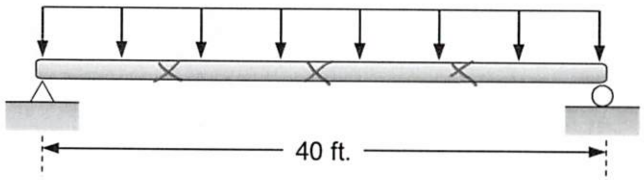
A 1/2

Classroom Problem 5.5-5: A **W18 x 86** of **A992** steel with F_y = 50 *ksi*; F_u = 65 *ksi* is used as a simply supported beam. The only additional load, in addition to the beam weight, is a uniform live load. If lateral support is provided at 10-foot intervals, what is the maximum service load that can be supported?



$L_b = 10\,ft$

* FROM TABLE 3-1: $\underline{C_b = 1.06}$

* FROM TABLE 3-2: $\phi_b M_p = 698\,k\,ft$, $L_p = 9.29\,ft$, $L_r = 28.6\,ft$

$\therefore L_p < L_b < L_r \Rightarrow$ USE F2-2

$M_p = 775.6\,k\,ft$ $\quad M_r = 0.7 F_y S_x$

$= 0.7(50\,ksi)\,166\,in^3 = 5{,}810\,k\cdot in = 484.2\,k\,ft$

$$M_n = C_b\left[M_p - (M_p - M_r)\right]\left[\frac{L_b - L_p}{L_r - L_p}\right] < M_p$$

$$= 1.06\left[775.6\,kft - (775.6\,kft - 484.2\,kft)\left[\frac{10 - 9.29}{28.6 - 9.29}\right]\right]$$

$$= 810.78\,kft > M_p \Rightarrow M_n = M_p = 775.6\,kft$$

$$\phi M_n = 0.90(775.6\,kft) = \underline{\underline{698.0\,kft}}$$

CR PROBLEM 5.5-5

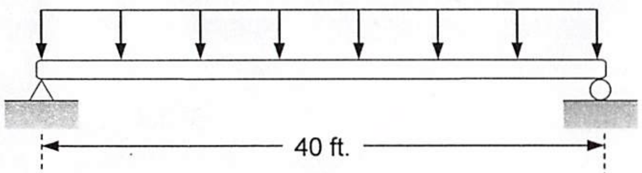
$$M_u = \frac{WL^2}{8} = \frac{(1.2(0.086\,k/ft) + 1.6L)(40ft)^2}{8} = (20.64 + 320L)\,kft$$

$$\phi M_n = M_u \quad \therefore \quad 698\,kft = (20.64 + 320L)\,kft$$

$$\underline{\underline{L = 2.12\,k/ft}}$$

5.5-5

Classroom Problem 5-7: A **W18 x 86** of **A992** steel with $F_y = 50\ ksi$; $F_u = 65\ ksi$ is used as a simply supported beam. The only load is addition to the beam weight is a uniform live load. If lateral support is provided at 10-foot intervals, what is the maximum service load that can be supported?



FROM TABLE 1-1 (1-22)

$h/t_w = 33.4 \quad b/2t = 7.2 \quad S_x = 166\ in^3$

$Z_x = 186\ in^3 \quad r_y = 2.63\ in \quad r_{st} = 3.05\ in$

$h_o = 17.6\ in \quad J = 4.1\ in^4$

CHECK COMPACTNESS

$h/t = 33.4 < \text{LIMIT } 3.76\sqrt{\frac{E}{F_y}} = 90.55$ ok

$b/2t = 7.2 < \text{LIMIT } 0.38\sqrt{\frac{E}{F_y}} = 9.15$ ok

$L_b = 10\ ft\ (12\ in/ft) = \underline{120\ in}$

FROM TABLE 3-1 (3-18) FOR QUARTER POINTS

$\underline{C_b = 1.06}$

$$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}} = 1.76(2.63\ in)\sqrt{\frac{29{,}000\ ksi}{50\ ksi}} = 111.48\ in < L_b$$

* COMPUTE L_r

$$\frac{Jc}{S_x h_o} = \frac{4.1\ in^4 (1.0)}{166\ in^3 (17.6\ in)} = 0.001403$$

$$L_r = 1.95(3.05\text{in})\frac{29{,}000\text{ksi}}{0.7(50\text{ksi})}\sqrt{0.001403 + \sqrt{(0.001403)^2 + 6.76\left(\frac{0.7(50\text{ksi})}{29{,}000\text{ksi}}\right)^2}}$$

$$= 342.86\text{in} > L_b$$

$$\therefore \; L_p < L_b < L_r \Rightarrow \text{USE AISC EQ. F2-2}$$

$$M_n = C_b\left[M_p - (M_p - 0.7F_y S_x)\left[\frac{L_b - L_p}{L_r - L_p}\right]\right] \le M_p$$

$$M_p = F_y Z_x = 50\text{ksi}(186\text{in}^3) = 9{,}300\text{k}\cdot\text{in}$$

$$M_n = 1.06\left[9{,}300\text{kin} - (9{,}300\text{kin} - 0.7(50\text{ksi})(166\text{in}^3))\left[\frac{120 - 111.48}{342.86 - 111.48}\right]\right]$$

$$= 9{,}721.79\text{k}\cdot\text{in} > M_p$$

$$= \underline{9{,}300\text{k}\cdot\text{in}} \quad = \underline{775.0\text{kft}}$$

$$\phi M_n = 0.9(775.0\text{kft}) = \underline{697.5\text{kft}}$$

CR PROBLEM 5.5-5

$$M_u = \frac{wL^2}{8} = \frac{(1.2(0.086k/ft) + 1.6L)(40ft)^2}{8}$$

$$= (20.64 + 320L)\,kft$$

$$\phi M_n = M_u \quad \therefore \quad 697.5\,kft = 20.64\,kft + (320L)\,k\cdot ft$$

$$\underline{\underline{L = 2.11\,k/ft}}$$