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ARCH 324 - Structures 2, Winter 2009

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FLOOR LOAD 100 PSF
EXTERIOR WALL 300 PSF
B1 - B7: GLULAM BEAMS

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

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

CHECK FLEXURE AND SHEAR STRESS IN ALL MEMBERS
CHECK JOISTS

Floor A
span = 12'
size = 2 x 12
S = 31.64
A = 16.88

Floor B
span = 4'
o.c. = 2'
size = 2 x 6
S = 7.76
A = 8.25

Floor C
span = 8'
o.c. = 2'
size = 2 x 10
S = 21.39
A = 13.88

Floor D
span = 6'
o.c. = 2'
size = 2 x 8
S = 21.14
A = 10.88

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

\[ f_v = \frac{3V}{2A} = \frac{3 \times 72.7}{2 \times 8} = 10.5 < 15 \]

\[ f_v = \frac{3 \times 72.7}{2 \times 8} = 10.5 \]

\[ f_v = \frac{3 \times 72.7}{2 \times 8} = 10.5 \]

No 4 x 4
Try smaller o.c. spacing

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

\[ f_v = \frac{3V}{2A} = \frac{3 \times 400}{2 \times 2.25} = 72.7 < 90 \]

\[ f_v = \frac{3 \times 400}{2 \times 2.25} = 72.7 < 90 \]

\[ 2 \times 6 \text{ OK} \]

\[ M = \frac{wL^2}{8} = \frac{(200)(8)^2}{8} = 1600 \text{ kips} \]
\[ f_b = \frac{M}{S} = \frac{1600 \times 12}{8} = 2400 \]

\[ f_v = \frac{3V}{2A} = \frac{3 \times 800}{13.88} = 18.6 < 90 \]

\[ f_v = \frac{3 \times 800}{13.88} = 18.6 < 90 \]

\[ 2 \times 10 \text{ OK} \]

\[ M = \frac{wL^2}{8} = \frac{(200)(6)^2}{8} = 900 \text{ kips} \]
\[ f_b = \frac{M}{S} = \frac{900 \times 13.14}{73.14} = 182 \text{ psi} < 1200 \]

\[ f_v = \frac{3V}{2A} = \frac{3 \times 600}{10.88} = 82.7 < 90 \]

\[ f_v = \frac{3 \times 600}{10.88} = 82.7 < 90 \]

\[ 2 \times 8 \text{ OK} \]
B1

\[ W_2 = \frac{200}{5} = 400 \]

\[ W = 600 \times \frac{4}{5} = 4800 \]

BENDING:

\[ F_w = 2000 = \frac{1}{5} S \]

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

SHEAR:

\[ F_v = 135 = \frac{3}{2} \frac{W}{A} \]

\[ A = 77.8 \text{ in}^2 \left\downarrow \text{CONTROLS} \]

USE \[ 5 \frac{1}{8} " \times 16 \frac{1}{2} " \]
BENDING:

$$F_b = 2000 \text{ psi} = \frac{14}{5}$$

$$S = \frac{22533 \times 12}{2000} = 135.2 \text{ in}^3$$

SHEAR:

$$F_v = 135 \text{ psi} = \frac{135 \times 5200}{135} = 57.8 \text{ in}^2$$

USE $5\frac{1}{8}'' \times 15''$
Bending:
\[ F_b = \frac{2000 \text{ psi}}{5} \; \frac{\text{fs}}{\text{in}} \]
\[ S = \frac{76400.4 \times 12}{200} = 458.4 \text{ in}^3 \]

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

Use 5/8" x 24"
BENDING:

\[ F_b = 2000 \text{ psi} \times \frac{M}{E_I} \quad \tau = \frac{85304 \times 12}{2000} = 511.8 \text{ m}^3 \]

SHEAR:

\[ F_V = 135 \text{ psi} = \frac{3}{2} \frac{V}{A} \quad A = 1.5 \times \frac{13775}{135} = 102 \text{ in}^2 \]

USE \( 5 \frac{1}{8} \times 25 \frac{1}{2} \)
Bending:
\[ F_b = 2000 = \frac{M}{S} ; \quad S = \frac{78875 (12)}{2000} = 473.2 \text{ ft}^3 \]

Shear:
\[ F_V = 135 = \frac{3}{2} \frac{V}{A} ; \quad A = 135 \frac{13525}{135} = 100.12 \text{ ft}^2 \]

Use 5 \( \frac{1}{8} \)" x 24".
W = 300 PLF = 7200
W1 = 300 PLF = 7200

\[ V_{\text{max}} = \frac{Wl}{2} = \frac{600 (24)}{2} = 7200 \text{ kN} \]
\[ M_{\text{max}} = \frac{Wl^2}{8} = \frac{600 \cdot 24^2}{8} = 43200 \text{ kNm} \]

BENDING:
\[ F_0 = 2000 \text{ kN}; \quad S = \frac{43200 \times 12}{2000} = 259.2 \text{m}^3 \]

SHEAR:
\[ F_v = 135 \text{ kN}; \quad A = 135 \frac{7200}{135} = 80 \text{ in}^2 \]

USE 5\(\frac{3}{4}\)" × 18"