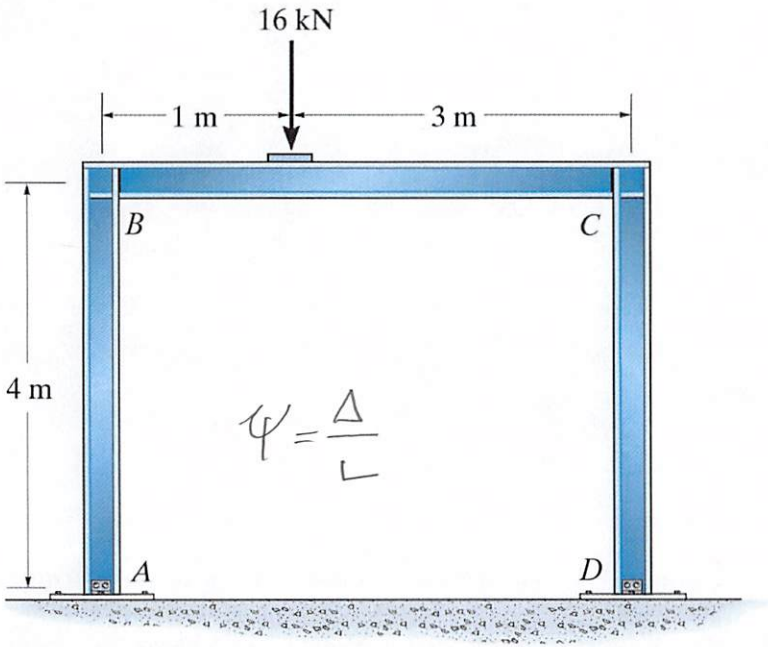
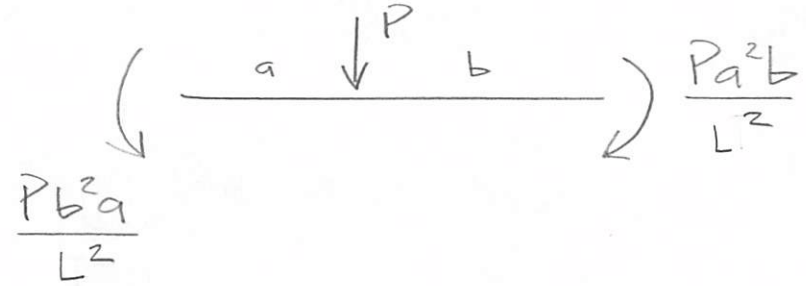
Problem 10c-1 – Determine the moments at *B* and *C*. Assume the supports at *A* and *D* are pins. *EI* is constant.



FEM



$$-\frac{Pb^2a}{L^2} = \frac{-16kN(3m)^2(1m)}{(4m)^2} = -9kNm$$

$$\frac{Pa^2b}{L^2} = \frac{16kN(1m)^2(3m)}{(4m)^2} = 3kNm$$

$$M_{BA} = \frac{3EI}{4m}\left[\theta_B - \psi\right] \quad (1)$$

$$M_{BC} = \frac{2EI}{4m}\left[2\theta_B + \theta_C\right] - 9kNm \quad (2)$$

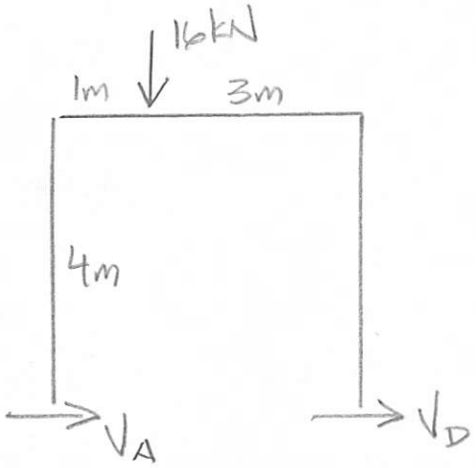
$$M_{CB} = \frac{2EI}{4m}\left[2\theta_C + \theta_B\right] + 3kNm \quad (3)$$

$$M_{CD} = \frac{3EI}{4m}\left[\theta_C - \psi\right] \quad (4)$$

$$M_{BA} + M_{BC} = 0 \quad (5)$$

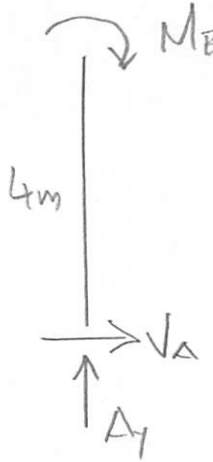
$$M_{CB} + M_{CD} = 0 \quad (6)$$

Problem 10c-1 – Determine the moments at *B* and *C*. Assume the supports at *A* and *D* are pins. *EI* is constant.



