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ARCH 324 - Structures 2, Winter 2009

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**Problem 12-5 II**

**Given:**
- 300 ft = 24 ft up
- 2,000 KSI for Wood
- 30,000 KSI for Steel
- Fb, Wood = 1.5 KSI
- Fb, Steel = 22.5 KSI

**Reactions:**
- \[ \sum M_{R1} = 0 = 7.2(12) - R_2(24) + 6(28) \]
  \[ R_2 = 10.6 \text{ k} \]
- \[ \sum M_{R2} = 0 = R_1(24) - 7.2(12) + 6(4) \]
  \[ R_1 = 2.6 \text{ k} \]

**Shear:**
- \[ 2.6^n \]
- \[ 11.267 \]
- \[ 8.67' \]
- \[ 35.267 \]
- \[ -4.6' \]

**Moment:**
- \[ 11.267 \text{ k} \cdot \text{ft} \]
- \[ 4.88' \]
- \[ 12^n \]
- \[ -24^n \]

**Design Moment = 24.0 K-1**

**Notes:**
- "Plates here"
STRAIN COMPATIBILITY:

ASSUME WOOD CONTROLS STRAIN:

\[ e = \frac{f}{E} = \frac{30,000 (0.0075)}{5000} = 0.00075 \]

STRAIN IN WOOD CHECK \rightarrow STRESS IN STEEL

STEEL AND WOOD HAVE BALANCED STRAIN AS IS

FIND MOMENT CARRIED BY WOOD:

\[ M_w = f \cdot S = 1.5 \left( \frac{4 \cdot (12)^2}{6} \right) = 144 \text{ K-ft} \]

\[ = 12 \text{ K-ft} \]

FIND MOMENT CARRIED BY STEEL:

\[ M_s = M_{total} - M_w = 24 - 12 = 12 \text{ K-ft} \]

FIND \( b \) OF STEEL PLATES; TWO PLATES

\[ M_s = f_s \cdot S = f \left( \frac{b \cdot d^2}{6} \right) \times 2 = 22.5 \left( \frac{b \cdot (12)^2}{6} \right) \times 2 = 12 \times 12 \]

\[ b = 0.133'' \]

FIND LENGTH OF PLATES (SEE MOMENT DIAGRAM)

WOOD WILL CARRY 12 K-FT ALONE, THEREFORE FIND PORTION OF MOMENT DIAGRAM > 12 K-FT

ON CANTILEVER:

\[ 0 \times l_1 = 12 \]

\[ l_1 = 2' \]

BETWEEN SUPPORTS:

\[ 12 = l_2 (4.6 - 3.32) + l_2 (3.32) \]

\[ 0 = -0.15 l_2^2 + 4.6 l_2 - 12 \]

\[ l_2 = -4.6 \pm \sqrt{4.6^2 - 4(15)12} \]

\[ l_2 = \frac{2.8791}{-2(1.15)} \]

\[ \text{TOTAL} = l_1 + l_2 = 2 + 2.88 = 4.88' \]