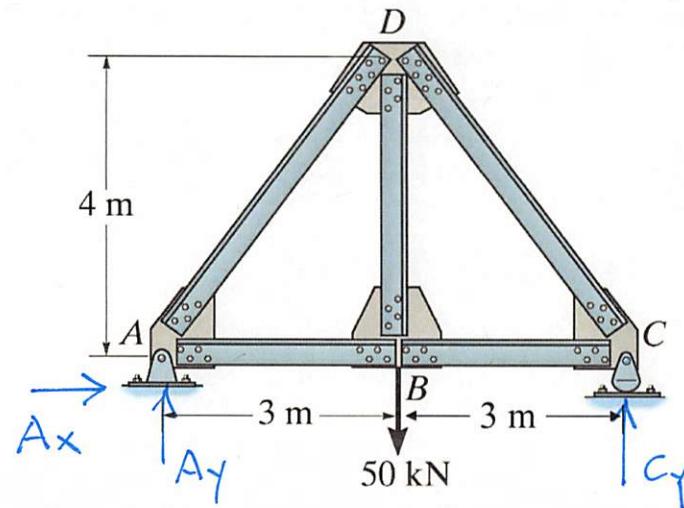


Example 8a-1: Determine the vertical displacement of joint D. Assume AE is constant.



$$\text{At } D: \sum M_C = 0 = 50\text{ kN}(3\text{ m}) - A_y(6\text{ m})$$

$$A_y = 25\text{ kN}$$

$$+ \uparrow \sum F_y = 0 = A_y + C_y - 50\text{ kN}$$

$$C_y = 25\text{ kN}$$

$$\rightarrow \sum F_x = 0 = A_x$$

REAL FORCES

JOINT A

$$\begin{aligned} & \text{At } A: + \uparrow \sum F_y = 0 \\ & = \frac{4}{5} F_{AD} + 25\text{ kN} \\ & F_{AD} = -31.25\text{ kN} \end{aligned}$$

$$\begin{aligned} & + \rightarrow \sum F_x = 0 \\ & = \frac{3}{5} F_{AD} + F_{AB} \end{aligned}$$

$$F_{AB} = 18.75\text{ kN}$$

JOINT C

$$\begin{aligned} & \text{At } C: + \uparrow \sum F_y = 0 \\ & = \frac{4}{5} F_{CD} + 25\text{ kN} \\ & F_{CD} = -31.25\text{ kN} \end{aligned}$$

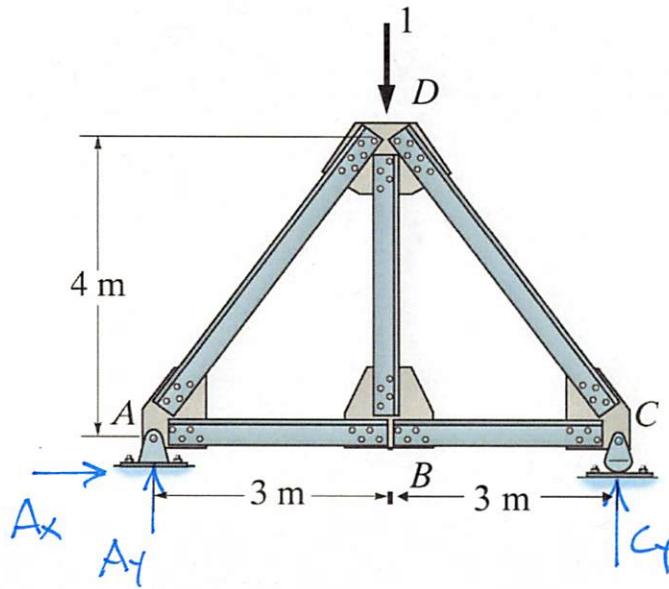
$$\begin{aligned} & + \rightarrow \sum F_x = 0 \\ & = -\frac{3}{5} F_{CD} - F_{BC} \end{aligned}$$

$$F_{BC} = 18.75\text{ kN}$$

JOINT B

$$\begin{aligned} & \text{At } B: + \uparrow \sum F_y = 0 \\ & F_{BD} - 50\text{ kN} \\ & F_{BD} = 50\text{ kN} \end{aligned}$$

Example 8a-1: Determine the vertical displacement of joint D. Assume AE is constant.



$$\begin{aligned} \text{At Joint C: } & \sum M_C = 0 = 1(3m) - A_y(6m) \\ & \underline{A_y = \frac{1}{2}} \\ + \uparrow \sum F_y = 0 &= A_y + C_y - 1 \\ \rightarrow \sum F_x = 0 &= A_x \end{aligned}$$

VIRTUAL FORCES

JOINT A

$$\begin{aligned} \sum F_y &= 0 \\ f_{AD} \frac{3}{5} + f_{AB} \frac{4}{5} &= \frac{4}{5} f_{AD} + \frac{1}{2} \\ f_{AD} &= -0.625 \\ \rightarrow \sum F_x &= 0 \\ \frac{3}{5} f_{AD} + f_{AB} &= 0.375 \\ f_{AB} &= 0.375 \end{aligned}$$

JOINT C

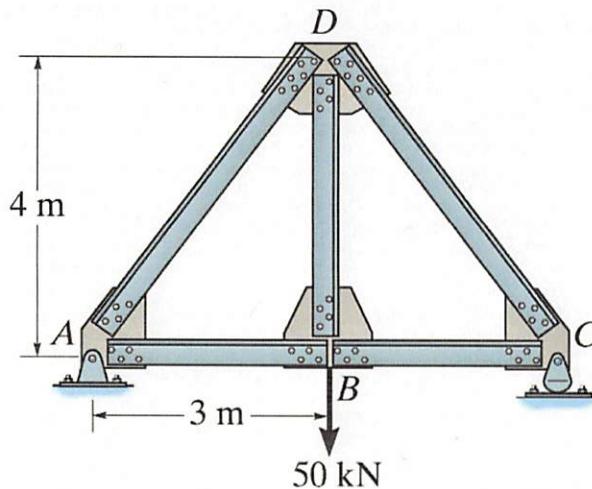
$$\begin{aligned} \sum F_y &= 0 \\ f_{CD} \frac{3}{5} + f_{BC} \frac{4}{5} &= \frac{4}{5} f_{CD} + \frac{1}{2} \\ f_{CD} &= -0.625 \\ \rightarrow \sum F_x &= 0 \\ -\frac{3}{5} f_{CD} - f_{BC} &= 0 \\ f_{BC} &= 0.375 \end{aligned}$$

JOINT B

$$\begin{aligned} \sum F_y &= 0 = f_{BD} \\ f_{AB} &= f_{BC} \end{aligned}$$

$$+ \uparrow \sum F_y = 0 = f_{BD}$$

Example 8a-1: Determine the vertical displacement of joint D. Assume AE is constant.



$$\sum \frac{F_f L}{A_E}$$

Element	F (kN)	f	L (m)	$F_f L$
AB	18.75	0.375	3	21.094
AD	-31.25	-0.625	5	97.656
BC	18.75	0.375	3	21.094
CD	-31.25	-0.625	5	97.656
BD	50	0	4	0

$$A_E = [L^2] \left[\frac{F}{L^2} \right] = F$$

$$\sum \frac{237.5 \text{ kNm}}{A_E}$$