ARCH 324 - Structures 2, Winter 2009

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A) Find the stress @ the ends of the beam:
- No moment @ ends of the beam
- Only axial forces due to cables

\[ f_a = f_w \]
\[ \frac{f_w}{f_u} = \frac{8}{16} \Rightarrow f_w = \frac{1}{2} f_u \]
\[ f_u = 53.7 \text{ k}, f_w = 26.9 \]

\[ \sigma_{\text{Axial}} = \frac{f_a}{A} = \frac{53.7K}{10 \text{ in}^2} = 5.37 \text{ ksi Compression} \]

B) Find the stress in the top fibers of the beam:

\[ M_{\text{Dist}} = \frac{WL}{8} = \frac{96 \times 32}{8} = 384 \text{ k-ft} (+) \]

\[ M_{\text{Point}} = \frac{PL}{4} = \frac{53.7 \times 32}{4} = 429.6 \text{ k-ft} (-) \]

\[ M_{\text{Dist}} - M_{\text{Point}} = 384 - 429.6 = -45.6 \text{ k-ft} \]
\[ = -547200 \text{ in-lb} \text{ (Tension on top)} \]

\[ f_b = \frac{M}{S} = \frac{-547200}{48.6} = -11.259 \text{ ksi} \]

\[ f_{\text{Total}} = f_b + f_{\text{Axial}} = -11.259 + 5.37 = -5.88 \text{ ksi} \text{ Tension in top fibers} \]
c) FIND THE TRUSS CENTERLINE DEFLEXION:

\[ \Delta_{\text{point load}} = \frac{PL^3}{48EI} = \frac{(53.7 \times 1000)(32 \times 12)^3}{(48)(29,000,000)(340)} = 6.43 \text{ in} \uparrow \]

\[ \Delta_{\text{dist. load}} = \frac{5WL^3}{384EI} = \frac{5(96 \times 1000)(32 \times 12)^3}{(384)(29,000,000)(340)} = 7.18 \text{ in} \downarrow \]

\( \Delta_{\text{total}} = 6.43 - 7.18 = -0.75 \text{ in} \) — DEFLECTION IN THE DOWN DIRECTION