PROBLEM 2.15

Solve Problem 2.2 by trigonometry.

PROBLEM 2.2 The cable stays \(AB\) and \(AD\) help support pole \(AC\). Knowing that the tension is 120 lb in \(AB\) and 40 lb in \(AD\), determine graphically the magnitude and direction of the resultant of the forces exerted by the stays at \(A\) using (a) the parallelogram law, (b) the triangle rule.

\[\tan \alpha = \frac{8}{10} \]
\[\alpha = 38.66^\circ\]

\[\tan \beta = \frac{6}{10} \]
\[\beta = 30.96^\circ\]

Using the triangle rule:
\[\alpha + \beta + \psi = 180^\circ\]
\[38.66^\circ + 30.96^\circ + \psi = 180^\circ\]
\[\psi = 110.38^\circ\]

Using the law of cosines:
\[R^2 = (120 \text{ lb})^2 + (40 \text{ lb})^2 - 2(120 \text{ lb})(40 \text{ lb}) \cos 110.38^\circ\]
\[R = 139.08 \text{ lb}\]

Using the law of sines:
\[\frac{\sin \gamma}{40 \text{ lb}} = \frac{\sin 110.38^\circ}{139.08 \text{ lb}}\]
\[\gamma = 15.64^\circ\]
\[\phi = (90^\circ - \alpha) + \gamma\]
\[\phi = (90^\circ - 38.66^\circ) + 15.64^\circ\]
\[\phi = 66.98^\circ\]

\[R = 139.1 \text{ lb} \quad \theta = 67.0^\circ\]
PROBLEM 2.21

Determine the x and y components of each of the forces shown.

SOLUTION

80-N Force:

\[ F_x = +(80 \text{ N}) \cos 40^\circ \]
\[ F_y = +(80 \text{ N}) \sin 40^\circ \]

\[ F_x = 61.3 \text{ N} \]
\[ F_y = 51.4 \text{ N} \]

120-N Force:

\[ F_x = +(120 \text{ N}) \cos 70^\circ \]
\[ F_y = +(120 \text{ N}) \sin 70^\circ \]

\[ F_x = 41.0 \text{ N} \]
\[ F_y = 112.8 \text{ N} \]

150-N Force:

\[ F_x = -(150 \text{ N}) \cos 35^\circ \]
\[ F_y = +(150 \text{ N}) \sin 35^\circ \]

\[ F_x = -122.9 \text{ N} \]
\[ F_y = 86.0 \text{ N} \]
PROBLEM 2.26

Cable $AC$ exerts on beam $AB$ a force $\mathbf{P}$ directed along line $AC$. Knowing that $\mathbf{P}$ must have a 350-lb vertical component, determine $(a)$ the magnitude of the force $\mathbf{P}$, $(b)$ its horizontal component.

SOLUTION

(a)

\[
P = \frac{P_y}{\cos 55^\circ}
\]

\[
= \frac{350 \text{ lb}}{\cos 55^\circ}
\]

\[
= 610.21 \text{ lb}
\]

$p = 610 \text{ lb} \uparrow$

(b)

\[
P_x = P \sin 55^\circ
\]

\[
= (610.21 \text{ lb}) \sin 55^\circ
\]

\[
= 499.85 \text{ lb}
\]

$p_x = 500 \text{ lb} \uparrow$