**PROBLEM 2.70**

An 1800-N load \( Q \) is applied to the pulley \( C \), which can roll on the cable \( ACB \). The pulley is held in the position shown by a second cable \( CAD \), which passes over the pulley \( A \) and supports a load \( P \). Determine \( a \) the tension in cable \( ACB \), \( b \) the magnitude of load \( P \).

**SOLUTION**

Free-Body Diagram: Pulley \( C \)

\[ \begin{align*}
\Sigma F_x &= 0: \quad T_{ACB} (\cos 25^\circ - \cos 55^\circ) - P \cos 55^\circ = 0 \\
\text{or} \quad P &= 0.58010 T_{ACB} \quad (1) \\
\Sigma F_y &= 0: \quad T_{ACB} (\sin 25^\circ + \sin 55^\circ) + P \sin 55^\circ - 1800 \text{ N} = 0 \\
\text{or} \quad 1.24177 T_{ACB} + 0.81915 P &= 1800 \text{ N} \quad (2)
\end{align*} \]

\( a \) Substitute Equation (1) into Equation (2):

\[ 1.24177 T_{ACB} + 0.81915 (0.58010 T_{ACB}) = 1800 \text{ N} \]

Hence:

\[ T_{ACB} = 1048.37 \text{ N} \]

\[ T_{ACB} = 1048 \text{ N} \blacktriangleleft \]

\( b \) Using (1), \( P = 0.58010 (1048.37 \text{ N}) = 608.16 \text{ N} \)

\[ P = 608 \text{ N} \blacktriangleleft \]
PROBLEM 2.75

Cable $AB$ is 65 ft long, and the tension in that cable is 3900 lb. Determine (a) the $x$, $y$, and $z$ components of the force exerted by the cable on the anchor $B$, (b) the angles $\theta_x$, $\theta_y$, and $\theta_z$ defining the direction of that force.

SOLUTION

From triangle $AOB$:

$$\cos \theta_y = \frac{56 \text{ ft}}{65 \text{ ft}} = 0.86154$$

$$\theta_y = 30.51^\circ$$

$$F_x = -F \sin \theta_y \cos 20^\circ$$

$$= -(3900 \text{ lb}) \sin 30.51^\circ \cos 20^\circ$$

$$F_x = -1861 \text{ lb}$$

$$F_y = +F \cos \theta_y = (3900 \text{ lb})(0.86154)$$

$$F_y = +3360 \text{ lb}$$

$$F_z = +(3900 \text{ lb}) \sin 30.51^\circ \sin 20^\circ$$

$$F_z = +677 \text{ lb}$$

(b)$$\cos \theta_x = \frac{F_z}{F} = \frac{677 \text{ lb}}{3900 \text{ lb}} = 0.1736$$

$$\theta_z = 80.0^\circ$$

From above:

$$\theta_y = 30.51^\circ$$

$$\theta_z = 30.5^\circ$$

$$\cos \theta_z = \frac{F_z}{F} = \frac{677 \text{ lb}}{3900 \text{ lb}} = 0.1736$$

$$\theta_z = 80.0^\circ$$
PROBLEM 2.90

For the frame and cable of Problem 2.89, determine the components of the force exerted by the cable on the support at \( E \).

PROBLEM 2.89 A frame \( ABC \) is supported in part by cable \( DBE \) that passes through a frictionless ring at \( B \). Knowing that the tension in the cable is 385 N, determine the components of the force exerted by the cable on the support at \( D \).

SOLUTION

\[
\overrightarrow{EB} = (270 \text{ mm})\hat{i} - (400 \text{ mm})\hat{j} + (600 \text{ mm})\hat{k}
\]

\[
EB = \sqrt{(270 \text{ mm})^2 + (400 \text{ mm})^2 + (600 \text{ mm})^2} = 770 \text{ mm}
\]

\[
\mathbf{F} = F_k\overrightarrow{EB}
\]

\[
= F \frac{EB}{EB}
\]

\[
= \frac{385 \text{ N}}{770 \text{ mm}}[(270 \text{ mm})\hat{i} - (400 \text{ mm})\hat{j} + (600 \text{ mm})\hat{k}]
\]

\[
\mathbf{F} = (135 \text{ N})\hat{i} - (200 \text{ N})\hat{j} + (300 \text{ N})\hat{k}
\]

\[
F_x = +135.0 \text{ N}, \quad F_y = -200 \text{ N}, \quad F_z = +300 \text{ N}
\]