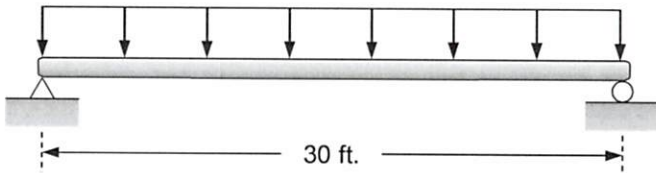


Classroom Problem 5.5-1: The beam shown is a **W16 x 77** of **A992** steel with $F_y = 50$ ksi; $F_u = 65$ ksi. It supports a reinforced concrete floor slab that provides continuous lateral support of the compression flange. The service dead load is 1 k/ft. This load is superimposed on the beam; it does not include the beam's weight. The service live load is 2 k/ft.



FROM TABLE 1-1

$$\left[\begin{array}{ll} A = 22.6 \text{ in}^2 & Z_x = 150 \text{ in}^3 \\ b/t_f = 6.77 & h/t_w = 31.2 \end{array} \right.$$

* CHECK FLANGE FOR COMPACTNESS

$$b/t_f = 6.77 \quad \text{LIMIT} \quad 0.38 \sqrt{\frac{E}{F_y}} = 0.38 \sqrt{\frac{29,000 \text{ ksi}}{50 \text{ ksi}}} = 9.15 \quad \underline{\underline{\text{COMPACT}}}$$

* CHECK WEB FOR COMPACTNESS

$$h/t_w = 31.2 \quad \text{LIMIT} \quad 3.76 \sqrt{\frac{E}{F_y}} = 3.76 \sqrt{\frac{29,000 \text{ ksi}}{50 \text{ ksi}}} = 90.55 \quad \underline{\underline{\text{COMPACT}}}$$

$$M_n = M_p = F_y Z_x = 50 \text{ ksi} (150 \text{ in}^3) = 7,500 \text{ k}\cdot\text{in} = \underline{\underline{625 \text{ k}\cdot\text{ft}}}$$

$$W_D = 1 \text{ k/ft} + \overset{\text{BEAM WT.}}{0.077 \text{ k/ft}} = 1.077 \text{ k/ft}$$

$$W_U = 1.2 W_D + 1.6 W_L = 1.2(1.077 \text{ k/ft}) + 1.6(2 \text{ k/ft}) = 4.492 \text{ k/ft}$$

CR PROBLEM 5.5-1

$$M_{\text{MAX}} = \frac{w_u L^2}{8} = \frac{4.492 \text{ k/ft} (30 \text{ ft})^2}{8} = 505.4 \text{ kft}$$

$$\phi_b M_n > M_u \quad \Rightarrow \quad 0.90 (625 \text{ kft}) = 562.5 \text{ kft} > M_u \quad \underline{\underline{\text{O.K.}}}$$