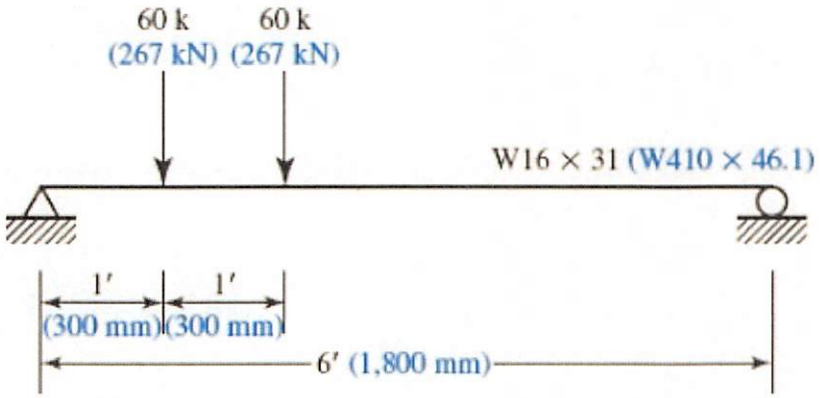
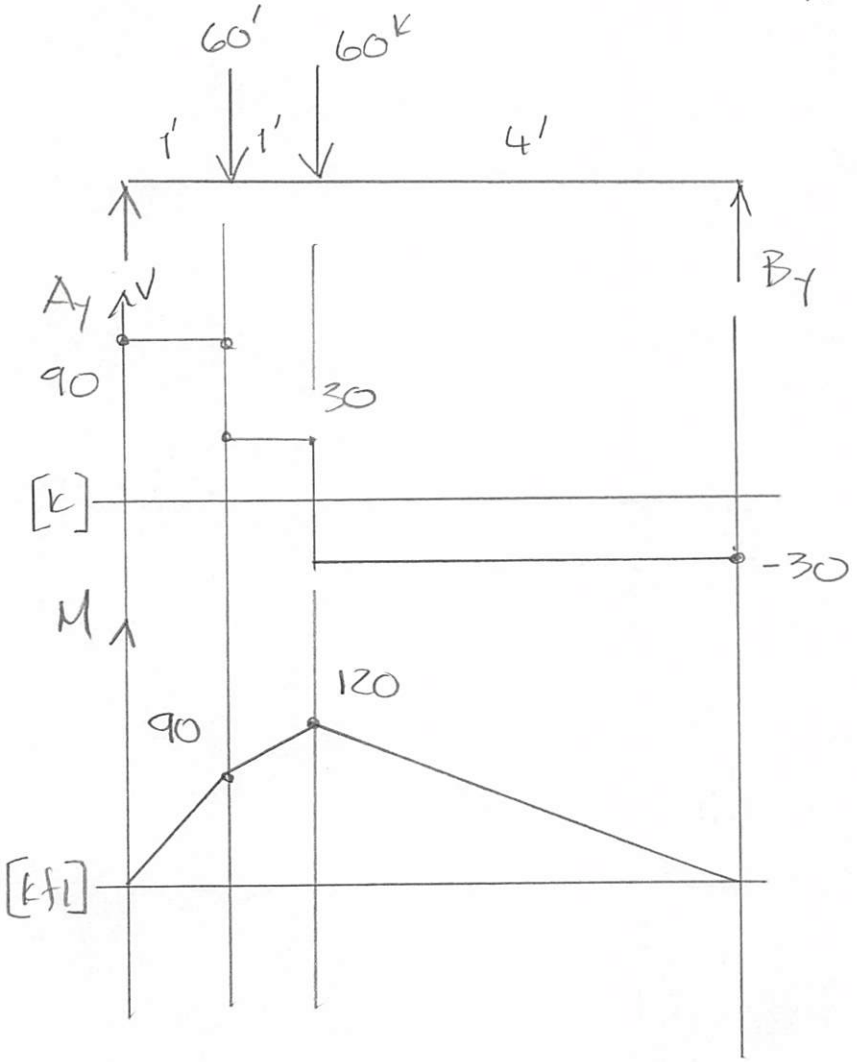
5.8-3 The beam shown in Figure P5.8-3 is a $\mathbf{W16 \times 31 (W410 \times 46.1)}$ of A992 steel $(F_y = 50 \text{ ksi} (345 \text{ MPa}))$ and has continuous lateral support. The two concentrated loads are service live loads. Neglect the weight of the beam and determine whether the beam is adequate.



FROM TABLE 1-1 (1-22) $\frac{bf}{2t} = 6.28$ $\frac{h}{tw} = 51.6$ $S_x = 47.2 \text{ IN}^3$

$Z_x = 54.0 \text{ IN}^3$ $d = 15.9 \text{ IN}$ $t_w = 0.275 \text{ IN}$



$\circlearrowleft \Sigma M_B = 0 = 60^k(4' + 5') - A_y(6')$

$A_y = 90^k$

$+\uparrow \Sigma F_y = A_y + B_y - 60^k - 60^k$

$B_y = 30^k$

$$M_n = M_p = F_y Z_x = 50 ksi (54.0 in^3)$$

$$= 2{,}700 k \cdot in = \underline{225 k ft} \quad \therefore \phi_b M_n = 0.9 M_n$$

$$= \underline{202.5 k ft}^{*}$$

* FROM "Z_x TABLE" TABLE 3-2 (3-26)

$\underline{\phi_b M_{px} = 203 k ft}$ & $\underline{M_{px}/\Omega_b = 135 k ft}$

LRFD

$$M_u = 1.6(M_{MAX}) = 1.6(120 k \cdot ft) = 192.0 k ft$$

$M_u < \phi_b M_n$ $\underline{\text{O.K.}}$

CHECK SHEAR

$V_n = 0.6 F_y A_w C_{v_1}$ AISC EQN. G2-1

$\frac{h}{t_w} = 51.6$ $\qquad 2.24\sqrt{E/F_y} = 53.94 > \frac{h}{t_w}$

$\therefore C_{v_1} = 1.0 \quad \phi_v = 1.0 \quad \Omega_v = 1.5$

$$V_n = 0.6(50 ksi)(15.9 in)(0.275 in)(1.0) = 131.18^{k}$$

$V_u = 1.6(90^k) = 144^k$ $\qquad \phi_v V_n = 1.0 V_N$

$V_u > V_n$ $\underline{\text{N. G.}}$

5.8-3

ASD $M_U = M_{MAX} = 120 k\text{-}ft < \frac{M_P}{\Omega_b}$ O.K.

$V_U = 90^k < \frac{V_n}{\Omega_v} = \frac{131.18^k}{1.5} = 87.45^k$ N.G.