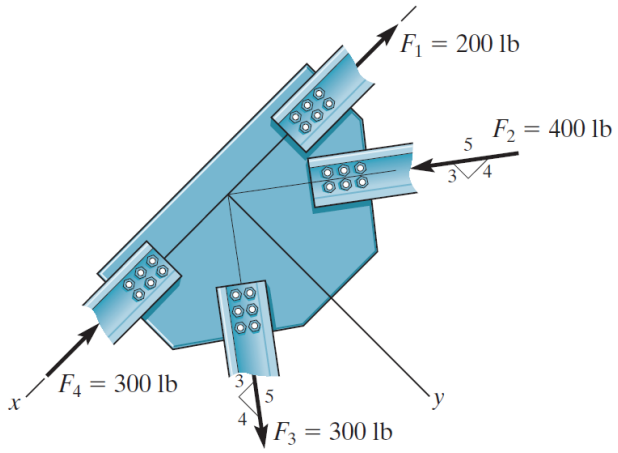
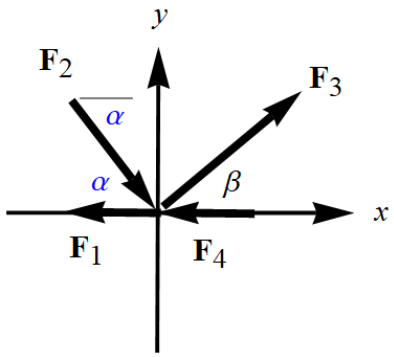
Problem R2-3

Determine the magnitude of the resultant force acting on the *gusset plate* of the bridge truss.



Prob. R2–3

Solution



Begin by finding the angles, α and β, that $\mathbf{F}_2$ and $\mathbf{F}_3$ make with the x-axis, respectively.

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

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

Write each of the forces in component form.

$$\mathbf{F}_1 = 200\,\langle -1, 0\rangle \text{ lb}$$

$$\mathbf{F}_2 = 400\,\langle \cos\alpha, -\sin\alpha\rangle \text{ lb} = 400\left\langle \frac{4}{5}, -\frac{3}{5}\right\rangle \text{ lb} = \langle 320, -240\rangle \text{ lb}$$

$$\mathbf{F}_3 = 300\,\langle \cos\beta, \sin\beta\rangle \text{ lb} = 300\left\langle \frac{3}{5}, \frac{4}{5}\right\rangle = \langle 180, 240\rangle \text{ lb}$$

$$\mathbf{F}_4 = 300\,\langle -1, 0\rangle \text{ lb}$$

Add the four forces together to get their resultant.

$$\begin{aligned}\mathbf{F}_R &= \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \mathbf{F}_4 \\ &= 200\,\langle -1, 0\rangle \text{ lb} + \langle 320, -240\rangle \text{ lb} + \langle 180, 240\rangle \text{ lb} + 300\,\langle -1, 0\rangle \text{ lb} \\ &= \langle 0, 0\rangle \text{ lb}\end{aligned}$$

Its magnitude is

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