Problem 5. A 12 lb, 4 ft diameter wheel (model as a hoop) spins at a constant rate of 10 rev/s, mounted to the end of the shaft ABC, which is affixed to the top of a rotating platform by a pin connector at A and a vertical strut BD. Given that the turntable is rotating at a constant rate of 4 rev/s, determine the support reactions at the pin A and the force transmitted through the strut BC, taking care to specify whether it is in tension or compression. For this calculation you are instructed to neglect the mass of the shaft and support strut.

\[ \Omega = \frac{4(2\pi)}{6} = 8\pi \text{ rad/s} \]

\[ \bar{p} = \bar{p} \hat{a} \quad \text{and} \quad \hat{a} = -\frac{1}{2} \hat{i} - \frac{\sqrt{3}}{2} \hat{j} \]

\[ \Omega \hat{a} = -40\sqrt{3} \hat{k} \quad \text{and} \quad \bar{I}_a = \frac{2I}{L} \]

\[ \bar{I}_b = I = \frac{1}{2}MR^2 \]

\[ \bar{I} = \frac{1}{2}(2\pi)^2 = \frac{24}{\pi} \]

\[ iC_b = \left[ I_a + (I_b - I_a)(1 - \hat{k}) \right] 4\pi \hat{k} \]

\[ = \left[ 2I(2\pi) + I(-4\sqrt{3}) \right] 4\pi \hat{k} \]

\[ = \frac{24}{\pi} \left[ 40\pi - 4\sqrt{3} \pi \right] 4\pi \hat{k} \]

\[ iC_b = 24(2\pi)^2 \left[ 10 - 4\sqrt{3} \right] \hat{k} \Rightarrow iC_b = 973.13 \hat{k} \text{ ft-lb} \]

\[ F(\text{BD}) = -(1)\Omega^2 \hat{z} \Rightarrow iF = \frac{12}{\pi}(8\pi)^2 \Rightarrow iF = 235.4 \text{ lb} \]

\[ \begin{align*}
\text{BD is a 2-force member!} \\
A_x &= 12 \text{ lb} \\
A_y &= 12 + T = 235.4 \text{ lb} \\
T &= -[24 + 815.4 + 973.1] = -1813 \text{ lb} \quad \text{(negative means compression)}
\end{align*} \]

\[ \begin{align*}
\text{A:} & \quad -20T = (2\sqrt{3})(235.4) + 973.1 \\
T &= -\left[ 24 + 815.4 + 973.1 \right] = -1813 \text{ lb} \\
A_x &= -235.4 \text{ lb} \\
A_y &= 12 + T = -1801 \text{ lb}
\end{align*} \]

- Serious candidate for "buckling" failure!!