For the flitched beam show find the maximum allowable W load.

Transformed section:

\[ I_{tr} = \frac{bh^3}{12} = \frac{19(10)^3}{12} = 1583.33 \text{ in}^4 \]

\[ n = \frac{E_{steel}}{E_{wood}} = \frac{30}{2} = 15 \]

Assume wood controls:

\[ M_{max} = \frac{Wl^2}{8} \quad \text{Also} \quad M_{max} = \frac{f_{tr}I_{tr}}{c} \]

\[ \frac{Wl^2}{8} = \frac{f_{tr}I_{tr}}{c} \]

\[ W = \frac{E_{steel}I_{tr}8}{c \ l^2(15)} = \frac{1.5(1583.33)8}{(5)(24 \times 12)^2(15)} = 0.04581 \text{ k/in} = 0.599 \text{ k/ft} \]

Assume steel controls

\[ W = \frac{f_s I_{tr}8}{c \ l^2(15)} = \frac{20(1583.33)8}{5(24 \times 12)^2(15)} = 0.0407 \text{ k/in} = 0.488 \text{ k/ft} \]

Steel controls

\[ w = 0.488 \text{ k/ft} \quad \text{and} \quad W = 11.7 \text{ k} \]
\[ M_{\text{max}} = \frac{W_{\text{total}} l}{8} \quad \text{and} \quad W_{\text{total}} = \frac{M_{\text{max}} b}{l} \]

**Transformed Section:**

\[ I_{\text{tr}} = \frac{b h^3}{12} = \frac{19 (10)^3}{12} = 1583.33 \text{ in}^4 \]

**Strain Compatibility:** (Alternate Method)

**Assume Wood Controls Strain**

\[ \frac{f}{E} = \frac{1.5 \text{ ksi}}{20000 \text{ ksi}} = 0.000075 \]

**Check:**

\[ \frac{f}{E} = \frac{20 \text{ ksi}}{30000 \text{ ksi}} = 0.000667 \]

**Steel Controls Strain**

\[ \frac{f}{E} = \frac{22.5 \text{ ksi}}{30000 \text{ ksi}} = 0.00075 \]

\[ \frac{f}{E} = \frac{1.33 \text{ ksi}}{20000 \text{ ksi}} = 0.000067 \]
Find Max Allowable Moment:

\[ f = \frac{Nc}{I} \]

\[ M = f \frac{I}{c} = 1.33 \frac{(1583.33)}{5} = 422.22 \text{ in-k} \]

\[ = 35.18 \text{ ft-k} \]

For Steel:

\[ M = f \frac{I}{c(\eta)} = 20 \frac{(1583.33)}{5(15)} = 422.22 \text{ in-k} \]

\[ = 35.18 \text{ ft-k} \]

Moments agree; ok

Find Load W:

\[ WJ = \frac{M \cdot 8}{f} = \frac{35.18 \cdot 8}{24} = 11.73 \text{ k total} \]