ARCH 324 - Structures 2, Winter 2009

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GIVEN: A 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:
   \[ L = 10' - 0" \quad 20' - 8" \quad 30' - 0" \]

Braced at ends only

\[ E = 1760,000 \text{ psi} \]
\[ E_c = 18,000 \text{ psi} \]
\[ f_c = \frac{3.60 \times E}{(\frac{L}{2})^2} \]
\[ f \leq 170 \]

Placing the material as far as possible from the N.A.

Results in a 7" x 7" square

\[ A = 4(6) = 24 \]
\[ I_x = I_y = \frac{7(7)^3}{12} - \frac{5(5)^3}{12} = 148.0 \]
\[ r = \frac{\sqrt{148}}{24} = 2.483 \]

\[ P = \frac{3.6 \times E}{(\frac{L}{r})^2} = \frac{3.6 \times (1760000)}{2.483^2} = \frac{1}{A} \left( \frac{39072000}{A} \right) = \frac{P}{A} \]

\[ P = \frac{1}{24} \left( 937728000 \right) \text{ lbs} \]

For \( L = 10' - 0" \):

\[ \frac{P}{f_c} = \frac{120}{2.48} = 48.4 < 170 \quad \checkmark \]
\[ P = \frac{1}{24} \left( 937728000 \right) = 65120 \text{ lbs} \]
\[ f_y = 1800(24) = 43200 \text{ lbs} \]

For \( L = 20' - 8" \)

\[ \frac{P}{f_c} = \frac{248}{2.48} = 100 < 170 \quad \checkmark \]
\[ P_{cr} = \frac{1}{24} \left( 937728000 \right) = 15246 \text{ lbs} < 43200 \]

For \( L = 30' - 0" \)

\[ \frac{P}{f_c} = \frac{360}{2.48} = 145.2 < 170 \quad \checkmark \]
\[ P_{cr} = \frac{1}{360} \left( 937728000 \right) = 23515 \text{ lbs} < 43200 \]