The thin-walled cylinder shown below has closed ends and is supported by one cord attached at each end as shown. The cylinder is made of steel with $E = 30\text{Msi}$ and $\nu = 0.3$. The total weight of the contents is 10,000 lbs, and the internal pressure is 80 psi. Determine the axial and hoop stresses at point A, which is located on the bottom surface of the midspan. Ignore the mass of the cylinder.

Recall: $\sigma_a = \frac{pR}{2t}$, $\sigma_\theta = \frac{pR}{t}$, and $I = \pi R^3 t$ for a thin-walled cylindrical pressure vessel.

For 2 additional points, determine the maximum principal strain at point A.
ME 423
QUIZ 2 SOLUTIONS

FBD:

\[ \begin{align*}
\Sigma F_y &= 0 \\
M_2 &= 5,000 \left( \frac{L}{2} \right) - 5,000 \left( \frac{L}{4} \right) \\
&= 240,000 \text{ lb.in}
\end{align*} \]

STATICS:

\[ \begin{align*}
\theta &= \frac{PR}{2t} - \frac{M_2 y}{I_z} = \frac{(80)(24) - (240k)(-24)}{(2)(0.25)} \\
&= 3840 + 530.5 \\
&= 4370.5 \text{ psi}
\end{align*} \]

STRESSES: AT POINT A:

\[ \begin{align*}
\sigma_x &= \frac{PR}{2t} - \frac{M_2 y}{I_z} = \frac{(80)(24)}{0.25} = 7680 \text{ psi} \\
\sigma_\theta &= \sigma_z = 4370.5 \text{ psi}
\end{align*} \]

STRAINS: AT POINT A:

\[ \begin{align*}
\varepsilon_x &= \frac{\sigma_x}{E} - \frac{\nu \sigma_z}{E} = 6.89 \times 10^{-5} = \varepsilon_3 \\
\varepsilon_z &= -\frac{\nu \sigma_x}{E} + \frac{\sigma_z}{E} = 2.99 \times 10^{-4} = \varepsilon_1 \\
\varepsilon_y &= -\frac{\nu \sigma_x}{E} - \frac{\sigma_y}{E} = 1.205 \times 10^{-4} = \varepsilon_2
\end{align*} \]

NOTE: \( \sigma_y = 0 \)