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14-2 (I)

- TRANSFORMED SECTION

Determine the Neutral Axis

\[ x = \frac{\sum A_i \cdot y_i}{\sum A} = \frac{(4 \times 8) \times (2'' + 11.8 \times 1.005'' - \frac{4.695''}{(4 \times 8)} + 11.8)}{1181''} = 20.01'' \]

Determine \( I_{tr} \)

\[
\begin{align*}
I_{tr} &= 8 \times 4^2 \times \frac{12}{12} = 48.47''^4 \\
I_{tr} &= 11.8 \times 7.31 \times 639.95 = 1148.55''^4 \\
I_{tr} &= 1423.64''^4
\end{align*}
\]

Resisting Moment Capacity

- Steel: \( M = \frac{f_y}{C_s} \cdot I_{tr} = 24 \text{ ksi} \times \frac{1423.64''^4}{15,315''^4} = 2230.97 \text{ k-in} = 185.91 \text{ k-ft} \)

- Concrete: \( M = \frac{f_y}{C_{con}} \cdot I_{tr} = 135 \text{ ksi} \times \frac{1423.64''^4}{4.695''^4} = 3684.18 \text{ k-in} = 307.01 \text{ k-ft} \)

Steel governs.

\[ M = 185.91 \text{ k-ft} \]
(2) Safe uniform load on a simple span of 24 ft.

\[ M = \frac{WL}{8} \]

\[ \bar{W} = \frac{8M}{L} = \frac{8 \times 185.91}{24} = \frac{61.97}{24} = 2.58 \text{k-ft} \]

(3) Determine the most economical wide flange steel section needed for the same load, without composite action.

\[ M_{\text{max}} = \frac{WL}{8} = \frac{61.97 \times 24}{8} = 185.91 \text{k-ft} \]

\[ S > \frac{M_{\text{max}}}{f_{\text{steel}}} = \frac{185.91 \times 12}{24} = 92.955 \text{ in}^3 \]

From DATA SHEET D-36, choose [W21x50]