ARCH 324 - Structures 2, Winter 2009

von Buelow, Peter

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GIVEN: 4 boards each 1" x 6" glued and nailed as a column section.

A) DETERMINE ARRANGEMENT FOR THE STRONGEST SECTION.

B) DETERMINE ALLOWABLE AXIAL LOAD FOR:
   \( L = 10' - 0" \), \( 20' - 8" \), \( 30' - 0" \)
   BRACED AT ENDS ONLY

\[
E = 1760000 \text{ psi} \\
E_c = 1800 \text{ psi} \\
f_c = \frac{3.60E}{(1/4)^2} \Rightarrow \frac{f}{f_c} \leq 170
\]

Placing the material as far as possible from the N.D.
RESULTS IN A 7" x 7" SQUARE

\[
A = 4(7) = 28 \\
I_x = I_y = \frac{7(7)^3}{12} - \frac{5(5)^3}{12} = 148.0 \\
r = \frac{\sqrt{148}}{28} = 2.483
\]

\[
F = \frac{3.6 \times E}{(f/r)^2} = \frac{3.6(1760000)}{28^2/2.483^2} = \frac{1}{f^2} (39072000) = \frac{P}{A}
\]

\[
P = \frac{1}{f^2} (937728000) \text{ lbs}
\]

For \( L = 10' - 0" \):
\[
\frac{f}{f_c} = 120/2.48 = 48.4 < 170 \quad \text{OK}
\]

\[
P_{cr} = \frac{1}{f^2} (937728000) = 65120 \text{ lbs} \\
P_{g} = 1800(24) = 43200 \text{ lbs}
\]

For \( L = 20' - 8" \):
\[
\frac{f}{f_c} = 248/2.48 = 100 < 170 \quad \text{OK}
\]

\[
P_{cr} = \frac{1}{f^2} (937728000) = 15246 \text{ lbs} < 43200
\]

For \( L = 30' - 0" \):
\[
\frac{f}{f_c} = 360/2.48 = 145.2 < 170 \quad \text{OK}
\]

\[
P_{cr} = \frac{1}{f^2} (937728000) = 7235 \text{ lbs} < 43200
\]