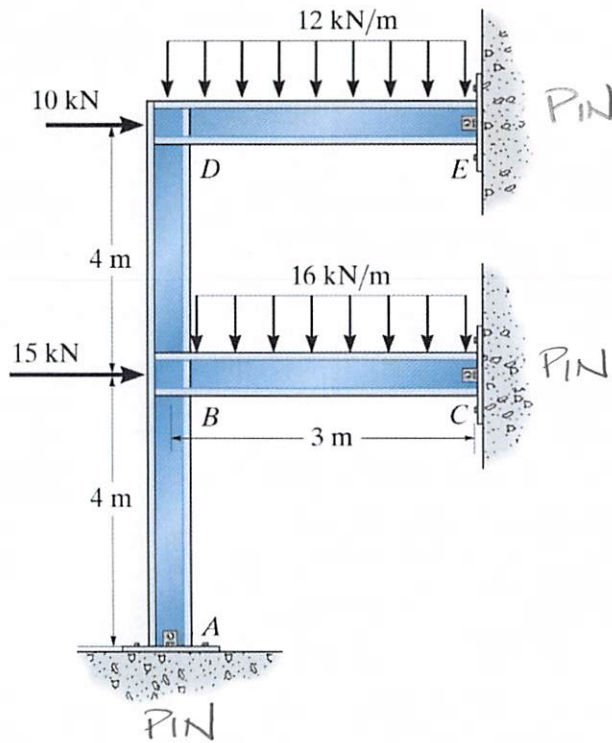


Problem 10-20 – Determine the moment that each member exerts on the joints at B and D , then draw the moment diagram for each member of the frame. Assume the supports at A , C , and E are pins. EI is constant.



$$FEM_{BC} = -\frac{WL^2}{8} = -\frac{16\text{ kN/m}(3\text{ m})^2}{8} = -18\text{ kNm}$$

$$FEM_{DE} = -\frac{WL^2}{8} = -\frac{12\text{ kN/m}(3\text{ m})^2}{8} = -13.5\text{ kNm}$$

$$M_{BA} = \frac{3EI}{4\text{ m}} [\theta_B] \quad (1)$$

$$M_{BC} = \frac{3EI}{3\text{ m}} [\theta_B] - 18\text{ kNm} \quad (2)$$

$$M_{BD} = \frac{2EI}{4\text{ m}} [2\theta_B + \theta_D] \quad (3)$$

$$M_{DB} = \frac{2EI}{4\text{ m}} [2\theta_D + \theta_B] \quad (4)$$

$$M_{DE} = \frac{3EI}{3\text{ m}} [\theta_D] - 13.5\text{ kNm} \quad (5)$$

$$\text{FROM JOINT B} \Rightarrow M_{BA} + M_{BC} + M_{BD} = 0 \quad (6)$$

$$\text{FROM JOINT D} \Rightarrow M_{DB} + M_{DE} = 0 \quad (7)$$

Problem 10-20 – Determine the moment that each member exerts on the joints at B and D , then draw the moment diagram for each member of the frame. Assume the supports at A , C , and E are pins. EI is constant. 3/5

$$\textcircled{6} \quad M_{BA} + M_{BC} + M_{BD} = 0 = \frac{3EI}{4m} \theta_B + \frac{3EI}{3m} \theta_B - 18 \text{ kNm} + \frac{2EI}{4m} [2\theta_B + \theta_D]$$

$$\Rightarrow \frac{11}{4} \theta_B + \frac{1}{2} \theta_D = \frac{18 \text{ kNm}^2}{EI} \quad \textcircled{6a}$$

$$\textcircled{7} \quad M_{DB} + M_{DE} = 0 = \frac{2EI}{4m} [2\theta_D + \theta_B] + \frac{3EI}{3m} \theta_D - 13.5 \text{ kNm}$$

$$\Rightarrow \frac{1}{2} \theta_B + 2\theta_D = \frac{13.5 \text{ kNm}^2}{EI} \quad \textcircled{7a}$$

$$4 \times \textcircled{6a} - \textcircled{7a} \Rightarrow \frac{21}{2} \theta_B = \frac{58.5 \text{ kNm}^2}{EI}$$

$$\underline{\underline{\theta_B = \frac{39 \text{ kNm}^2}{7EI}}} \Rightarrow \underline{\underline{\theta_D = \frac{75 \text{ kNm}^2}{14EI}}}$$

