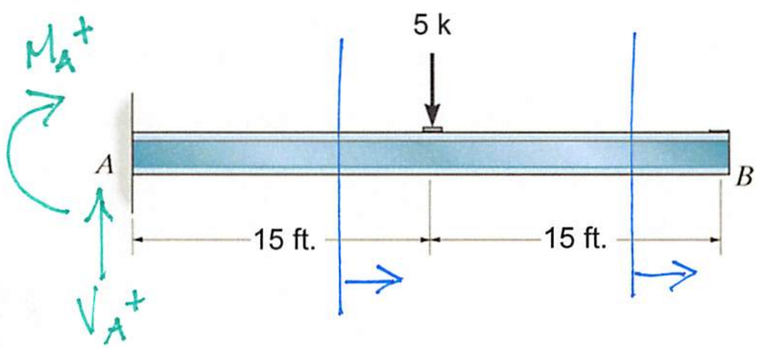
Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

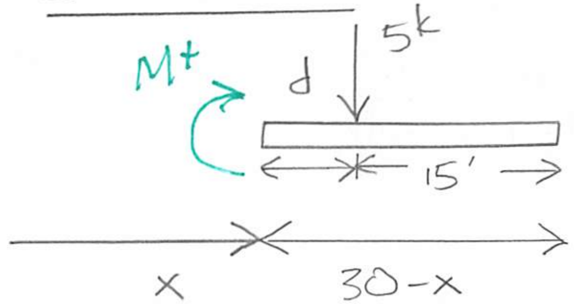
Real loads



$$\circlearrowleft^{+} \sum M_A = 0 = -M_A - 5^k(15\ ft) = \quad \underline{M_A = -75\ k\ ft}$$

$$+\uparrow \sum F_y = 0 = V_A - 5^k \qquad \underline{V_A = 5k}$$

$\underline{0 \le x \le 15\ ft}$



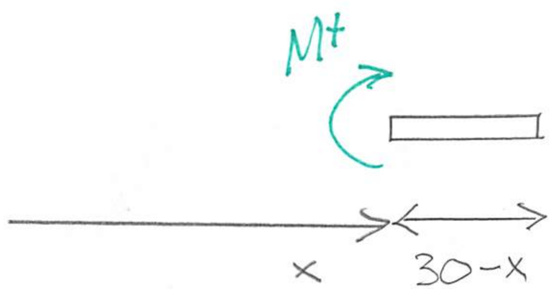
$$\circlearrowleft^{+} \sum M_{CUT} = 0 = -M - 5^k(15-x)$$

$$M(x) = -5(15-x)\ k\ ft$$

$$\underline{= (5x-75)\ k\ ft}$$

$$d = 30 - x - 15 = 15 - x$$

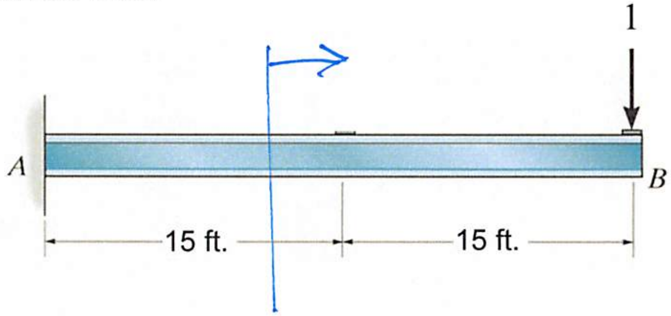
$\underline{15 \le x \le 30\ ft}$



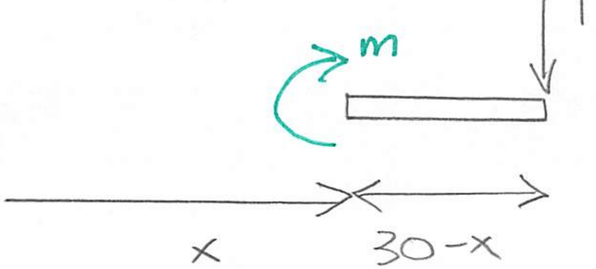
$$\circlearrowleft^{+} \sum M_{CUT} = \underline{0 = -M}$$

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



$0 \leq x \leq 30\,\text{ft}$



$\circlearrowleft + \sum M_{CUT} = 0 = -m - 1(30-x)$

$m = x - 30$ ✓

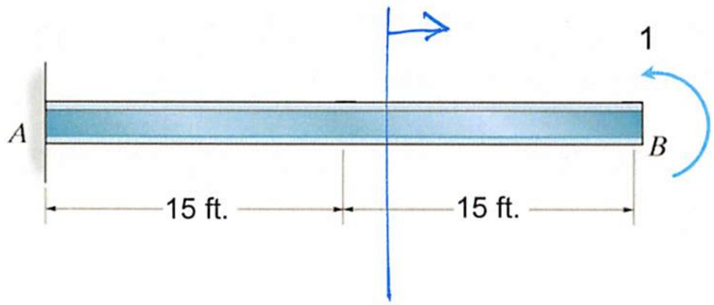
$$Y_B = \int_0^L \frac{Mm}{EI}dx = \int_0^{15} \frac{Mm}{EI}dx + \int_{15}^{30} \frac{Mm}{EI}dx = \frac{1}{EI}\int_0^{15} (5x-75)(x-30)\,dx + \cancel{\frac{1}{EI}\int_{15}^{30} 0\,dx}^{\,0}$$

$$= \frac{1}{EI}\left[\frac{5x^3}{3} - \frac{225x^2}{2} + 2{,}250x\right]_0^{15} = \frac{28{,}125\,\text{k ft}^3}{EI}$$

$$= \frac{28{,}125\,\text{kft}}{} \left|\frac{\text{IN}^2}{30{,}000\,\text{k}}\right| \frac{}{800\,\text{IN}^4} \left| \left(\frac{12\,\text{in}}{\text{ft}}\right)^3 = \underline{\underline{1.01\,\text{in}}}\right.$$

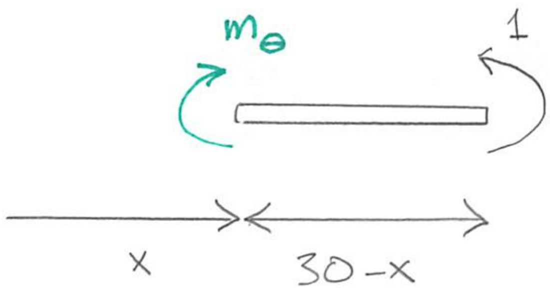
Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

Virtual moment



$0 \leq x \leq 30\,ft$

$\circlearrowleft^{+} \Sigma M_{CUT} = 0 = -m_\theta + 1 \qquad \underline{m_\theta = 1}$



$$\theta_B = \int_0^{30} \frac{M m_\theta}{EI}\,dx = \underline{\frac{1}{EI}\left[\int_0^{15} (5x-75)(1)\,dx\right]} = \frac{1}{EI}\left[\frac{5x^2}{2} - 75x\right]_0^{15} = -\frac{562.5\,k\,ft^2}{EI}$$

$$= -\frac{562.5\,k\,ft^2}{} \,\Big|\, \frac{IN^2}{30{,}000\,k} \,\Big|\, \frac{}{800\,in^4} \,\Big|\, \left(\frac{12\,in}{ft}\right)^2 = \underline{\underline{-0.0034 \text{ RADIANS}}}$$