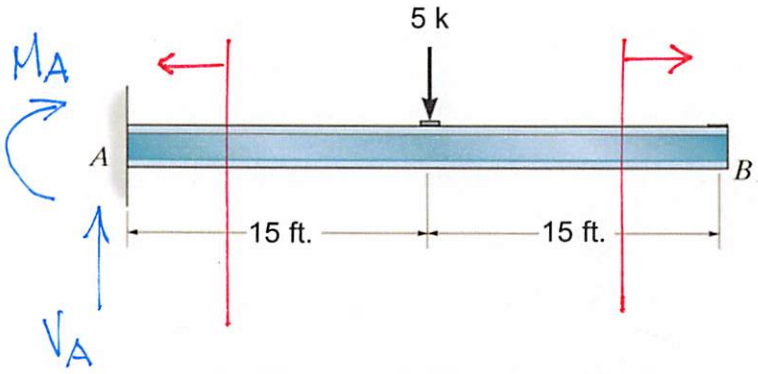
Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

Real loads

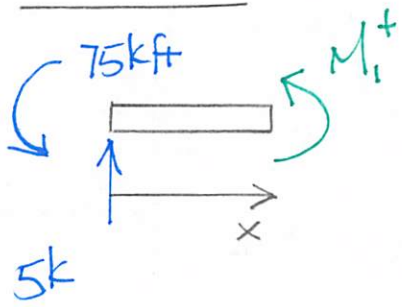


$\circlearrowleft + \sum M_A = 0 = -M_A - 5k(15\,ft)$ $\quad M_A = -75\,k\,ft$

$+\uparrow \sum F_y = 0 = V_A - 5k$ $\quad V_A = 5^k$

V_A

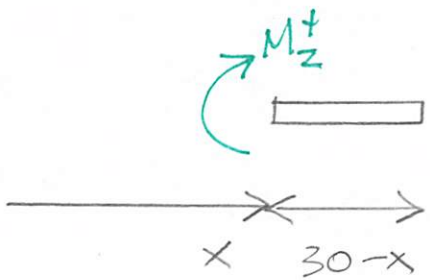
$0 \le x \le 15\,ft$



$\circlearrowleft + \sum M_{CUT} = 0 = M + 75k\,ft - 5k(x)$

$M(x)_1 = [5x - 75]\,k\,ft$

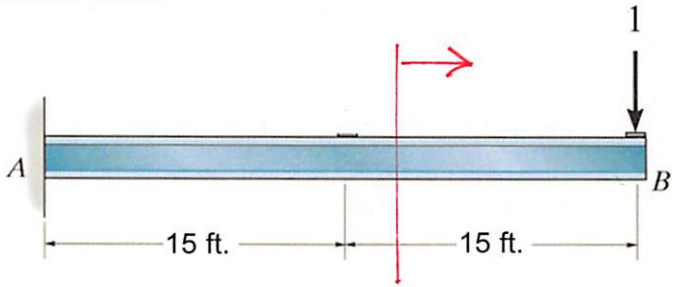
$15 \le x \le 30$

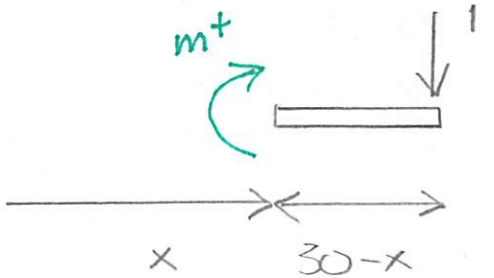


$\circlearrowleft + \sum M_{CUT} = 0 = -M_2$

Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

Virtual load





$\curvearrowleft + \Sigma M_{CUT} = 0$

$= -m - 1(30-x)$

$\underline{M = [x - 30]\ ft}$

$$Y_B = \int_0^{30} \frac{Mm}{EI}dx = \int_0^{15} \frac{M_1 m}{EI}dx + \int_{15}^{30} \frac{M_2 m}{EI}dx \quad (M_2 = 0) = \frac{1}{EI}\int_0^{15} \frac{(5x-75)}{k\,ft}\frac{(x-30)}{ft}\frac{dx}{ft}$$

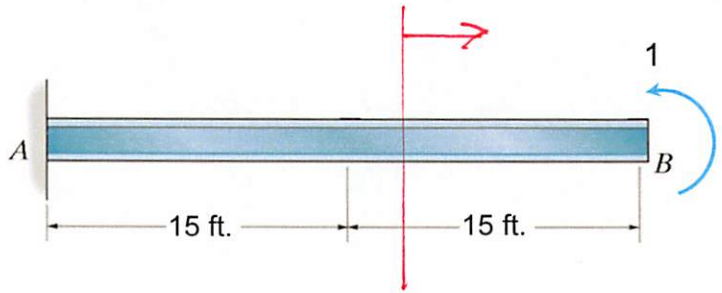
$$= \frac{1}{EI}\int_0^{15}(5x^2 - 225x + 2{,}250)dx = \frac{1}{EI}\left[\frac{5x^3}{3} + \frac{225x^2}{2} + 2{,}250x\right]_0^{15}$$

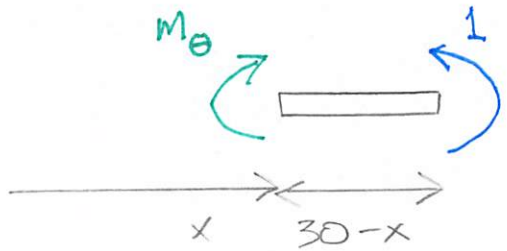
$$= \frac{28{,}125\,k\,ft^3}{2EI} = \frac{28{,}125\,k\,ft^3}{2} \cdot \frac{in^2}{30{,}000\,k} \cdot \frac{1}{800\,in^4} \cdot \frac{1{,}728\,in^3}{ft^3}$$

$$= \underline{\underline{1{,}013\,in}}$$

Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

Virtual moment





$\circlearrowleft + \Sigma M_{CUT} = 0$

$-m_\theta + 1$

$m_\theta = 1$

$$\theta_B = \int_0^{30} \frac{M m_\theta}{EI} dx = \int_0^{15} \frac{M_1 m_\theta}{EI} dx + \int_{15}^{30} \frac{M_2 m_\theta}{EI} dx = \frac{1}{EI} \int_0^{15} \frac{(5x-75)}{k\text{-ft}} 1 \frac{dx}{\text{ft}}$$

$$= \frac{1}{EI}\left[\frac{5x^2}{2} - 75x\right]_0^{15} = -\frac{1{,}125\ k\text{-ft}^2}{2EI}$$

$$= -\frac{1{,}125\ k\text{-ft}^2}{2} \cdot \frac{\text{in}^2}{30{,}000\ k} \cdot \frac{144\ \text{in}^2}{800\ \text{in}^4} \cdot \frac{144\ \text{in}^2}{\text{ft}^2} = -0.0034 \text{ RADIANS}$$