Problem 10-20 – Determine the moment that each member exerts on the joints at B and D , then draw the moment diagram for each member of the frame. Assume the supports at A , C , and E are pins. EI is constant. 3/5

$$M_{BA} = \frac{3EI}{4m} \Theta_B = \underline{4.18 \text{ kNm}}$$

$$M_{BC} = \frac{3EI}{3m} \Theta_B - 18 \text{ kNm} = \underline{-12.43 \text{ kNm}}$$

$$M_{BD} = \frac{2EI}{4m} [2\Theta_B + \Theta_D] = \underline{8.25 \text{ kNm}}$$

$$M_{BA} + M_{BC} + M_{BD} = 0 \quad \checkmark$$

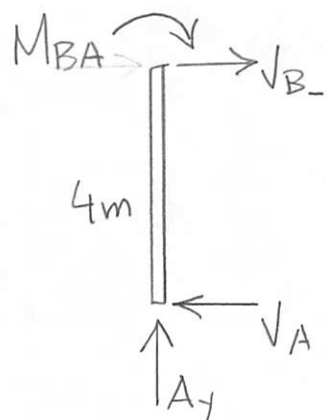
$$M_{DB} = \frac{2EI}{4m} [2\Theta_D + \Theta_B] = \underline{8.14 \text{ kNm}}$$

$$M_{DE} = \frac{3EI}{3m} [\Theta_D] - 13.5 \text{ kNm} = \underline{-8.14 \text{ kNm}}$$

$$M_{DB} + M_{DE} = 0 \quad \checkmark$$

Problem 10-20 – Determine the moment that each member exerts on the joints at B and D, then draw the moment diagram for each member of the frame. Assume the supports at A, C, and E are pins. EI is constant. 4/5

SECTION AB



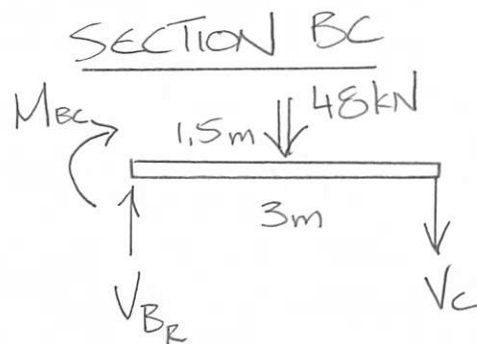
$$\begin{aligned} \sum M_B &= 0 \\ &= -M_{BA} - V_A(4\text{m}) \end{aligned}$$

$$\underline{V_A = -1.05 \text{ kN}}$$

$$\begin{aligned} \sum F_x &= 0 \\ &= -V_A + V_B \end{aligned}$$

$$\underline{V_B = -1.05 \text{ kN}}$$

SECTION BC



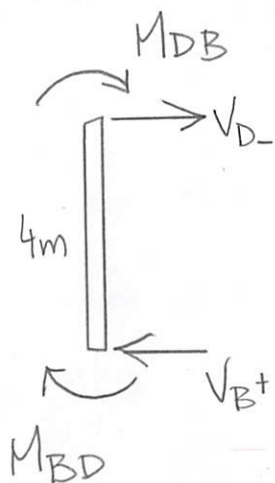
$$\begin{aligned} \sum M_B &= 0 \\ &= -M_{BC} - V_C(3\text{m}) - 48\text{kN}(1.5\text{m}) \end{aligned}$$

$$\underline{V_C = -19.86 \text{ kN}}$$

$$\sum F_y = 0 = V_{BR} - V_C - 48\text{kN}$$

$$\underline{V_{BR} = 28.14 \text{ kN}}$$

SECTION BD



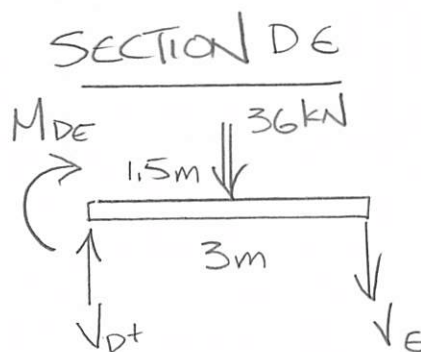
$$\begin{aligned} \sum M_B &= 0 \\ &= -M_{DB} - M_{BD} - V_{D+}(4\text{m}) \end{aligned}$$

$$\underline{V_{D+} = -4.10 \text{ kN}}$$

$$\sum F_x = 0 = V_{D+} - V_{B+}$$

$$\underline{V_{B+} = -4.10 \text{ kN}}$$

SECTION DE



$$\begin{aligned} \sum M_D &= 0 \\ &= -M_{DE} - 36\text{kN}(1.5\text{m}) - V_E(3\text{m}) \end{aligned}$$

