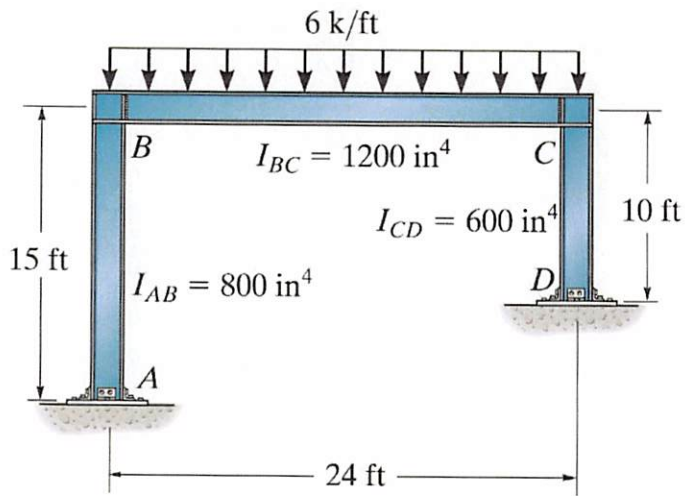


Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at A and D are fixed, and $E = 29(10^3)$ ksi.



$$I_{AB} = 800 \text{ in}^4 = \frac{4}{3} I_{CD}$$

$$I_{BC} = 1,200 \text{ in}^4 = 2 I_{CD}$$

$$I_{CD} = 600 \text{ in}^4 = I_{CD}$$

$$FEM_{BC} = \frac{WL^2}{12} = \pm \frac{6 \text{ k/ft} (24 \text{ ft})^2}{12} = \pm 288 \text{ kft}$$

SECTION AB - 2 EQNS

$$M_{AB} = \frac{2E(\frac{4}{3}I_{CD})}{15 \text{ ft}} [\theta_B - 3(\Delta/L_{AB})] \quad (1)$$

$$M_{BA} = \frac{2E(\frac{4}{3}I_{CD})}{15 \text{ ft}} [2\theta_B - 3(\Delta/L_{AB})] \quad (2)$$

SECTION BC - 2 EQNS

$$M_{BC} = \frac{2E(2I_{CD})}{24 \text{ ft}} [2\theta_B + \theta_C] - 288 \text{ kft} \quad (3)$$

$$M_{CB} = \frac{2E(2I_{CD})}{24 \text{ ft}} [2\theta_C + \theta_B] + 288 \text{ kft} \quad (4)$$

SECTION CD - 2 EQNS

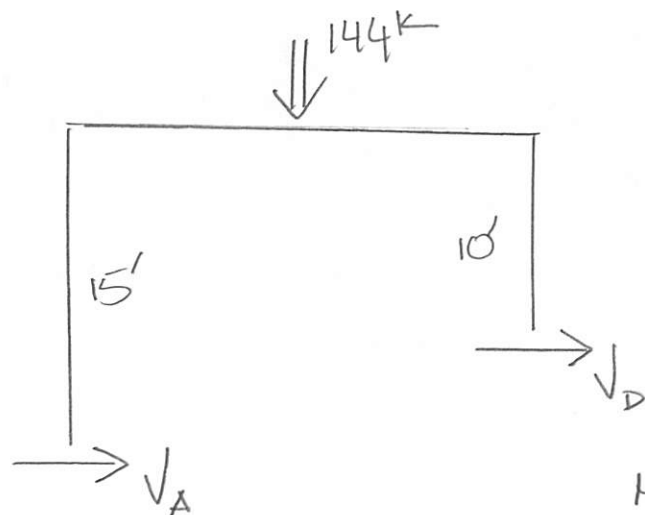
$$M_{CD} = \frac{2EI_{CD}}{10 \text{ ft}} [2\theta_C - 3(\Delta/L_{CD})] \quad (5)$$

$$M_{DC} = \frac{2EI_{CD}}{10 \text{ ft}} [\theta_C - 3(\Delta/L_{CD})] \quad (6)$$

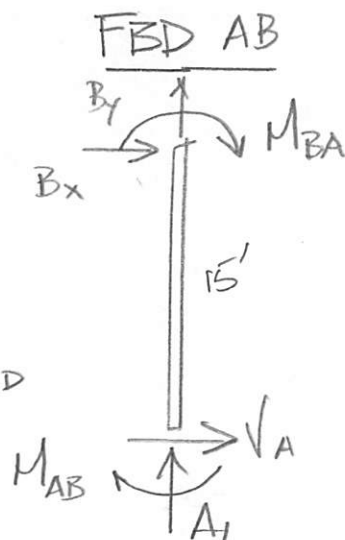
JOINT B $M_{BA} + M_{BC} = 0 \quad (7)$

JOINT C $M_{CB} + M_{CD} = 0 \quad (8)$

Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at A and D are fixed, and $E = 29(10^3)$ ksi.

