ARCH 324 - Structures 2, Winter 2009

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<http://hdl.handle.net/2027.42/64938>
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GIVEN: 4 boards each 1" x 4" 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

\[ E = 1760000 \text{ psi} \]
\[ F_c = 1800 \text{ psi} \]
\[ f_c = \frac{3.60 E}{(\frac{8}{12})^2} \quad \frac{f_c}{f_c} \leq 170 \]

Placing the material as far as possible from the N.A. results in a 7" x 7" square.

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

\[ F = \frac{3.6 E}{(\frac{8}{12})^2} = \frac{3.6 (1760000)}{2^2 \times 2.483^2} = \frac{1}{F^2} (39072000) = \frac{P}{A} \]
\[ P = \frac{1}{4^2} (937728000) \text{ lbs} \]

For \( L = 10' - 0" \):
\[ \frac{P}{F} = 120 / 2.48 = 48.4 < 170 \quad \text{OK} \]
\[ P_{cr} = \frac{1}{4^2}(937728000) = 65120 \text{ lbs} \]
\[ f_{cr} = 1800 (24) = 43200 \text{ lbs} \]

For \( L = 20' - 8" \):
\[ \frac{P}{F} = 248 / 2.48 = 100 < 170 \quad \text{OK} \]
\[ P_{cr} = \frac{1}{4^2}(937728000) = 15246 \text{ lbs} < 43200 \]

For \( L = 30' - 0" \):
\[ \frac{P}{F} = 360 / 2.48 = 145.2 < 170 \quad \text{OK} \]
\[ P_{cr} = \frac{1}{360^2}(937728000) = 7.235 \text{ lbs} < 43200 \]