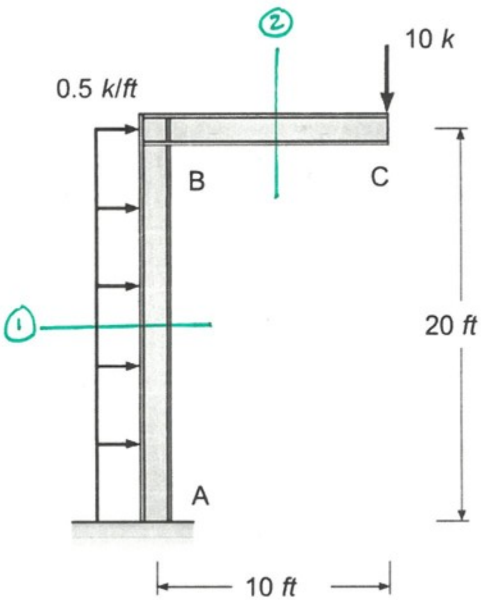
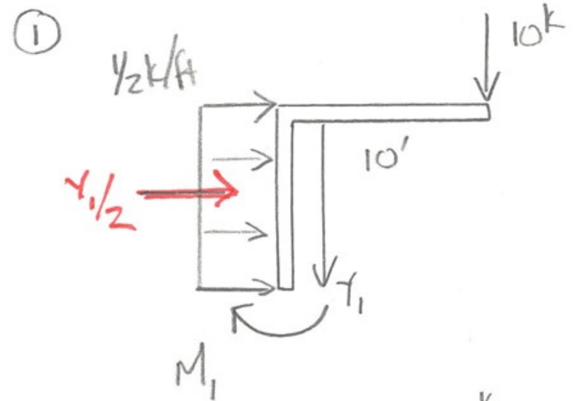
Example 8c-1: Compute the vertical deflection and rotation at point C on the frame shown. Include only the effects of the bending moment in your virtual work equations. Assume E = 29,000 *ksi* and I = 1,000 in^4.

F d

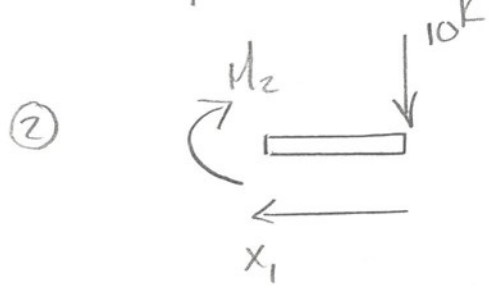
Real loads





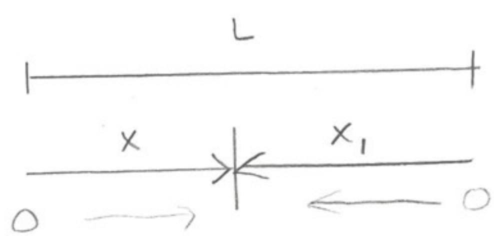
$$\circlearrowleft^{+} \sum M_{CUT} = 0 = -M_1 - \frac{Y_1}{2}\left(\frac{Y_1}{2}\right) - 10^k(10')$$

$$\underline{M_1 = \left[-\frac{Y_1^2}{4} - 100\right] k\,ft}$$



$$\circlearrowleft^{+} \sum M_{CUT} = 0 = -M_2 - 10^k(x_1)$$

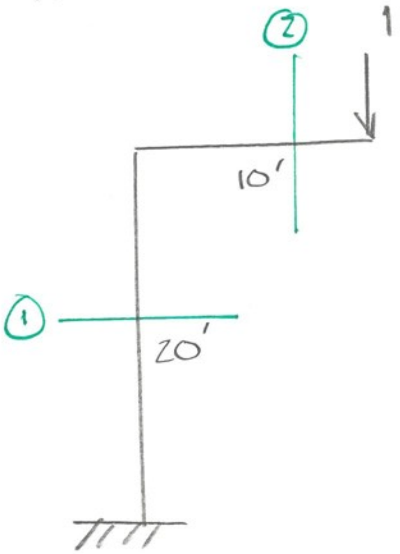
$$\underline{M_2 = \left[-10x_1\right] k\,ft}$$



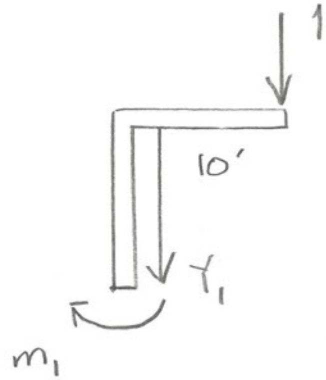
$$x + x_1 = L$$

$$\underline{x = L - x_1}$$

VIRTUAL LOAD



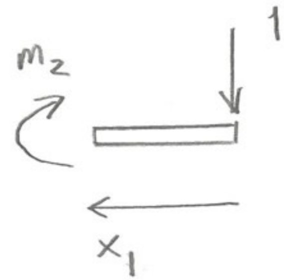
1



$$\circlearrowleft + \sum M_{CUT} = 0 = -m_1 - 1(10')$$

$$\underline{m_1 = -10 \text{ ft}}$$

2



$$\circlearrowleft + \sum M_{CUT} = 0 = -m_2 - 1x_1$$

$$\underline{m_2 = -x_1}$$

$$\underline{Y_{C_V} = \int_0^{20} \frac{M_1 m_1}{EI} dY_1 + \int_0^{10} \frac{M_2 m_2}{EI} dx_1} = \frac{1}{EI}\left[\int_0^{20}\left(-\frac{Y_1^2}{4} - 100\right)(-10)\,dY_1 + \int_0^{10}(-10x_1)(-x_1)\,dx_1\right]$$

$$= \frac{1}{EI}\left[\frac{80{,}000}{3} + \frac{10{,}000}{3}\right] = \frac{30{,}000 \text{ k ft}^3}{EI}$$

$$= \underline{\underline{1.79 \text{ IN}}}$$