ARCH 324 - Structures 2, Winter 2009

von Buelow, Peter

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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

FBD BEAM END

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

\[
f_a = f_h
\]

\[
\frac{f_u}{f_h} = \frac{8}{140} \implies f_u = \frac{1}{140} f_h
\]

\[
60^2 = f_h^2 + f_u^2
\]

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

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

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

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

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

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

\[
f_{\text{total}} = f_b + f_{\text{axial}} = -11.259 + 5.37 = -5.88 \text{kSI} \text{ TENSION IN TOP FIBERS}
\]
C) Find the truss centerline deflection:

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

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

\[ \Delta_{\text{total}} = 6.43 - 7.18 = -0.75 \text{ in} — \text{deflection in the down direction} \]