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

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

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

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

B) FIND THE STRESS IN THE TOP FIBERS OF THE BEAM:

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

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

\[ M_{dist.} - M_{point} = 384 - 429.6 = -45.6 \text{ k-ft} \]
\[ = -547200 \text{ in-lb} \text{ (TENSION ON TOP)} \]

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

\[ f_{total} = f_b + f_{axial} = -11.259 + 5.37 = -5.88 \text{ ksi} \text{ TENSION IN TOP FIBERS} \]
C) FIND THE TRUSS CENTERLINE DEFLECTION:

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

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

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