Combining equations gives:

\[ T_1 = -T_2 + 36 + 1.12AE_y \]

\[ T_2 = T_1 + 0.24A_E \]

\[ T_2 \left(\frac{2}{3}\right) - T_3 \left(\frac{2}{3}\right) = 0.04A_H \]

\[ T_3 - 40 = 1.24A_E \]

\[ 20 + b = 36 \text{ lb} \]

\[ \sum F_y = T_1 + T_2 - 36 = \frac{36}{32.2} AE_y \]

\[ \sum M_H = -T_1(1) + T_2(1) = I_E d_E \]

\[ \text{Note } I_E = 0.24 \text{ slug-ft}^2 \]

\[ \sum F_y = T_3 - 40 = \frac{40}{32.2} AE_y \]

\[ \sum M_H = T_2 \left(\frac{2}{3}\right) - T_3 \left(\frac{2}{3}\right) = I_H d_H \]

\[ \text{Note } I_H = 0.04 \text{ slug-ft}^2 \]

\[ \therefore T_2 = 18 + 0.56AE_y + 0.12A_E \]

\[ T_3 = 18 + 0.56AE_y + 0.12A_E - 0.06A_H \]

\[ 20 + b = 36 \text{ lb} \]

\[ \therefore T_3 - 40 = 1.24AE_y \]

\[ 20 + b = 36 \text{ lb} \]

\[ \therefore T_3 - 40 = 1.24AE_y \]

\[ 20 + b = 36 \text{ lb} \]

\[ \therefore T_3 - 40 = 1.24AE_y \]
Now we need a way of relating $a_{xy}$, $a_E$, $a_H$, and $a_{xy}$. We will use kinematics. Note that $a_{xy} = 0$ (because it is fixed). Continuity mandates that $a_{xy} = a_{xy} = 0$.

Calculating relative accelerations gives

$$\hat{a}_E = \hat{a}_D + \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & a_E \\ 0 & 0 & 1 \end{vmatrix} - \omega_E^2 (1 \hat{i}) = (a_{Dx} - \omega_E^2) \hat{i} + a_E \hat{j}$$

$$\therefore a_{xy} = a_E$$

Likewise we can show that $a_{xy} = 2a_E$.

Continuity mandates that $\alpha_{xy} = \alpha_{xy} = 2a_E$

We can also calculate an expression for $a_{xy}$ by relating it to $\hat{a}_H$, which equals zero, because it is fixed.

$$\hat{a}_G = \hat{a}_H + \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & a_H \\ -\frac{2}{3} & 0 & 0 \end{vmatrix} - \omega_H^2 (-\frac{2}{3} \hat{i})$$

$$\therefore \hat{a}_G = \frac{2}{3} \omega_H^2 \hat{i} - \frac{2}{3} a_H \hat{j} \quad \therefore a_{xy} = -\frac{2}{3} a_H$$

Equating this result with the expression for $a_{xy}$ above gives:

$$-\frac{2}{3} a_H = 2a_E \quad \Rightarrow [a_H = -3a_E]$$

Continuity mandates that $\alpha_{xy} = \alpha_{xy}$ and we can calculate an expression for $a_{xy}$ relative to $\hat{a}_H = 0$. 

Continued →
Problem 7.51 continued

\[
\dot{\mathbf{a}}_J = \dot{\mathbf{a}}_H + \begin{vmatrix}
1 & \dot{\mathbf{w}}_H \cdot \frac{2}{3} \mathbf{i} \\
0 & 0 & a_H \\
\frac{2}{3} & 0 & 0
\end{vmatrix}
\]

\[
= -\frac{2}{3} \omega_H \mathbf{\hat{i}} + \frac{2}{3} a_H \mathbf{\hat{j}}
\]

\[
\therefore \dot{a}_{Jy} = \frac{2}{3} a_H \quad \text{and} \quad \dot{a}_{By} = \frac{2}{3} a_H
\]

Combining the 3 boxed kinematic equations gives:

\[
\dot{a}_H = \frac{3}{2} a_{By}
\]

\[
\dot{a}_E = -\frac{1}{3} a_H = -\frac{1}{2} a_{By}
\]

\[
\dot{a}_{By} = \dot{a}_E = -\frac{1}{2} a_{By}
\]

Now we plug these three expressions into the equation we found by combining the equations for the sum of the forces and the sum of the moments,

\[
-22 + 0.56 a_{By} + 0.12 a_E - 0.06 a_H = 1.24 a_{By}
\]

\[
\Rightarrow -22 + 0.56 \left(-\frac{1}{2} a_{By}\right) + 0.12 \left(-\frac{1}{2} a_{By}\right) - 0.06 \left(\frac{2}{3} a_{By}\right) = 1.24 a_{By}
\]

\[
\Rightarrow -22 - 0.43 a_{By} = 1.24 a_{By}
\]

\[
1.67 a_{By} = -22 \quad \therefore a_{By} = -13.17 \text{ ft/sec}^2 \quad \text{Answer}
\]