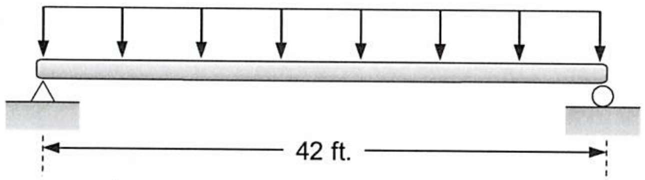
Classroom Problem 5.10-2: Select a **W** section of **A992** steel (F_y = 50 *ksi*; **F** = 65 *ksi*) for the beam shown below. The beam has continuous lateral support and must support a uniform dead load of 0.5 *k/ft* and a live load of 1.0 k/ft. The live load deflection is limited to ***L***/360



$$W_U = 1.2W_D + 1.6W_L = 1.2(0.5k/ft) + 1.6(1k/ft) = 2.2k/ft$$

$$M_U = \frac{W_U L^2}{8} = \frac{2.2k/ft(42ft)^2}{8} = 485.1\ kft$$

$$\phi_b M_n = \phi_b M_p = \phi_b F_y Z_x$$

$$REQ.\ Z_x = \frac{M_U}{\phi F_y} = \frac{485.1\ kft(12in/ft)}{0.90(50ksi)} = 129.4\ in^3$$

* FROM Z_x TABLE (TABLE 3-2)

TRY W24 x 55 $\quad Z_x = 134\ in^3 \quad I_x = 1{,}350\ IN^4 \quad d = 23.6\ in \quad t_w = 0.395\ in$

* CHECK LIVE LOAD DEFLECTION $\quad \Delta = L/360 = \frac{42ft(12in/ft)}{360} = 1.4\ in$

$$\Delta = \frac{5wL^4}{384EI} \Rightarrow I_x = \frac{5(1k/ft)(42ft)^4(12in/ft)^3}{384(29{,}000ksi)1.4in} = 1{,}724.5\ IN^4 > I_x$$

N.G.

CR PROBLEM 5.10-2

USING TABLE I_x (TABLE 3-3) TRY W24 x 68 $I_x = 1{,}830\ in^4$

$Z_x = 177\ in^3$

$$W_U = 1.2(0.5\,k/ft + 0.068\,k/ft) + 1.6(1\,k/ft) = 2.282\,k/ft$$

$$M_U = \frac{W_U L^2}{8} = \frac{2.282\,k/ft(42\,ft)^2}{8} = 503.1\,k\,ft$$

$$\phi M_n = \phi M_p = \phi F_y Z_x = 0.9(50\,ksi)177\,in^3 = 7{,}965\,k \cdot in = 663.75\,k\,ft$$

$\phi M_n > M_U$ o.k.

CHECK SHEAR TABLE 1-1 W24 x 68 $d = 23.7\,in$ $t_w = 0.415\,in$ $h/t = 52.0$

$$V_U = \frac{W_U L}{2} = \frac{2.282\,k/ft(42\,ft)}{2} = 47.92^k$$

$$2.24\sqrt{E/F_y} = 54.0$$

$$h/t < 2.24\sqrt{E/F_y}$$

$$\phi_v V_n = \phi(0.6F_y) A_w C_{v_1}$$

$$= 1.0(0.6)50\,ksi(23.7\,in)0.415\,in(1.0)$$

$$= 295.1^k > V_U$$

$\phi = 1.0$ $C_{v_1} = 1.0$

o.k.

USE W24 x 68