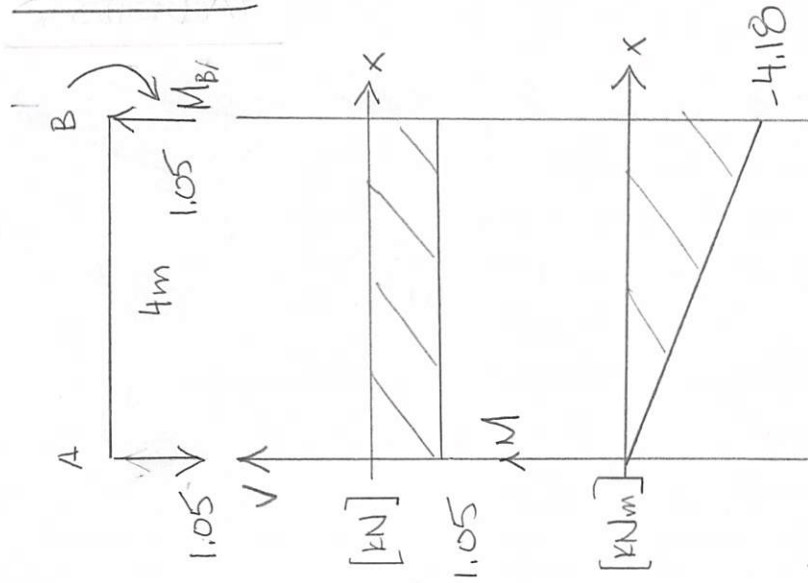
$$\underline{V_E = -15.29 \text{ kN}}$$

$$\sum F_y = 0 = V_{D+} - V_E - 36\text{kN}$$

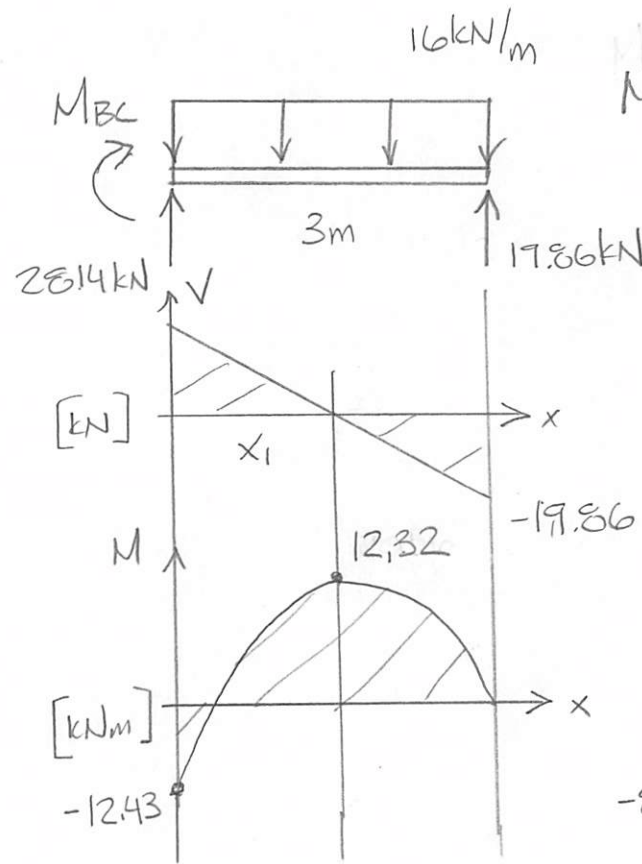
$$\underline{V_{D+} = 20.71 \text{ kN}}$$

Problem 10-20 – Determine the moment that each member exerts on the joints at B and D, then draw the moment diagram for each member of the frame. Assume the supports at A, C, and E are pins. EI is constant. 5/5

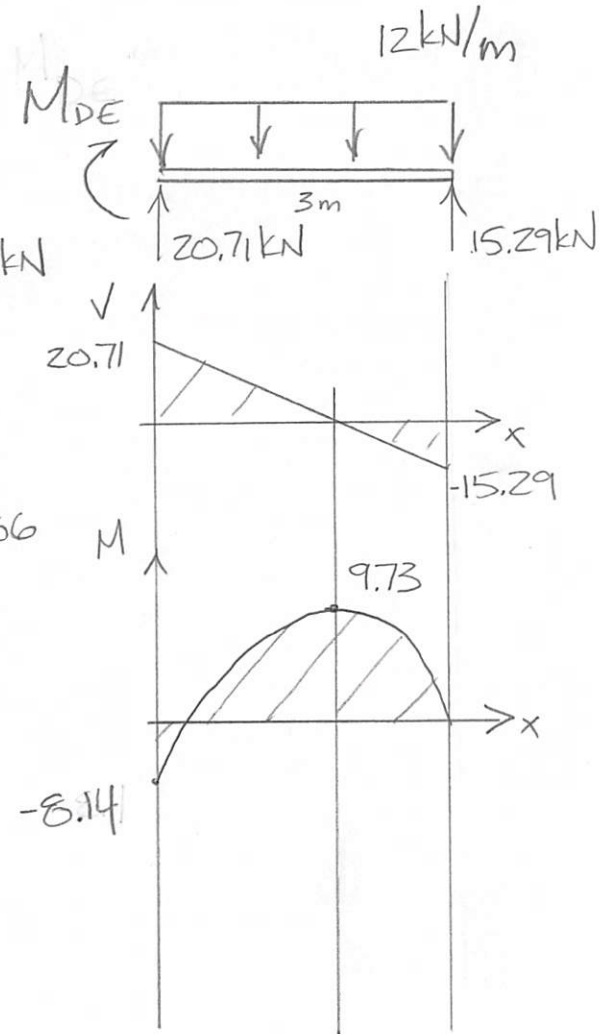
SECTION AB



SECTION BC



SECTION DE



SECTION BD

