(true for most rolled beams)

Concept: Typically, if compact flanges and

\[ M_n = M_p \]

are compactly supported.

- Two types of beams

Design/Analysis

Limit states

Moments Capacity Summary

- Local Flexural Buckling
- Web Local Buckling
- Flange Local Buckling
- Web Flattening
- Yielding

MLP, LR

\( L_{TB} \)
Design using Design Charts

- Cb
- Cb'
- Cb2
- Cb3
- Cb4

- Cb e Flows arc Important

- Mn 5 MP

2. Interim Initial Lateral Support

- Non - Complete beams arc noted
- Circular for Complete Flanges and web

Design using 2x Table
Living outside the point of calculation taken

\[ Q = \text{Shear force} \]

\[ V = \frac{EI}{a} \]

\[ T = \sqrt{a} \]

Shear \[ \text{Design} \]

Deflection

Also check: Shear

\[ \text{Do not govern} \]

Check that:

\[ V_C = 0 \]

Circular \( A \), \( C_P \) then \( M_P = 0 \)

- If \( C_P > 1.0 \)

- Based on \( C_P = 1.0 \)
For rectangular beams, \( I_0 \) is the moment of inertia about the neutral axis.
For I Section:

\[ \frac{Ge}{Fg} \]

Example:

Shear Strength: (All allowable shear stress) \( (kLm) \) = Shear Strength

All elements

\( H/L \)
Given in 2x formulas

\[ 0 \leq (0.90, 0.6 \text{ Fey A&m} \]

\[ \bar{q} = 0.90 \]

For \( k/\mu = 2.45 \text{ V/eY} \), \( v_n = 0.6 \text{ Fey A&m} \)

Governed by q.e.Y.

Almost all rolled because shorter captions is
\[ V_u = 350 \text{ kips} \]

\[ V_a = 850 \text{ kips} \]

\[ P_a = 350 \text{ kips} \]

\[ P_u = 350 \text{ kips} \]

\[ F_y = 50 \text{ksi} \]

**Solution:**

- Consider moment and shear
- Neglect beam weight
- Continuous internal bracing
- \[ F_y = 50 \text{ksi} \]
- Slackest lift first, M-section
- Shear Design Example: (10-11)
Choose new scissor:

(3) Check for Shear: $\Phi_{\text{un}} = 284 \text{ kips} < 350 \text{ kips}$

* $\Phi_m = 750 \text{ kips}$

Select $L_{24} \times 7/8$, $\Phi_{mp} = 750 \text{ kips (compact)}$

Find $\Phi_m > \Phi_{un}$

- Use $Z_x$ section (Continuously Iternally Supported)

(2) Design (Based on Moment)

$M_h = 700 \text{ ft-k}$

$M_w$
\[ \Delta \text{max} = \frac{x}{L} \]

- 9.66, Crocking in dry mud (\(r/36\))
- Asthetics
- Precision for Amplitude deflections:

Dilations

Use 350 x 9.6

\[ q_{\text{min}} = 1060 \text{ fl. kips} > 700 \text{ fl. kips} \]

\[ \phi_{\text{mp}} = 1060 \text{ fl. kips (corrected)} \]

\[ q_{\text{min}} = 374 \text{ kips} > 350 \text{ kips} \]
Design Based on Deflections

- Compute deflection, \( \Delta = f \left( \frac{\text{Loading} \cdot \text{Length}}{E \cdot I} \right) \)
  - can be varied

- Compare to limit (given)

- Increase \( I \) to reduce deflection if necessary

- Deflection checks are based on service loads

Example (10-19)
Select the lightest W-section

\( F_y = 50 \text{ ksi} \)
\( 24\' \) simple span
(1) Structural Analysis

\[ V_m = 71.04 \text{k}

\[ M_m = 1.2 (1.2 \times 1.6) + 1.6 (2.8) = 5.92 \text{k-ft}

\[ \Delta \text{max} = \frac{L}{1200} \]

Continuous Lateral Support

Length: \( W_o = 1.2 \text{k-ft}, W_l = 2.8 \text{k-ft} \]
(4) Check Deflection: \( \Delta = \frac{384EI}{5W^4} \)

For typical deflection, \( \Delta = 5.4" \) ...

(3) Check Stress: \( \sigma = 211 \text{ ksi} < 71 \text{ ksi} \)

(Compact) \( \phi_m = 473 \text{ ksi} \)

(Minimum Section): \( W_{21} = 55 \text{ ksi} \phi_m = 473 \text{ ksi} \)

Use Zx Holes (Continuous Vertical Support)

(2) Design (Based on Moment)

\( \frac{1200}{1200} = \frac{1200}{241} \)

\( \Delta \max = 0.24" \)

\( M_r = \frac{8}{\ell^2} \) (for 24, 12in 14")

\( W_r = \frac{8}{\ell} \)
\[ \phi_{\text{min}} = 1300 \, \text{ft.-lb.} > 426 \, \text{ft.-lb.} \]
\[ \phi \land 171 > 439 \, \text{k} \]

Try: \[ 0.30 \times 10^8 : I = 4470 < 4740 \]

\[ I = 4290 \, \text{in.}^4 \]

\[ = \frac{0.24}{5 \, (4 \, \text{k/ft.}^3) (1/12) (24 \times 12)^4} \]

\[ = \frac{0.24}{384 (29000 \, \text{ksi}^2) (1140 \, \text{in.}^4)} \]

\[ = 0.90 \]