(199.8)}{2.5(199.8) + 3(125.03) + 4(50.28) + 3(+24.46)}$$

$= \sout{2.49}\ 2.17 \le 3.0$

$P_c = 500k$

$M_c = \phi_b M_n \cdot C_b = 284\ k\text{-}ft\ (\sout{2.49}\ 2.17) = \sout{707}\ 616\ k\text{-}ft \le 324\ k\text{-}ft = \phi_b M_p$

$= 324\ k\text{-}ft$

Check Interaction Equation.

$\frac{P_r}{P_c} = \frac{176k}{500k} = 0.352 \rightarrow$ Use H1-1a

$\frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) = 0.352 + \frac{8}{9}\left(\frac{199.8}{324}\right)$

$= 0.9 \le 1.0 \rightarrow$ o.k

The given member satisfies the AISC interaction equation.