PROB #9-2

Assume beam wt = 68 lbs/ft

LRFD	ASD
$w_u = (1.2)(2.068) = 2.48$ k/ft	$w_a = 2.068$ k/ft
$P_u = (1.6)(24) = 38.4$ k	$P_a = 24$ k
$M_u = \frac{(2.48)(30)^2}{8} + (38.4)(10)$	$M_a = \frac{(2.068)(30)^2}{8} + (24)(10)$
$= 663$ ft-k	$= 472.6$ ft-k
From AISC Table 3-2	From AISC Table 3-2
USE W24X68	USE W24X76

PROB #9-4

Assume beam wt = 84 lbs/ft

LRFD	ASD
$w_u = (1.2)(1.584) = 1.90$ k/ft	$w_a = 1.584$ k/ft
$P_u = (1.6)(24) = 38.4$ k	$P_a = 24$ k
$\frac{1}{2}P_u = (\frac{1}{2})(38.4) = 19.2$ k	$\frac{1}{2}P_a = 12$ k
$M_u = (1.90)(16)(8) + (38.4)(8)$ $+(19.2)(16) = 857.4$ ft-k	$M_a = (1.584)(16)(8) + (24)(8)$ $+(12)(16) = 586.7$ ft-k
From AISC Table 3-2	From AISC Table 3-2
USE W27X84	USE W27X84

PROB #9-15

Using a W21X73 ($\phi_b M_{px} = 645$ ft-k, $\frac{M_{px}}{\Omega_b} = 429$ ft-k, $\phi_b M_{rx} = 396$ ft-k, $\frac{M_{rx}}{\Omega_b} = 264$ ft-k, $L_p = 6.39$ ft, $L_r = 19.2$ ft, BF for LRFD = 19.4 k, BF for ASD = 12.9 k, $r_{ts} = 2.19$, $J = 3.02$ in.^{4}, $C = 1.0$ for doubly sym I section, $S_x = 151$ in.^{3}, $h_o = 20.5$ in.)

For 6 ft unbraced length

$L_b = 6$ ft $< L_p$

LRFD	ASD
$\phi_b M_p = 645$ ft-k	$\frac{M_n}{\phi_b} = 429$ ft-k

For 12 ft unbraced length

$L_b = 12$ ft $> L_p < L_r$

LRFD	ASD
$\phi_b M_{nx} = C_b [\phi_b M_{px} - BF(L_b - L_p)]$ $\leq \phi_b M_{px}$	$\frac{M_{nx}}{\Omega_b} = C_b [\frac{M_{px}}{\Omega_b} - BF(L_b - L_p)]$ $\leq \frac{M_{px}}{\Omega_b}$
$\phi_b M_{nx} = 1.0 [645 - (19.4)(12 - 6.39)]$ $= 536.2$ ft-k	$\frac{M_{nx}}{\Omega_b} = 1.0 [429 - (12.9)(12 - 6.39)]$ $= 356.6$ ft-k

PROB #9-15 CONTD.

For 22 ft Unbraced Length

$L_b = 22\text{ ft} > L_u$ of 19.2 ft

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2} \sqrt{1 + 0.078 \frac{Jc}{S_x h_o} \left(\frac{L_b}{r_{ts}}\right)^2}$$

$$= \frac{(1.0)(\pi)^2 (29 \times 10^3)}{\left(\frac{12 \times 22}{2.19}\right)^2} \sqrt{1 + 0.078 \frac{(3.02)(1.0)}{(151)(20.5)} \left(\frac{12 \times 22}{2.19}\right)^2}$$

$$= 28.585 \text{ ksi}$$

$$M_{mx} = F_{cr} S_x = \frac{(28.585)(151)}{12} = 359.7 \text{ ft-k}$$

LRFD $\phi_b = 0.9$	ASD $\Omega_b = 1.67$
$\phi_b M_{mx} = (0.90)(359.7) = 323.7$ ft-k	$\frac{M_{mx}}{\Omega_b} = \frac{359.7}{1.67} = 215.4$ ft-k