ARCH 324 - Structures 2, Winter 2009

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

\[ f_a = f_h, \quad \frac{f_u}{f_h} = \frac{8}{16} \Rightarrow f_u = \frac{1}{2} f_h \]

\[ 60^2 = f_h^2 + \left(\frac{f_u}{2}\right)^2 \]

\[ f_h = 53.7 \text{ k}, \quad f_u = 26.9 \]

\[ \sigma_{axial} = \frac{f_a}{A} = \frac{53.7 \text{ k}}{10 \text{ in}^2} = 5.37 \text{ kpsi} \text{ compression} \]

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

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

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

\[ M_{dist} - M_{point} = 384 - 429.6 = -45.6 \text{ k-ft} \]

\[ f_t = \frac{M}{s} = \frac{-457200}{48.6} = -11.259 \text{ksi} \]

\[ f_{total} = f_b + f_{axial} = -11.259 + 5.37 = -5.88 \text{ ksi} \text{ tension in top fibers} \]
C) FIND THE TRUSS CENTERLINE DEFLECTION:

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

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

\[ \Delta_{\text{Total}} = 6.43 - 7.18 = -0.75 \text{ in} \quad \text{DEFLECTION IN THE DOWN DIRECTION} \]