ARCH 324 - Structures 2, Winter 2009

von Buelow, Peter

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FLOOR LOAD 100 PSF
EXTERIOR WALL 200 PSF
B1 - B7: GLULAM BEAMS

JOISTS  
\[ F_b = 1200 \text{ psi} \]  
\[ F_v = 90 \text{ psi} \]

GLULAM  
\[ F_b = 2000 \text{ psi} \]  
\[ F_v = 135 \text{ psi} \]

CHECK FLEXURE AND SHEAR STRESS IN ALL MEMBERS
CHECK JOISTS

Floor A
Span = L = 12'
O.C. = 2'
Size = 2 x 12
\( S = 31.64 \)
\( A = 16.88 \)

\[ M = \frac{wL^2}{8} = \frac{(200)(12)^2}{8} = 3600 \] 
\( f_b = \frac{M}{S} = \frac{3600 \times 12}{31.64} = 1365 > 1200 \)

No, try smaller O.C. spacing

Floor B
Span = L = 4'
O.C. = 2'
Size = 2 x 6
\( S = 7.76 \)
\( A = 8.25 \)

\[ M = \frac{wL^2}{8} = \frac{200(4)^2}{8} = 400 \] 
\( f_b = \frac{M}{S} = \frac{400 \times 12}{7.76} = 635 < 1200 \)

\[ V = \frac{wL}{2} = 15 \times \frac{400}{8.25} = 72.7 < 90 \]

\( 2 \times 6 \) OK

Floor C
Span = L = 8'
O.C. = 2'
Size = 2 x 10
\( S = 21.39 \)
\( A = 13.88 \)

\[ M = \frac{wL^2}{8} = \frac{200(8)^2}{8} = 1600 \] 
\( f_b = \frac{M}{S} = 1600 / 21.39 = 75.6 < 1200 \)

\[ V = \frac{wL}{2} = \frac{200 \times 8}{2} = 800 \]
\( f_v = \frac{V}{A} = 15 \times \frac{800}{13.88} = 86 < 90 \]

\( 2 \times 10 \) OK

Floor D
Span = L = 6'
O.C. = 2'
Size = 2 x 8
\( S = 73.14 \)
\( A = 10.88 \)

\[ M = \frac{wL^2}{8} = \frac{200(6)^2}{8} = 900 \] 
\( f_b = \frac{M}{S} = 900 / 73.14 = 12.3 \mathrm{psf} < 1200 \)

\[ V = \frac{wL}{2} = \frac{200 \times 6}{2} = 600 \]
\( f_v = \frac{V}{A} = 15 \times \frac{600}{10.88} = 82.7 < 90 \]

Use 2 x 8
B1

\[ W_2 = 200 \times \frac{1}{4} = 500 \]

\[ W = 600 \times \frac{1}{4} = 1500 \]

**BENDING:**

\[ F_{w} = 2000 = \frac{1}{5} \]

\[ S = \frac{30625 \times 12}{2000} = 183.72 \text{ m}^3 \]

**SHEAR:**

\[ F_v = 135 = \frac{3}{2} \frac{w}{h} \]

\[ A = 77.8 \text{ m}^2 \leftarrow \text{CONTROLS} \]

**USE:** \( \frac{5}{8}'' \times 16 \frac{1}{2}'' \)
B2

\[
W_2 = 200 \times 1.2 = 2400
\]

\[
W_1 = 400 \times 1.1 = 7200
\]

\[
\frac{3600}{800} + \frac{3600}{5200}
\]

\[
\frac{4400}{4400}
\]

\[
\frac{7200}{2000}
\]

\[
8.67
\]

\[
\frac{22533}{600}
\]

\[
\frac{19200}{22533}
\]

\[
\frac{1}{5200}
\]

**BENDING**

\[
F_b = 2000 \text{ psi} = \frac{14}{S} \quad S = \frac{22533 \times 12}{2000} = 135.2 \text{ in}^3
\]

**SHEAR**

\[
F_v = 135 \text{ psi} = \frac{14 \times V}{A} \quad A = 1.5 \times \frac{5200}{135} = 57.8 \text{ in}^2
\]

**USE** \[\frac{5}{8}\]" x 15\"
BENDING:

\[ F_b = 2000 \text{ psi} = \frac{W}{S} \quad \text{and} \quad S = \frac{M}{F_b} = \frac{84399.6 \times 12}{2000} = 506.4 \text{ in} \]

SHEAR:

\[ F_V = \frac{3}{2} \frac{V}{A} \quad \text{and} \quad A = 1.5 \frac{10566.7}{135} = 117.4 \text{ in}^2 \]

USE \[ 6\frac{3}{4}'' \times 22\frac{1}{2}'' \]
BENDING:

\[ F_{bd} = 2000 \text{psi} \]
\[ f = \frac{F_{bd}}{S} \]
\[ S = \frac{76400.4 \times 12}{2000} = 458.4 \text{ in}^2 \]

CAUTION

SHEAR:

\[ F_v = \frac{3}{2} \frac{V}{A} = 135 \text{psi} \]
\[ A = 1.5 \times \frac{9633.3}{135} = 107.03 \text{ in}^2 \]

USE \(5\frac{8}{16}\)" x 24"
BENDING:

\[ F_b = 2000 \text{ psi} \cdot \frac{M}{E} \]

\[ S_b = \frac{85304 \times 12}{2000} = 511.8 \text{ in}^3 \]

SHEAR:

\[ F_v = 135 \text{ psi} \cdot \frac{5}{2} \cdot \frac{1}{4} \cdot \frac{13775}{135} = 102 \text{ in}^2 \]

USE \( 5\frac{1}{8} \times 25\frac{1}{2} \)
**ARCH 331**

**PROB 11-2**

\[
\begin{align*}
W_2 &= 400 \text{ kF} = 7200 \text{ k} \\
W_1 &= 300 \text{ kCF} = 7200 \text{ k}
\end{align*}
\]

\[
9633.3 \quad 18
\]

\[
\text{24'}
\]

\[
\begin{align*}
3600 &\quad 4500 \\
2700 &\quad 2408.3 \\
7225 &\quad 10508.3
\end{align*}
\]

**BENDING**:

\[
F_b = 2000 = \frac{M}{S} \quad S = \frac{78875 \text{ kF}}{2000} = 473.2 \text{ kF}^2
\]

**SHEAR**:

\[
F_v = 135 = \frac{3}{2} \frac{v}{4} \quad d = 1.5 \left( \frac{13525}{135} \right) = 100.12 \text{ kF}
\]

**USE** 5 1/8" x 24"
\[ W_L = 300 \text{ PLF} = 7200 \text{ kN} \]
\[ W_J = 300 \text{ PLF} = 7200 \text{ kN} \]

\[ V = \frac{W \times 0}{2} = \frac{600 \times (24)}{2} = 7200 \text{ kN} \]

\[ M_{max} = \frac{W \times f^2}{8} = \frac{600 \times 24^2}{8} = 43200 \text{ kN}\cdot\text{m} \]

**BENDING:**
\[ f_0 = 2000 \text{ kN/m} = \frac{M}{S} ; \quad S = \frac{43200 \times 12}{2000} = 259.2 \text{ m}^2 \]

**SHEAR:**
\[ f_v = 135 \text{ kN/m} = \frac{3}{2} \frac{V}{A} ; \quad A = 1.5 \frac{7200}{135} = 80 \text{ in}^2 \]

**USE:** 5\(\frac{1}{2}\)" x 18"