W16x40

Classroom Problem 5.8-1: Check the shear capacity of a simply supported beam with a span of 25 ft. that uses a ~~**W12 x 65**~~ (F_y = 50 *ksi*). Assume the beam has continuous lateral support and is subjected to the following service loads: dead load is 0.75 *k/ft* (including the weight of the beam), and live load is 1 *k/ft*.

FROM TABLE 1-1 $\quad A = 11.8\,in^2 \quad d = 16.0\,in \quad t_w = 0.305\,in \quad h/t_w = 46.5 \quad Z_x = 73\,in^3$

$$W_u = 1.2W_D + 1.6W_L = 1.2(0.75k/ft) + 1.6(1k/ft) = 2.5k/ft$$

$$M_u = \frac{W_u L^2}{8} = \frac{(2.5k/ft)(25ft)^2}{8} = 195.3k\,ft$$

$$V_u = \frac{W_u L}{2} = \frac{(2.5k/ft)(25ft)}{2} = 31.25^k$$

$$\phi M_n = \phi F_y Z_x = 0.90(50ksi)\,73in^3 = 3{,}285k\cdot in = 273.8k\,ft$$

$$\phi M_n > M_u \quad \underline{o.k.}$$

CHECK SHEAR

$h/t_w = 46.5 \qquad 2.24\sqrt{\frac{E}{F_y}} = 2.24\sqrt{\frac{29{,}000ksi}{50ksi}} = 53.9 > h/t_w \;\therefore\; C_{v_1} = 1.0$

$\phi_v = 1.0$

$$\phi_v V_n = 1.0(0.6F_y)A_w C_{v_1}$$
$$= 0.6(50ksi)(16in)(0.305in) = 146.4^k > V_u \quad \underline{o.k.}$$