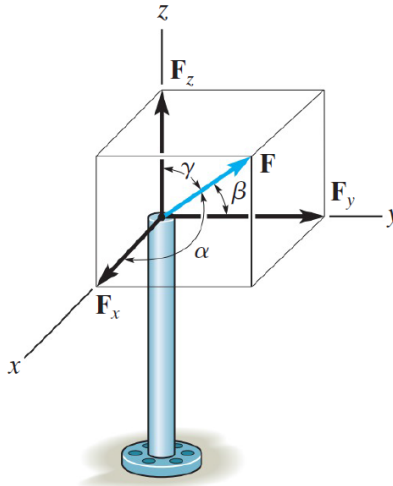


Problem 2-85

The pole is subjected to the force \mathbf{F} which has components $F_x = 1.5$ kN and $F_z = 1.25$ kN. If $\beta = 75^\circ$, determine the magnitudes of \mathbf{F} and F_y .



Probs. 2–84/85

Solution

Write the force in component form.

$$\mathbf{F} = F \langle \cos \alpha, \cos \beta, \cos \gamma \rangle \text{ N}$$

$$\langle F_x, F_y, F_z \rangle \text{ N} = \langle F \cos \alpha, F \cos \beta, F \cos \gamma \rangle \text{ N}$$

$$\langle 1500, F_y, 1250 \rangle \text{ N} = \langle F \cos \alpha, F \cos 75^\circ, F \cos \gamma \rangle \text{ N}$$

Match the components to get a system of equations.

$$1500 = F \cos \alpha \tag{1}$$

$$F_y = F \cos 75^\circ \tag{2}$$

$$1250 = F \cos \gamma \tag{3}$$

Square both sides of each equation and add the respective sides to get F .

$$F^2(\cos^2 \alpha + \cos^2 75^\circ + \cos^2 \gamma) = 1500^2 + F_y^2 + 1250^2$$

$$F^2(1) = 1500^2 + F_y^2 + 1250^2$$

$$F^2 = 1500^2 + (F \cos 75^\circ)^2 + 1250^2$$

$$F^2(1 - \cos^2 75^\circ) = 1500^2 + 1250^2$$

$$F = \sqrt{\frac{1500^2 + 1250^2}{1 - \cos^2 75^\circ}}$$

$$F \approx 2.02 \times 10^3 \text{ N}$$

Plug this value for F back into equations (1), (2), and (3) to determine the remaining variables.

$$\begin{cases} \cos \alpha = \frac{1500}{F} \\ F_y = F \cos 75^\circ \\ \cos \gamma = \frac{1250}{F} \end{cases} \rightarrow \begin{cases} \alpha \approx 42.1^\circ \\ F_y \approx 523 \text{ N} \\ \gamma \approx 51.8^\circ \end{cases}$$