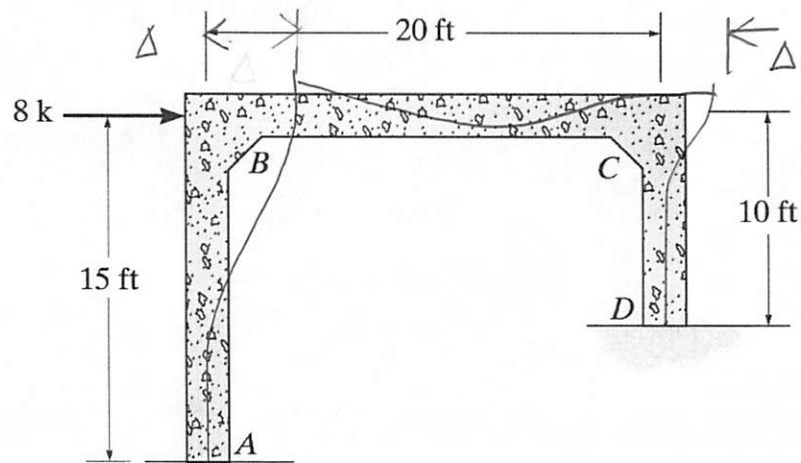


Problem 10-23 – Determine the moments at each joint and fixed support. Assume EI is constant.

1/4



$$\underline{FEM = 0}$$

$$M_{AB} = \frac{2EI}{15ft} [\theta_B - 3\psi_{AB}] \quad (1)$$

$$M_{BA} = \frac{2EI}{15ft} [2\theta_B - 3\psi_{AB}] \quad (2)$$

$$\psi_{AB} = \frac{\Delta}{15ft}$$

$$M_{BC} = \frac{2EI}{20ft} [2\theta_B + \theta_C] \quad (3)$$

$$M_{CB} = \frac{2EI}{20ft} [2\theta_C + \theta_B] \quad (4)$$

$$\psi_{CD} = \frac{\Delta}{10ft}$$

$$M_{CD} = \frac{2EI}{10ft} [2\theta_C - 3\psi_{CD}] \quad (5)$$

$$M_{DC} = \frac{2EI}{10ft} [\theta_C - 3\psi_{CD}] \quad (6)$$

$$\underline{\psi_{CD} = \frac{3}{2} \psi_{AB}}$$

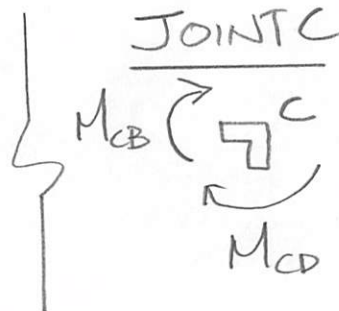
JOINT B

$$\sum M_B = 0$$

$$M_{BC} = -M_{BA} - M_{BC}$$

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

JOINT C



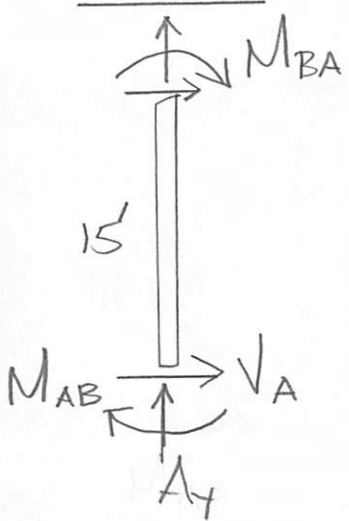
$$\sum M_C = 0$$

$$= -M_{CB} - M_{CD}$$

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

Problem 10-23 – Determine the moments at each joint and fixed support. Assume EI is constant.

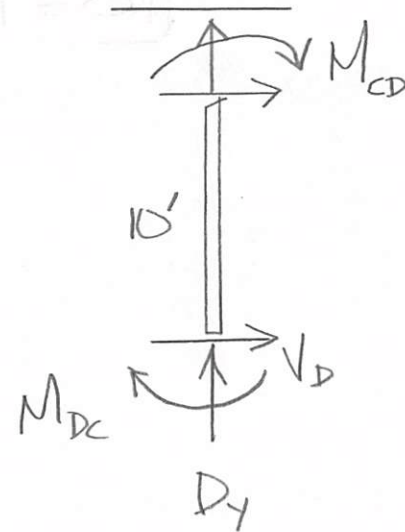
FBD AB



$$\begin{aligned} \sum M_B &= 0 \\ &= -M_{BA} - M_{AB} + V_A(15') \end{aligned}$$

