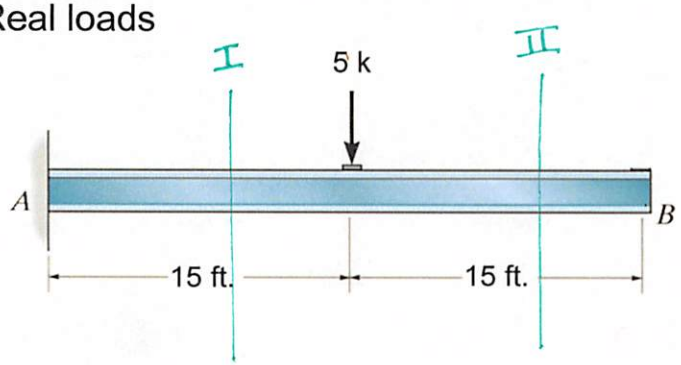
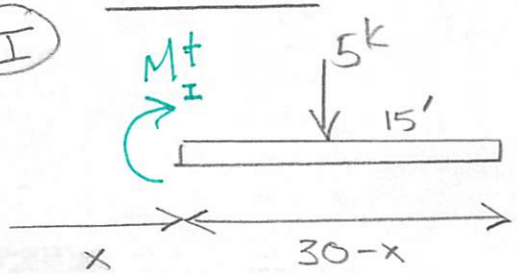
Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

Real loads



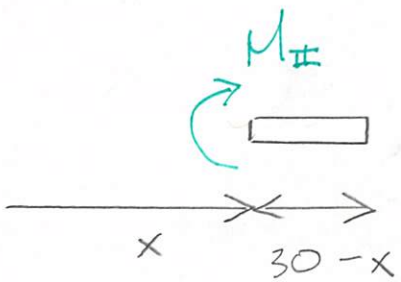
$0 \le x \le 15$

(I)



$\circlearrowleft + \Sigma M_{cut} = 0 = -M_I - 5^k(15 - x)$ $\quad M_I = [5x - 75]$ k ft

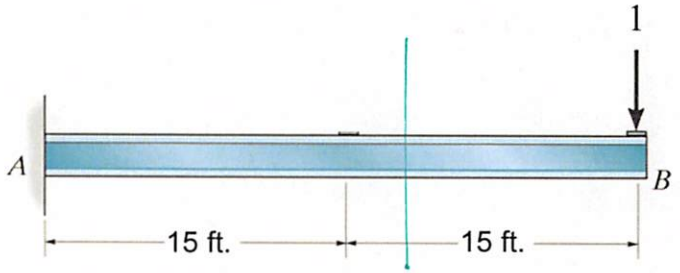
(II) $15 \le x \le 30$

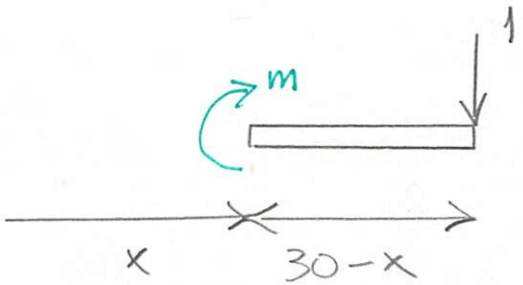


$\circlearrowleft + \Sigma M_{cut} = 0 = -M_{II}$

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





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

$$\gamma_B = \frac{1}{EI}\int_0^{30} M m\, dx = \frac{1}{EI}\left[\int_0^{15}(5x-75)(x-30)\,dx + \int_{15}^{30} 0\,(x-30)\,dx\right]$$

(0)

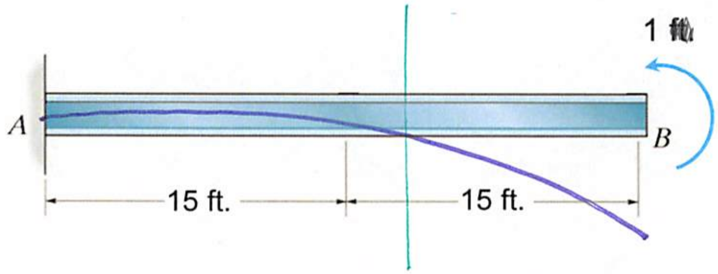
VW EXPRESSION *

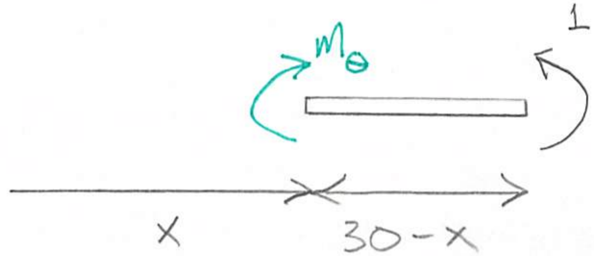
$$= \frac{1}{EI}\left[\frac{5x^3}{3} - \frac{225x^2}{2} + 2{,}250x\right]_0^{15} = \frac{28{,}125\ \text{k ft}^3}{2EI}$$

$$= \frac{28{,}125\ \text{k ft}^3}{30{,}000\ \text{k}} \cdot \frac{\text{IN}^2}{800\ \text{IN}^4} \cdot \frac{(12\ \text{IN})^3}{\text{ft}^3} = 1.01\ \text{IN.}$$

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





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

$$\theta_B = \frac{1}{EI}\int_0^{30} M m_\theta \, dx = \underline{\underline{\frac{1}{EI}\left[\int_0^{15} \overset{M_I}{(5x-75)}\overset{m_\theta}{(1)}\, dx\right.}} + \left.\int_{15}^{30} \cancelto{0}{0}(1)\, dx\right]$$

VW EXPRESSION*

$$= \frac{1}{EI}\left[\frac{5x^2}{2} - 75x\right]_0^{15} = -\frac{562.5 \, k ft^2}{EI}$$

$$= -\frac{562.5 \, k ft^2}{} \bigg| \frac{in^2}{30{,}000 \, k} \bigg| \frac{}{800 \, in^4} \bigg| \frac{(12 \, in)^2}{ft^2} = \underline{\underline{-0.0034 \text{ RADS}}}$$