ARCH 324 - Structures 2, Winter 2009

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E _WOOD_ \(= 2000 \text{ KSI}\)
E _STEEL_ \(= 30000 \text{ KSI}\)

\(F_b\) _WOOD_ = 15 KSI
\(F_b\) _STEEL_ = 22.5 KSI

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

**Shear:**
\[
2.6^k, 11.267
\]

**Moment:**
\[
11.267 \text{ k}\cdot \text{ft}
\]

**Design Moment** = 24.0 k-\text{ft}
STRAIN COMPATIBILITY:

ASSUME WOOD CONTROLS STRAIN:

\[ e = \frac{f_f E}{E_c} = 1.5 \times 0.3 \times 1000 = 0.00075 \]

\[ f_f E_c = 30000 \times (0.00075) = 22.5 = f_c \]

1. STEEL AND WOOD HAVE BALANCED STRAIN AS IS

FIND MOMENT CARRIED BY WOOD:

\[ M_{\text{wood}} = 1.5 \left( \frac{4.12^2}{6} \right) = 144 \text{ k}\cdot\text{ft} \]

\[ = 12 \text{ k}\cdot\text{ft} \]

FIND MOMENT CARRIED BY STEEL:

\[ M_{\text{steel}} = M_{\text{total}} - M_{\text{wood}} = 24 - 12 = 12 \text{ k}\cdot\text{ft} \]

FIND B OF STEEL PLATES:

\[ M_3 = f_f \sum I = f \left( \frac{b \cdot d^2}{6} \right) \times 2 = 22.5 \left( \frac{b \cdot (12)^2}{6} \right) \times 2 = 12 \times 12 \]

\[ b = 1.33'' \]

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:

\[ 0 \times f_1 = 12 \]

\[ f_1 = 2^1 \]

BETWEEN SUPPORTS:

From shear diagram:

\[ 12 = f_2 (4.6 - 3f_2) + f_3 (3.3) \]

\[ 0 = -0.15f_2^2 + 4.6f_2 - 12 \]

\[ f_2 = -4.6 \pm \sqrt{4.6^2 - 4 \times (15) \times 12} \]

\[ = 2.879 \]

\[ L_{\text{TOTAL}} = f_1 + f_2 \]

\[ = 2 + 2.88 \]

\[ = 4.88' \]