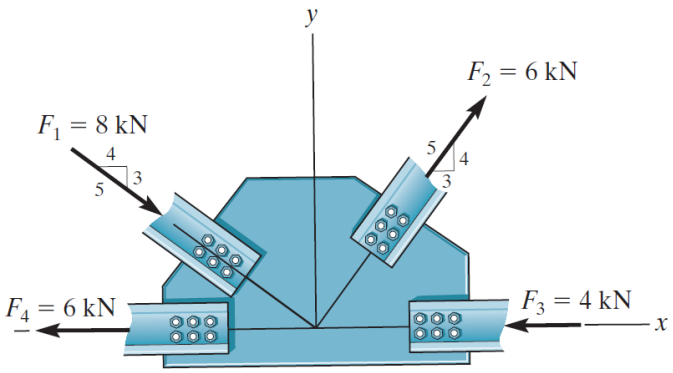
Problem 2-52

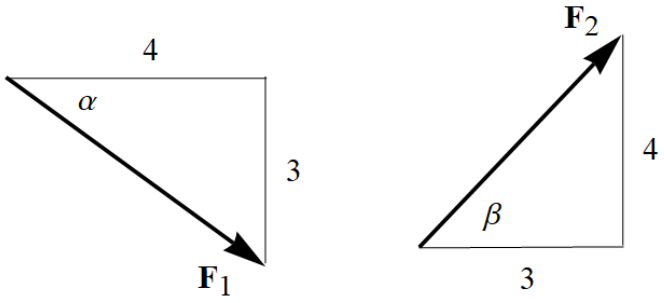
Determine the x and y components of each force acting on the *gusset plate* of a bridge truss. Show that the resultant force is zero.



Prob. 2–52

Solution

Begin by finding the angles that $\mathbf{F}_1$ and $\mathbf{F}_2$ make with the x-axis.



$$\tan\alpha = \frac{3}{4} \quad \rightarrow \quad \alpha = \tan^{-1}\left(\frac{3}{4}\right) \approx 36.9^\circ$$

$$\tan\beta = \frac{4}{3} \quad \rightarrow \quad \beta = \tan^{-1}\left(\frac{4}{3}\right) \approx 53.1^\circ$$

Write each of the forces in component form.

$$\mathbf{F}_1 = 8\,\langle\cos\alpha, -\sin\alpha\rangle \text{ kN} = 8\left\langle\frac{4}{5}, -\frac{3}{5}\right\rangle \text{ kN} = \langle 6.4, -4.8\rangle \text{ kN}$$

$$\mathbf{F}_2 = 6\,\langle\cos\beta, \sin\beta\rangle \text{ kN} = 6\left\langle\frac{3}{5}, \frac{4}{5}\right\rangle \text{ kN} = \langle 3.6, 4.8\rangle \text{ kN}$$

$$\mathbf{F}_3 = 4\,\langle -1, 0\rangle \text{ kN}$$

$$\mathbf{F}_4 = 6\,\langle -1, 0\rangle \text{ kN}$$

Add these four forces to get the resultant.

$$\begin{aligned}\mathbf{F}_R &= \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \mathbf{F}_4 \\ &= \langle 6.4 + 3.6 - 4 - 6, -4.8 + 4.8 \rangle \text{ kN} \\ &= \langle 0, 0 \rangle \text{ kN}\end{aligned}$$

Its magnitude is

$$|\mathbf{F}_R| = \sqrt{(0)^2 + (0)^2} \text{ kN} = 0 \text{ kN}.$$