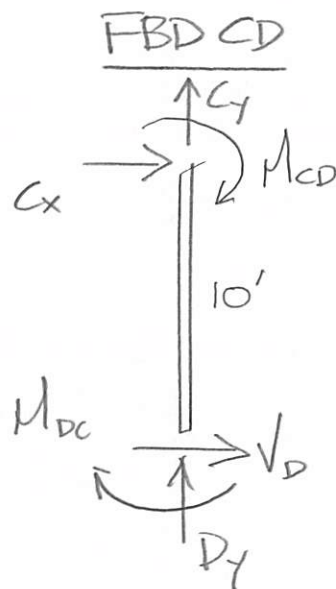


$$\sum \bar{F}_x = 0 = V_A + V_D \quad (9)$$



$$\sum M_B = 0 = -M_{BA} - M_{AB} + V_A(15\text{ft})$$

$$V_A = \frac{M_{BA} + M_{AB}}{15\text{ft}}$$



$$\sum M_C = 0 = -M_{CD} - M_{DC} + V_D(10\text{ft})$$

$$V_D = \frac{M_{CD} + M_{DC}}{10\text{ft}}$$

$$\frac{M_{BA} + M_{AB}}{15\text{ft}} + \frac{M_{CD} + M_{DC}}{10\text{ft}} \quad (9)$$

Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at A and D are fixed, and $E = 29(10^3)$ ksi.

$$\textcircled{7} \quad M_{BA} + M_{BC} = 0 = \frac{2E(4/3 I_{CD})}{15'} \left[2\theta_B - 3\left(\frac{\Delta}{15'}\right) \right] + \frac{2E(2 I_{CD})}{24'} \left[2\theta_B + \theta_C \right] - 288 \text{ kft}$$

$$0.6889 \theta_B + 0.1667 \theta_C - 0.0356 \Delta = 288 \text{ kft}^2 / EI_{CD} \quad \textcircled{7a}$$

$$\textcircled{8} \quad M_{BC} + M_{CD} = 0 = \frac{2E(2 I_{CD})}{24'} \left[2\theta_C + \theta_B \right] + 288 \text{ kft} + \frac{2E I_{CD}}{10'} \left[2\theta_C - \frac{3\Delta}{10'} \right]$$

$$0.1667 \theta_B + 0.7333 \theta_C - 0.0600 \Delta = -288 \text{ kft}^2 / EI_{CD} \quad \textcircled{8a}$$

$$\textcircled{9} \quad \frac{M_{BA} + M_{AB}}{15'} + \frac{M_{CD} + M_{DC}}{10'} = 0 = M_{BA} + M_{AB} + 1.5(M_{CD} + M_{DC})$$

$$\frac{2E(4/3 I_{CD})}{15'} \left[2\theta_B - 3\left(\frac{\Delta}{15'}\right) \right] + \frac{2E(4/3 I_{CD})}{15'} \left[\theta_B - 3\left(\frac{\Delta}{15'}\right) \right]$$

$$+ 1.5 \left[\frac{2E I_{CD}}{10'} \left[2\theta_C - 3\left(\frac{\Delta}{10'}\right) \right] + \frac{2E I_{CD}}{10'} \left[\theta_C - 3\left(\frac{\Delta}{10'}\right) \right] \right] = 0$$

$$0.5333 \theta_B + 0.9000 \theta_C - 0.2511 \Delta = 0 \quad \textcircled{9a}$$

USING EXCEL, SOLVE $7a$, $8a$, & $9a$

Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at A and D are fixed, and $E = 29(10^3)$ ksi.

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USING EXCEL, SOLVED θ_a , θ_c , & Δ

$$\theta_B = \frac{507.4804 \text{ kft}^2}{EI_{CD}}$$

$$\theta_C = - \frac{594.1733 \text{ kft}^2}{EI_{CD}}$$

$$\Delta = - \frac{1,051.8388 \text{ kft}^2}{EI_{CD}}$$

$$M_{AB} = \frac{2E(4/3 I_{CD})}{15'} \left[\theta_B - \frac{3\Delta}{15'} \right] = 127.62 \text{ kft}$$

$$M_{BA} = \frac{2E(4/3 I_{CD})}{15'} \left[2\theta_B - \frac{3\Delta}{15'} \right] = 217.84 \text{ kft}$$

$$M_{BC} = \frac{2E(2 I_{CD})}{24'} \left[2\theta_B + \theta_C \right] - 288 \text{ kft} = -217.87 \text{ kft}$$

$$\Rightarrow M_{BA} + M_{BC} = 0$$

$$M_{CB} = \frac{2E(2 I_{CD})}{24'} \left[2\theta_C + \theta_B \right] + 288 \text{ kft} = 174.52 \text{ kft}$$

$$\Rightarrow M_{CB} + M_{CD} = 0$$

$$M_{CD} = \frac{2E I_{CD}}{10'} \left[2\theta_C - \frac{3\Delta}{10'} \right] = -174.56 \text{ kft}$$

$$M_{DC} = \frac{2E I_{CD}}{10'} \left[\theta_C - \frac{3\Delta}{10'} \right] = -55.72 \text{ kft}$$