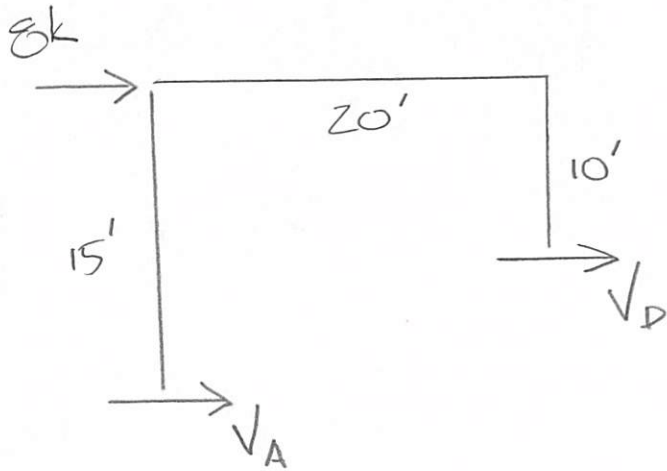
$$V_A = \frac{M_{BA} + M_{AB}}{15 \text{ ft}}$$

FBD CD



$$\begin{aligned} \sum M_C &= 0 \\ &= -M_{CD} - M_{DC} + V_D(10') \end{aligned}$$

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



$$\sum F_y = 0 = V_A + V_D + 8k$$

$$V_A + V_D = -8k$$

$$\Rightarrow \frac{M_{BA} + M_{AB}}{15 \text{ ft}} + \frac{M_{CD} + M_{DC}}{10 \text{ ft}} = -8k \quad (9)$$

Problem 10-23 – Determine the moments at each joint and fixed support. Assume EI is constant.

$$\textcircled{7} \quad M_{BA} + M_{BC} = 0 = \frac{2EI}{15\text{ft}} [2\theta_B - 3\psi_{AB}] + \frac{2EI}{20\text{ft}} [2\theta_B + \theta_C]$$

$$\underline{\underline{\frac{14}{30}\theta_B + \frac{1}{10}\theta_C - \frac{2}{5}\psi_{AB} = 0}} \quad \textcircled{7a}$$

$$\textcircled{8} \quad M_{CB} + M_{CD} = 0 = \frac{2EI}{20\text{ft}} [2\theta_C + \theta_B] + \frac{2EI}{10\text{ft}} [2\theta_C - 3(\frac{3}{2}\psi_{AB})]$$

$$\underline{\underline{\frac{1}{10}\theta_B + \frac{3}{5}\theta_C - \frac{9}{10}\psi_{AB} = 0}} \quad \textcircled{8a}$$

$$\textcircled{9} \quad \frac{M_{BA} + M_{AB}}{15\text{ft}} + \frac{M_{CD} + M_{DC}}{10\text{ft}} = -8\text{k}$$

$$2 \left[\frac{2EI}{15} (2\theta_B - 3\psi_{AB}) + \frac{2EI}{15} (\theta_B - 3\psi_{AB}) \right] + 3 \left[\frac{2EI}{10} (2\theta_C - 3(\frac{3}{2}\psi_{AB})) + \frac{2EI}{10} (\theta_C - 3(\frac{3}{2}\psi_{AB})) \right] = -240\text{k}$$

$$\underline{\underline{\frac{4}{5}\theta_B + \frac{9}{5}\theta_C - 7\psi_{AB} = -240}} \quad \textcircled{9a}$$

Problem 10-23 – Determine the moments at each joint and fixed support. Assume EI is constant.

SOLVING (7a), (8a), & (9a) USING EXCEL, GNES

$$\underline{\underline{\Theta_B = \frac{33.149 \text{ kft}^2}{EI}}}$$

$$\underline{\underline{\Theta_C = \frac{83.978 \text{ kft}^2}{EI}}}$$

$$\underline{\underline{\psi_{AB} = \frac{59.669 \text{ kft}^2}{EI}}}$$

$$\underline{\underline{\psi_{CD} = \frac{3}{2} \psi_{AB} = \frac{89.503 \text{ kft}^2}{EI}}}$$

$$M_{AB} = \frac{2EI}{15} [\Theta_B - 3\psi_{AB}] = \underline{-19.45 \text{ kft}}$$

$$M_{BA} = \frac{2EI}{15} [2\Theta_B - 3\psi_{AB}] = \underline{-15.03 \text{ kft}}$$

$$M_{BC} = \frac{2EI}{20} [2\Theta_B + \Theta_C] = \underline{15.03 \text{ kft}}$$

$$M_{CB} = \frac{2EI}{20} [2\Theta_C + \Theta_B] = \underline{20.11 \text{ kft}}$$

$$M_{CD} = \frac{2EI}{10} [2\Theta_C - 3\psi_{CD}]$$

$$= \underline{-20.11 \text{ kft}}$$

$$M_{DC} = \frac{2EI}{10} [\Theta_C - 3\psi_{CD}]$$

$$= \underline{-36.91 \text{ kft}}$$