$$\overset{+}{\rightarrow}\sum F_x = 0 = V_A + V_D \quad (7)$$

SECTION AB

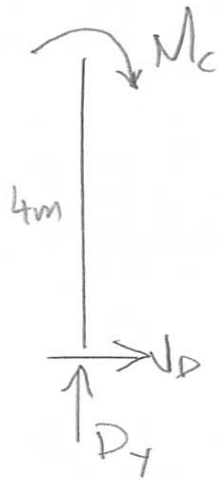


$$\circlearrowleft^{+}\sum M_B = 0$$

$$= -M_{BA} + V_A(4m)$$

$$V_A = \frac{M_{BA}}{4m}$$

SECTION CD



$$\circlearrowleft^{+}\sum M_C = 0$$

$$= -M_{CD} + V_D(4m)$$

$$V_D = \frac{M_{CD}}{4m}$$

(7a) $M_{BA} + M_{CD} = 0$

Problem 10c-1 – Determine the moments at *B* and *C*. Assume the supports at *A* and *D* are pins. *EI* is constant.

(4) $M_{BA} + M_{CD} = 0 = \underbrace{\frac{3EI}{4m}\left[\theta_B - \psi\right]}_{M_{BA}} + \underbrace{\frac{3EI}{4m}\left[\theta_C - \psi\right]}_{M_{CD}}$

$$\frac{3}{4}\theta_B + \frac{3}{4}\theta_C - \frac{6}{4}\psi = 0$$

(5) $M_{BA} + M_{BC} = 0 \quad \frac{3EI}{4m}\left[\theta_B - \psi\right] + \frac{2EI}{4m}\left[2\theta_B + \theta_C\right] - 9\,kNm$

$$\frac{7}{4}\theta_B + \frac{1}{2}\theta_C - \frac{3}{4}\psi = \frac{9\,kNm^2}{EI}$$

(6) $M_{CB} + M_{CD} = 0 = \frac{2EI}{4m}\left[2\theta_C + \theta_B\right] + 3kNm + \frac{3EI}{4m}\left[\theta_C - \psi\right]$

$$\frac{1}{2}\theta_B + \frac{7}{4}\theta_C - \frac{3}{4}\psi = -\frac{3kNm^2}{EI}$$

$$\begin{bmatrix} 3/4 & 3/4 & -6/4 \\ 7/4 & 1/2 & -3/4 \\ 1/2 & 7/4 & -3/4 \end{bmatrix} \begin{bmatrix} \theta_B \\ \theta_C \\ \psi \end{bmatrix} = \begin{bmatrix} 0 \\ 9 \\ -3 \end{bmatrix} \frac{kNm^2}{EI} \quad *$$

$$\theta_B = \frac{6.80\,kNm^2}{EI}$$

$$\theta_C = -\frac{2.8\,kNm^2}{EI}$$

$$\psi = \frac{2\,kNm^2}{EI}$$

Problem 10c-1 – Determine the moments at *B* and *C*. Assume the supports at *A* and *D* are pins. *EI* is constant.

$$M_{BA} = \frac{3EI}{4m}\left[\theta_B - \psi\right] = \underline{3.6\,kNm}$$

$$M_{BC} = \frac{2EI}{4m}\left[2\theta_B + \theta_C\right] - 9kNm = \underline{-3.6\,kNm}$$

$M_{BA} + M_{BC} = 0$ ✓

$$M_{CB} = \frac{2EI}{4m}\left[2\theta_C + \theta_B\right] + 3kNm = 3.6kNm$$

$$M_{CD} = \frac{3EI}{4m}\left[\theta_C - \psi\right] = -3.6kNm$$

$M_{CB} + M_{CD} = 0$ ✓