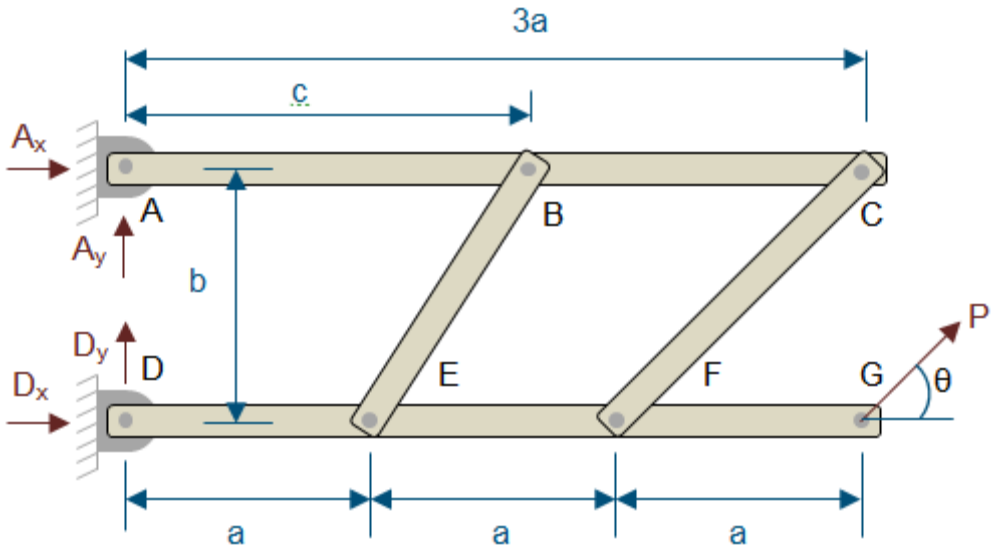
# Forces in a 4 Member Frame

This frame is subject to a load P at point G. This application will determine the forces at the supports and in members BE and CF.




Since the frame is in equilibrium, the sum of horizontal forces, sum of vertical forces, and sum of momentum about a point is zero. This allows us to identify the unknown forces in the frame.

Load and load angle $P := -800\,N$ $\theta := 30\,deg$

Length $a := 0.3\,m$ $b := 0.4\,m$ $c := 0.5\,m$

Sum of the moments about A

$$sum\_moments\_A := b \cdot D_x + b \cdot P \cdot \cos(\theta) + 3 \cdot a \cdot P \cdot \sin(\theta)$$

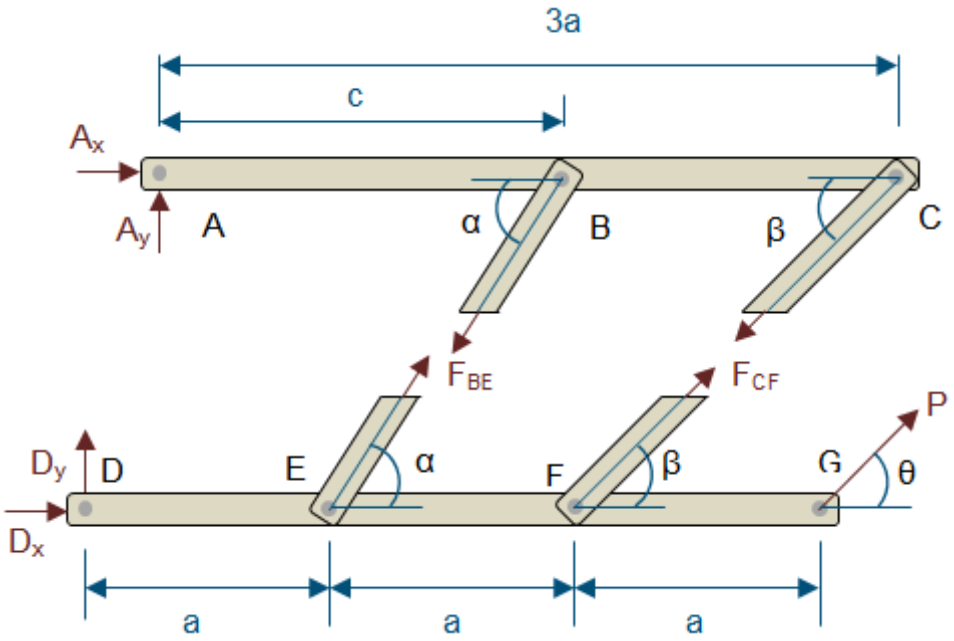
$$D_x := fsolve(sum\_moments\_A, D_x) = 1.593 \times 10^3 \frac{J}{m}$$

Sum of the forces about A

$$sum\_forces\_A := A_x + D_x + P \cdot \cos(\theta) = 0$$

$$A_x := fsolve(sum\_forces\_A, A_x) = -900.000 \frac{J}{m}$$

The forces on BE and CF must be equal (but opposite in sign) for the members to be at rest. Split BE and CF.




Angles

$$\alpha := \arctan\left(\frac{b}{c-a}\right) = 1.107 \qquad \beta := \arctan\left(\frac{b}{a}\right) = 0.927$$

Four forces remain:
Ay, Dy, FBE and FCF

$$\text{sum\_moments\_ABC} := c \cdot F_{BE} \cdot \sin(\alpha) + 3 \cdot a \cdot F_{CF} \cdot \sin(\beta) = 0$$

$$\text{sum\_moments\_DEFG} := a \cdot F_{BE} \cdot \sin(\alpha) + 2 \cdot a \cdot F_{CF} \cdot \sin(\beta) + 3 \cdot a \cdot P \cdot \sin(\theta)$$

Solve for FBE and FCF

$$\text{res} := \mathit{fsolve}(\{\text{sum\_moments\_ABC}, \text{sum\_moments\_DEFG}\}, \{F_{BE}, F_{CF}\})$$

$$\text{res} = \left\{F_{BE} = -1.207 \times 10^4 \frac{J}{m}, F_{CF} = 7.500 \times 10^3 \frac{J}{m}\right\}$$

$$F_{CF} := \text{eval}(F_{CF}, \text{res}) = 7.500 \times 10^3\ \text{N}$$

Member ABC

$$\text{sum\_forces\_ABC} := A_y - F_{BE} \cdot \sin(\alpha) - F_{CF} \cdot \sin(\beta) = 0$$

$$\text{fsolve}(\text{sum\_forces\_ABC}, A_y) = -4.800 \times 10^3\ \text{N}$$

Member DEFG

$$\text{sum\_forces\_DEFG} := D_y + F_{BE} \cdot \sin(\alpha) + F_{CF} \cdot \sin(\beta) + P \cdot \sin(\theta) = 0$$

$$\text{fsolve}(\text{sum\_forces\_DEFG}, D_y) = 5.200 \times 10^3\ \text{N}$$